Publication No. 04-069-215

CENTRIFUGAL SLURRY PUMP CONCENTRATION LIMIT TESTING AND EVALUATION PHASE 1

Prepared by
GIW INDUSTRIES, INC

under a grant sponsored by

FIPR
Florida Institute of Phosphate Research

September 2005

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CENTRIFUGAL SLURRY PUMP CONCENTRATION LIMIT TESTING AND EVALUATION--PHASE 1

FINAL REPORT

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FIPR Contract # 04-04-069

September 2005

DISCLAIMER

PERSPECTIVE

Patrick Zhang, Research Director, Beneficiation & Mining

Over 100 million tons of phosphate matrix are transported from mining pits to beneficiation plants in Florida every year. The phosphate matrix is first slurried using high-pressure water guns and then pumped to the beneficiation plants using large diameter pipelines. Assuming an average slurry density of 35%, the industry needs to pump approximately 300 million tons of matrix slurry annually. In many cases, the mining operations are several miles away from the processing plants. The energy cost for long-distance pumping of such a huge amount of slurry is tremendous. During its peak production years, the Florida phosphate industry consumed about 4 billion KWH of electricity annually, equivalent to $200 million at a price of five cents per KWH. Slurry pumping is believed to account for about one third of the total energy consumption.

In general, the pipeline friction increases moderately with increasing solids concentrations and particle velocity decreases with increasing mean concentration. Thus, provided there is enough water to make a fluid slurry and the slurry velocity is sufficiently high, then higher slurry concentrations lead to higher pipeline transport efficiencies. High concentrations also provide opportunities for reductions in capital cost for equipment. However, centrifugal pumps have upper-limit concentrations beyond which increasing solids becomes less efficient, even without choking the pipeline. Currently very little data is available for the different matrices, tails and consolidated clays at very high concentrations and with large pumps, particularly for the new low NPSH (Net Positive Suction Head) pit pumps. This study successfully addressed one of the major problems in a matrix pipeline—that of the variability of the slurry entering the pit pump and the suction lift condition under which the pump operates. In the pit pump operation, a vacuum at the suction inlet is used to draw solids into the pump. The higher the vacuum, the higher the solids concentration ingested. The higher the concentration in the line generally, the higher the output and higher the efficiency of the pipeline.

The rheology part of this project is perhaps the first major attempt to incorporate rheological properties into the optimization of pumping. The measurement of matrix characteristics and rheological properties conducted by the University of Florida proved to be of significant value to GIW's analysis.

ABSTRACT

Tests were carried out on three different types of phosphate matrix slurries with regards to their pipeline friction, effect on pump head quantity and cavitation performance at (high) concentrations of solids around 40, 50 and 60% by weight.

Rheological tests have also been carried out as part of FIPR Contract No. 04-04-070 on the fine carrier liquid component of the slurries by the University of Florida.

This report is about the original GIW Pipeline/Pump tests and with the University of Florida, results incorporated into the main report.

ACKNOWLEDGMENTS

GIW would like to thank PCS Phosphate, Mosaic (formerly Cargill and IMC) for their participation in this project. We would especially like to also thank Jon Courtney, Ron Hartung, Mike James, Carrol Moye, Don Heath, Steve Basey and Mike Hutchens of Mosaic and Eric Norman, Phillip Smith and Cheryl Belton of PCS for their help and cooperation in obtaining and loading the more than 400 tons of phosphate matrix necessary to perform this testing.

We would like to express our thanks to Roy Duval of GIW and Chris Beasley of Ryder Logistics for their effort with regard to obtaining the matrix samples. We also appreciate Dan Harrison generating the test loop diagram. Bob Visintainer's efforts in developing the Microsoft Excel® spreadsheets are also acknowledged. For the bulk of the analysis, the mathematical models, and the reporting we thank Professors Sellgren and Wilson along with Phyllis Korman with regard to the manuscript.

For the rheological phase of the work, we would like to also thank Dr. Abass Zaman, Dr. Hassan El-Shall from the University of Florida and Dr. David V. Boger from the Department of Chemical Engineering, University of Melbourne, Australia, for the very useful discussions on the project.

In closing we want to acknowledge the extra effort exhibited by GIW Hydraulic Test Lab staff to ensure this program was completed professionally and in a timely manner. Instrumentation calibrations and setup were performed by Luis Encarnacion, and equipment and piping were installed by Fred Reid, Allen Germany, Mike Mathews and Daniel Bartier.

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EXECUTIVE SUMMARY

The pumping characteristics at high solids concentrations for three Florida phosphate matrix products were investigated at the GIW Hydraulic Testing Laboratory in a 19.37" diameter, nearly 300 ft long pipeline loop with a newly designed 62" diameter pit pump. The three products represent high, medium and low pipeline friction loss characteristic slurries. It was found that the losses, at least in the case of two of the matrix types, were related in large part to the content of particles smaller than 40 microns. The evaluations were focused on operating data obtained at comparatively short exposure times, which mostly meant average times and number of pump passages that are representative. It was found that the slurries behaved in a laminar-like way for the highest solids concentrations, with larger particles moving in a partly sliding manner along the bottom of the pipe. Samples taken out showed that larger particles were to some extent embedded in clay lumps, also after a considerable exposure time in the loop.

Operation at 13 to 18 ft/sec for solids concentrations by weight (w%) of 40 to 60% corresponds to capacities of 1300 to 3300 tons/hr of dry solids. Operation at 15 ft/sec for 40 to 60w% corresponds to capacities of 1550 to 2700 tons/hr with water requirements of 10250 and 8800 gal/min, respectively. The specific energy consumption (hp-hr/ton-mile), to overcome pipeline frictional resistance when pumping the matrix is a measure of the energy-effectiveness. Values of 0.3 were obtained for the low friction loss product when pumped at about 60w%, corresponding to up to 3200 tons/hr. With the high friction loss matrixes, values of 0.5 to 0.7 were obtained for 50 to 55w% (about 2300 tons/hr). For 60w% at 3200 tons/hr, the value exceeded 1 hp-hr/ton-mile. The cost-effectiveness of using high solids concentrations is therefore also related to the higher capacity of dry solids, less use of gun water and to comparatively lower capital costs per ton of solids.

The energy consumption of pumping the slurry also includes the total efficiency of the pumps in the system. The pump head and efficiency when pumping water are generally lowered by the presence of solids. Experiences from tests and installations with suitable pumps at presently used solids concentrations up to about 45w% have shown that the reductions normally correspond to a few percent only. It was found that the reduction in head was practically negligible for the pit pump used in the test. However, average reductions of 8 and 12% in efficiency were observed at a solids concentration of 60w% for the low and high friction loss slurries, respectively. It was also indicated that the reductions approximately increased in direct proportion with the volumetric solids concentrations, corresponding to an increase from 40 to 60w%. The total pump efficiencies along the pipeline including pumps, gearboxes and motors for water pumping only may be about 75%. With pump solids effects included for 40, 50 and 60w%, then the corresponding slurry efficiencies are 71, 68 and 66%, respectively, for the high friction loss products. The corresponding system, or total, specific energy consumption in hp-hr/ton-mile is then 1.41, 1.47 and 1.52 times larger than the values to overcome pipeline friction losses partly discussed above.

The University of Florida's work established values for the carrier wall shear stress at different concentrations and confirmed the significance of the carrier effect on the pipeline head loss where it existed at the higher concentrations.

Operation practically without cavitation has been proven in the field for concentrations sometimes of up to 60w%. The NPSHR tests carried out here for concentrations of over 45w% also indicated an improved suction performance which is affected significantly by entrained air. The effect on the efficiency when operating close to cavitation with a pit pump may only influence the total energy cost in a matrix pipeline system by about 5%.

More work is recommended to be carried out in the field to better quantify the change of carrier with time and to look into the geological variability of the matrix and how the new XL model might work specifically with it.

INTRODUCTION

In 1989, GIW carried out tests on three different matrix slurries under FIPR contract number 87-04-037 (*Phosphate Matrix Pipeline Design Data and Tools for Efficiency Improvement*). This categorized the pipeline performance of so-called difficult, easy and average matrix slurries. The tests were limited to the moderate concentrations then in use.

In 1998, GIW carried out FIPR project 97-04-058 entitled *Matrix Pump Performance Evaluation while Cavitating*. This showed that with current pit pumps, cavitation-free concentrations were limited to about 40w%, confirming current practice.

Since the object is to transport solids, not water, it is usually more energy-efficient to pump at higher concentrations. However, at very high solid concentrations it is known from other work (Wilson 2004) that this trend is reversed.

Various schemes have been tried to overcome the cavitation-caused concentration limit at the pit. One of these was the so-called Land Dredge Proposal (*Development of a Positive Feed System for Matrix Transportation*) studied under FIPR contract number 88-04-044. All of these involved significant capital expenditures, however, which could not be justified.

In 2003, a new design of pit pump was developed that ran slower and had significantly better (NPSH) cavitation resistance. One of these pumps was installed early in 2004 and has been operating ever since. A paper entitled "New Pit Development and Field Experience" was presented at the 19th Annual Regional Phosphate Conference meeting in Lakeland, Florida, this year describing its operation.

The paper showed that during operation with a normal matrix, significant increases in concentration and throughput were possible but with difficult matrix, problems occurred. It was also seen that insufficient information was available on the pipeline, pump, and cavitation performance at high concentrations and when and how to take advantage of the higher concentrations.

The rheological component of the phosphate slurries is known to have a significant effect on the pipeline and the pump performance, but only limited information on its effect at the higher concentrations is available.

This work was to be addressed in a complementary proposal by the University of Florida.

This study addresses that need and is about tests on three different matrix types of slurries at 40, 50 and 60w% and the pipeline, pump head quantity, and pump cavitation performance tests at these concentrations.

This study also includes results on the effect of the rheological component of the slurry on the above using the complementary work carried out by the University of Florida.

GOALS

Pipeline head loss data, pump solids effect data, and cavitation limit data for different Florida phosphate matrix slurries at high concentrations are needed, as well as guidelines on how to operate the pumps and the pipeline in the most cost-effective way.

While the slurries involved are regarded as being primarily settling slurries, it was brought up at the FIPR board meeting in Bartow on July 16-20, 2004, that clays (or fines) present can modify the viscosity of the water carrier and the resulting slurry performance.

In a subsequent meeting held August 17th, it was agreed that Professors Zaman and El-Shall of the University of Florida would be given a separate contract to test and analyze the fines in each of the three matrix samples, and that GIW was to include this in its findings.

A main aim of this study, therefore, is to carry out pipeline and pump loop tests of three different matrix slurries at concentrations around 40, 50 and 60w%.

The primary deliverables in this case are to be mathematical algorithms and easy-to-read charts for the specific energy consumption for different concentration slurries in different size pipelines that include the effect on the performance of the pump, the cavitation limit of the pump, and friction characteristics.

As the GIW test work was scheduled to be completed by the end of 2004 and the University work was not expected to be completed until February 2005, it was necessary to split the work into two phases: the first, covering the main tests at GIW, and the second, covering the University of Florida work and its incorporation into the main study. This report is the final report and is about the two phases of the work.

CHARACTERIZATION

PIPELINE FRICTION LOSSES

The pressure gradient, $\Delta p / \Delta l$ (psf/ft), in a horizontal pipeline is:

$$\frac{\Delta p}{\Delta l} = \rho \cdot g \cdot j \qquad (1)$$

where j is the friction losses expressed in ft of slurry per ft of pipe, ρ is the delivered density of the slurry, and g is the acceleration due to gravity (32.2 ft/sec^2). The slurry density ratio can be expressed as:

$$S_m = \frac{\rho}{\rho_O} = 1 + C(S_S - 1) \qquad (2)$$

where ρ_o is the density of water and C is the delivered solids concentration by volume calculated by:

$$C = \frac{S_m - 1}{S_S - 1} \qquad (3)$$

and:

$$S_S = \frac{\rho_S}{\rho_O} \qquad (4)$$

where ρ_S is the density of solids.

The flow rate of solids, M_S, is related to the flow rate of mixture, Q, density of solids, ρ_S, and C in the following way:

$$M_S = Q \cdot \rho_S \cdot C \qquad (5)$$

The total pumping head, H, in a horizontal pipeline with length, L, is:

$$H = j \cdot L \qquad (6)$$

and the power, P, to overcome the frictional pipeline resistance is:

$$P = \rho \cdot g \cdot H \cdot Q \qquad (7)$$

The corresponding specific energy consumption per mass unit of dry solids, e_p, can be expressed (from Equations 5 and 7) as follows in hp-hr/ton-mile:

$$e_p = 5.33 \cdot \frac{\rho \cdot j}{\rho_S \cdot C} \tag{8}$$

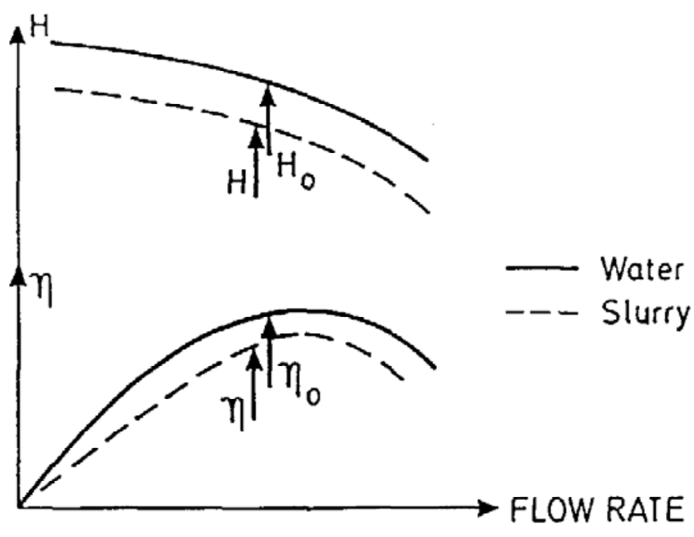
The representation of slurry friction losses in ft slurry per ft pipe, j, is useful when pump and pipeline characteristics are to be analyzed.

EFFECTS OF SOLIDS ON PUMP HEAD AND EFFICIENCY

The energy consumption of pumping the slurry in a horizontal pipeline also includes the total efficiency η_T of the pumps in a system. Assume that the power lost in the motor and in the transmission corresponds to an efficiency factor η_M. Then η_T can be related to the pump efficiency, η, in the following way:

$$\eta_T = \eta_M \cdot \eta \tag{9}$$

The pump head and efficiency when pumping water are generally lowered by the presence of solids. When pumping slurries, the relative reduction of the clear water head and efficiency for a constant flow rate and rotary speed may be defined by the ratios and factors shown in Figure 1.



Head ratio: $HR = H/H_0$ Efficiency ratio: $ER = \eta/\eta_0$
Head reduction factor: $R_H = 1 - HR$ Efficiency reduction factor: $R_\eta = 1 - ER$

Note: H and H_o are head in meters of slurry and water, respectively. Efficiencies in slurry and water service are denoted η and η_o, respectively.

Figure 1. Sketch Defining the Reduction in Head and Efficiency of a Centrifugal Pump Transporting a Solid-Water Mixture.

With the definition of R_η, it then follows that:

$$\eta_T = \eta_M \cdot \eta_O (1 - R_\eta) \qquad (10)$$

The system or total specific energy consumption, e_T, can then be expressed in the following way (from Equations 8, 9 and 10):

$$e_T = \frac{e_p}{\eta_T} = \frac{e_p}{\eta_M \cdot \eta_O (1 - R_\eta)} \qquad (11)$$

EFFECTS OF SOLIDS ON PUMP CAVITATION

Cavitation in a pump occurs when the local pressure falls below the vapour pressure of the liquid, i.e., the pressure at which it boils. When cavitation starts, the pump head decreases. The incipient cavitation point is here defined by a 3% reduction after correcting the pump head water curve for the effect of solids. Once cavitation started, it usually increased rapidly. The influence of cavitation is defined as a 3% reduction of the head (H) developed in slurry service.

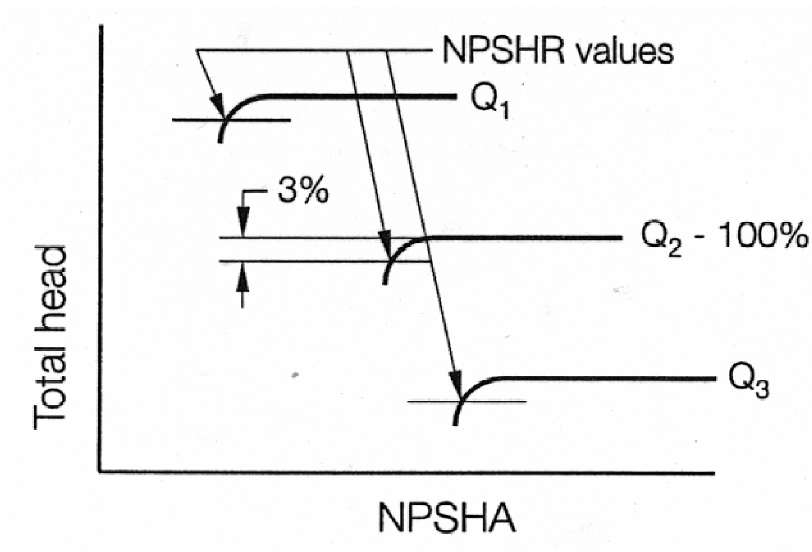


Figure 2. Definition of the Cavitation Inception Point When Pumping Slurries.

To ensure operation without cavitation, it is required that the absolute pressure at the pump impeller eye exceed the vapor pressure by a certain margin. By convention, the required absolute pressure at the pump entrance is expressed in terms of head of the mixture being pumped, using the term Net Positive Suction Head Required, or NPSHR. The NPSHR is usually specified by the pump manufacturer based on tests with water.

EXPERIMENTAL SETUP AND PROCEDURES

PUMP AND PIPELINE SETUP

Figure 3 illustrates the pump, pipeline, and drive train setup for this test program. As proposed and agreed to, GIW installed its newest design pit pump. This pump is designated as a 20x25LSA62 (C/3ME) indicating a 25" suction, 20" discharge, 62" impeller diameter with a semi-volute shell and 3-vane medium efficiency type impeller. Sphere passage on this pump is published as a little over 10". For simplicity of setup, this new wet end was installed on the Hydraulic Test Lab's existing 10¼" cartridge bearing assembly. Appendix A contains the published clear water performance information on this pump in the form of multi-speed sales curves in both English and SI units (# E17A-02). Also included in Appendix A are selected SLYSEL computer printouts providing fixed speed water operating data for this pump at 150, 225, 268 and 330 rpm which are of interest as relating to this test program.

The drive train used to operate the pump was powered by a 4160 volt, 2450 hp, 450 rpm AC motor. The output of this motor was connected to a variable speed fluid drive unit using a jack shaft V-belt drive arrangement. The output of the fluid drive was then run through two gear reducers, providing operation of the pump within the range of 57 to 270 rpm.

In order to ensure a sufficient range of flows was achievable while operating at high solids concentrations, GIW chose to shorten and alter its 16"/18"/20" slurry loop. The 16" and 18" loss sections were removed and a ~300' long system of predominately 20" piping remained. Refer again to the completed test loop provided in Figure 3.

As shown, the matrix would be drawn from a mixing tank to the pump and then back to the tank. System flow rate could be varied by changing pump rotational speed or by operation of a 20" butterfly valve located in the return line near the tank. Solids would be loaded into the tank with a 2½ yd^3 capacity front-end loader to achieve desired concentrations. During the NPSHR (suction performance) testing, a top was prepared that could be installed on the tank after loading. This top was fitted with a 4" nozzle for connecting to a vacuum pump via flex hose that would enable controlled lowering of the system NPSH, thus inducing pump cavitation. The tank was designed for, and capable of, operation from a vacuum up to ~10 psi while sealed. Both pump and pipeline performance data would be collected simultaneously during the various testing.

Pictures of the pump, drive train and pipeline setup have been provided in Appendix D.

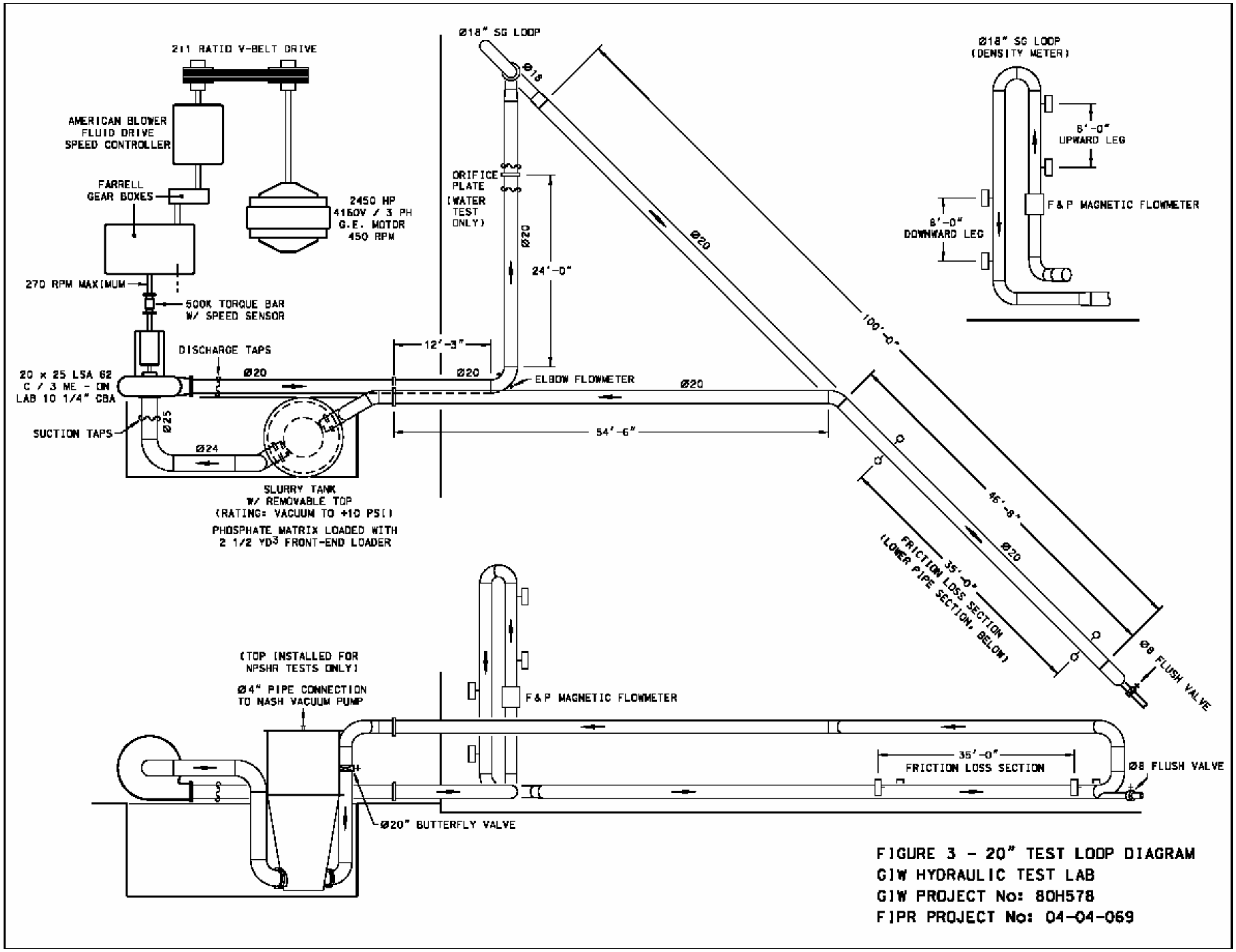


Figure 3. 20" Test Loop Diagram.

INSTRUMENTATION SETUP

The GIW Hydraulic Test Laboratory instrumentation associated with Test-Bay #1 was used for this program. All instrumentation was calibrated according to ISO 9001 standards at intervals as specified in GIW calibration procedure ER001. During all testing, measurements were taken with both a primary and secondary instrument(s). If any one instrument varied outside its specified accuracy, then the transducer would be examined and recalibrated if necessary. The instruments to be detailed in this section enabled sensing of flow rate, slurry density, pump suction head, pump discharge head, pump differential head, horizontal pipeline friction loss, pump shaft torque, pump shaft rotational speed, slurry temperature, and ambient temperature. As a result of these measurements, other valuable engineering calculations were made, stored and output at the conclusion of each test, many of which the test engineer could monitor during the test program.

The primary flow meter used during slurry testing was an 18” Fischer and Porter magnetic flow meter. As shown in Figure 3, this flow meter was located downstream of the pump in the upward flowing leg of the SG loop. The secondary flow meter in the system was a 20” bend flow meter located downstream of the pump discharge. This meter calculated flow rate from the measured pressure difference between the inner and outer curvature of the bend. During initial water testing, both the magnetic flow meter and bend flow meter would be calibrated to agree within +/- 1% of an orifice plate temporarily installed within the loop. This orifice would be removed prior to any slurry testing.

All pressure sensing used for the pump suction, discharge, differential head, orifice plate (used during water calibration), SG loop, friction head losses, and bend meter were transmitted via water-filled nylon tubing back to a bank of 13 differential pressure transducers. The Hydraulic Test Lab personnel installed the necessary piezometer taps for this sensing according to Figure 4. Two taps were installed at each location with transducers connected to both in order to provide duplicate or backup readings. The taps were located at 45 degrees above the horizontal centerline on each side of the pipe. A ¼” NPT pipe coupling was welded onto the pipe, then a ¼” diameter hole drilled through the pipe and de-burred. A collection pot, 4” in diameter and 1’ tall with bleeds at the top and bottom was closely connected to the taps with clear flexible nylon tubing. The pots were then connected to the pressure transducers located just outside the Test-Bay #1 control room using the same nylon tubing. Pump gland water supply was used to fill the transducer lines and pots with clear water. Any slurry that migrated from the pipeline into the transducer lines during the tests was intermittently forced back into the pipeline using this purge water supply. Purging was also used to prevent and clear any blockages of the piezometer taps. The collection pots were used to trap and remove any air or slurry that migrated from the pipeline before it could reach the transducer lines, thus eliminating any height-correction errors. Solid particles settle to the bottom of the pot where they can be bled off, and likewise air bubbles rise to the top where they are bled off also.

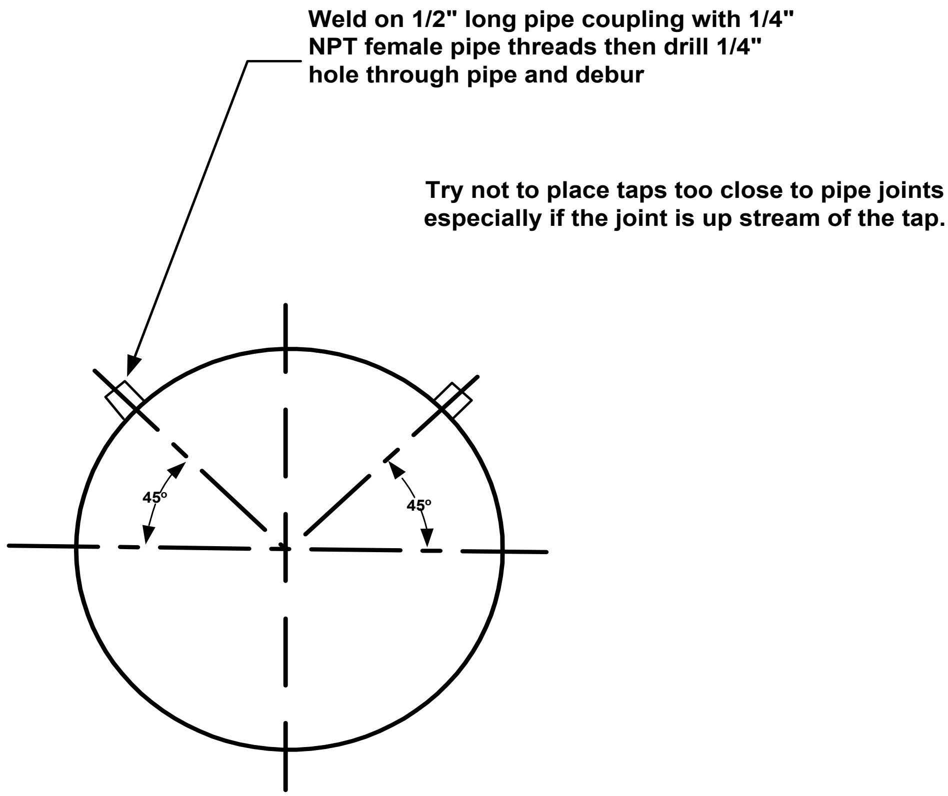


Figure 4. Illustration of Pressure Tap Configuration.

Suction and discharge taps were installed in the straight pipe sections before and after the pump. In addition to transducers measuring suction and discharge pressure, a differential pressure transducer was connected between them, giving two different means of determining pump head. The suction pipe was a custom-made 25” internal diameter 3/8” wall pipe. The discharge pipe was a 20” diameter 3/8” wall pipe having an internal diameter of 19.25”.

To monitor the slurry temperature, a 100 ohm platinum RTD-type temperature transducer was located in the tank. A second RTD was used to measure lab ambient temperature.

Measurement of the slurry density was accomplished by use of a specific gravity loop located in the pipeline downstream of the pump and upstream of the horizontal friction loss section. The SG loop shown in Figure 3 consisted of an inverted U-loop with the pressure differential measured between two points in the upward-flowing leg and also between two points in the downward-flowing leg. This U-loop measured the *in situ* concentration of the slurry, which when at steady state was taken to be the delivered concentration.

As the flow left the SG loop, a straight pipe section of ~40 pipe diameters enabled the flow to stabilize prior to entering the horizontal friction loss section. The distance between the head loss pressure taps was 35 feet with an internal diameter of 19.37”. From there, the slurry returned to the tank.

Pictures of the instrumentation have been provided in Appendix D.

DATA ACQUISITION SETUP

Table 1 provides a summary of each instrument detailing the use, description, range, units of calibration, calibration reference, and coefficients. Each of the instruments generates a 4-20 milliamp output that is converted through a 500 ohm, 0.01% precision resistor to a 2-10 volt signal. The 12-bit accuracy analog to digital (A/D) conversion unit converts this voltage to a digital reading with 8191 digits = 10 volts = 20 ma. The A/D was set up to read 13 channels at a rate of ~100 readings per second. The channels are scanned a number of times and then the digital readings averaged for each channel. The number of readings averaged for each point is controlled and set by the test engineer via the PC. The averaging period can be lengthened to dampen fluctuations and increase the stability of the data or it can be shortened to look at the instantaneous readings and study the actual fluctuations.

Once the digital readings are averaged, the quadratic calibration coefficients, specific to each instrument, are applied to convert the reading into selected engineering units. The FORTRAN computer program in operation then makes all necessary calculations to come up with the displayed results. During the FIPR tests, a new data point was displayed ~2-20 times per minute depending on the number of readings being averaged. The test engineer could capture data points at will by depressing the “T” key.

RHEOLOGICAL WORK SETUP

The rheological part of the work was carried out at the University of Florida using special instruments and tools that are described in Appendix E.

Table 1. Instrumentation Setup.

A/D Channel #	Transducer Assignment	Transducer Description	Transducer Range	Transducer Units	Calibration Reference
3	SG- Up	Rosemount	0 to 12	Ft-H_20	07093B
4	SG-Down	Rosemount	-4 to 8	Ft-H_20	07134B
5	Discharge	Rosemount	0 to 239	Ft-H_20	07093B
6	Difhead	Rosemount	0 to 236	Ft-H_20	07093B
8	Flow bend	Rosemount	0 to 24	Ft-H_20	07093B
9	Loss Section	Rosemount	0 to 24	Ft-H_20	07093B
10	Flow bend	Rosemount	0 to 12	Ft-H_20	07134B
11	Flow bend	Rosemount	0 to 12	Ft-H_20	07134B
12	Loss Section	Rosemount	0 to 12	Ft-H_20	07134B
13	Loss Section	Rosemount	-4 to 8	Ft-H_20	01164E
17	Suction	Rosemount	-30 to 30	Ft-H_20	07093B
18	Slurry Temp.	Omega	32 -212	Degrees F	10204D
19	Ambient Temp.	Omega	32 - 212	Degrees F	10204E
20	Shaft Torque	Binsfeld	30,000	Ft-Lb	02122B
21	Shaft Speed	Binsfeld	300	Rpm	02122D
22	Shaft Power	Binsfeld	3,000	Horsepower	02122F
25	Flow Meter	F&P	32,000	Gpm	11164B

Quadratic Coefficients: ($Y = Ax^2 + Bx + C$)

A/D Channel #	A	B	C
3	0.341385E-08	0.177678E-02	-0.276788E+01
4	-0.711335E-09	0.181242E-02	-0.676812E+01
5	0.594538E-07	0.364890E-01	-0.579597E+02
6	0.114767E-07	0.358139E-01	-0.575840E+02
8	-0.142364E-08	0.368311E-02	-0.613351E+01
9	-0.121512E-08	0.365090E-02	-0.614731E+01
10	0.927564E-08	0.174803E-02	-0.275159E+01
11	0.562581E-08	0.178916E-02	-0.283588E+01
12	0.722304E-08	0.175102E-02	-0.292747E+01
13	0.640812E-09	0.179761E-02	-0.674983E+01
17	-0.107422E-07	0.927610E-02	-0.447394E+02
18	0.147300E-07	0.279466E-01	-0.678460E+01
19	0.184378E-06	0.265703E-01	-0.283664E-01
20	-0.123658E-05	0.722542E+01	-0.868832E+01
21	0.549232E-08	0.721636E-01	-0.444467E-01
22	-0.175658E-06	0.722633E+00	-0.636416E+00
25	0.267808E-06	0.488539E+01	-0.803853E+04

GIW TEST PROGRAM PROCEDURES

During the period of December 10th-23rd, lab tests were conducted with a 20x25LSA62 C/3ME GIW pump in the GIW Hydraulic Test Lab. Table 2 has been provided to summarize the lab test work in sequential form. All test data mentioned can be found in Appendix B of this report.

Table 2. Summary of Laboratory Tests.

GIW Test Number	Date	Description of Test/Material Description	Pump Speed (rpm)
M216 -04	12/10/04	Variable speed water test (w/ Orifice Plate)	57 – 250
M217 -04	12/10/04	Fixed speed water test (w/ Orifice Plate)	225
S218 -04	12/10/04	NPSHR water test (w/ Orifice Plate)	225
Removed Orifice Plate			
M219 -04	12/11/04	Variable speed water test	58 – 202
M220 -04	12/13/04	PCS matrix, loading data up to 60% Cw	111 – 158
M221 -04	12/13/04	PCS matrix, 60% Cw pump & pipeline test	122 – 202
M222 -04	12/13/04	PCS matrix, 60% Cw NPSHR test	225
M223 -04	12/13/04	PCS matrix, 50% Cw NPSHR test	225
Removed Cross-Plate Straightening Vanes from Suction Pipe & Installed Root Cutter			
M224 -04	12/17/04	IMC matrix, loading data up to 60% Cw	126 – 215
M225 -04	12/17/04	IMC matrix, 60% Cw pump & pipeline test	215 – 266
S226 -04	12/17/04	IMC matrix, 60% Cw NPSHR test	268
M227 -04	12/17/04	IMC matrix, 55% Cw pump & pipeline test	182 – 242
S228 -04	12/17/04	IMC matrix, 55% Cw NPSHR test	268
M229 -04	12/20/04	Cargill matrix, loading data up to 29% Cw	125 – 157
M230 -04	12/20/04	Cargill matrix, 29% Cw pump & pipeline test	57 – 188
S231 -04	12/21/04	Cargill matrix, 30% Cw NPSHR test	268
M232 -04	12/21/04	Cargill matrix, loading data up to 50% Cw	102 – 153
M233 -04	12/21/04	Cargill matrix, 50% Cw pump & pipeline test	100 – 193
S234 -04	12/22/04	Cargill matrix, 46% Cw NPSHR test	268
M235 -04	12/22/04	Cargill matrix, loading data up to 59% Cw	117 – 204
M236 -04	12/22/04	Cargill matrix, 59% Cw pump & pipeline test	196 – 251
M237 -04	12/22/04	Cargill matrix,58% Cw fixed speed pump test	225
M238 -04	12/23/04	Variable speed water test	81 – 203
M239 -04	12/23/04	Fixed speed water test	225
M240 -04	12/23/04	NPSHR water test	268

Before slurry testing could begin, the loop was polished with sand for 6 hours to smooth the pump passages and the 35’ horizontal friction loss section located in the 20” straight pipe. This process was performed to remove any rust or rough spots that would smooth during the upcoming tests and result in altering the pump performance or relative roughness of the pipe. The goal here was to maintain the same pipe roughness throughout the water and slurry testing such that any change would not be significant.

Next a series of clear water tests was conducted. These were used to establish the relative roughness (e/d) of the loss section that was found to be 0.000010 in the 19.37" diameter pipe. This value was subsequently used in all of the testing thereafter. This testing was also necessary for calibration of the flow meters. The magnetic flow meter and bend flow meter measurements were compared directly with those of a temporarily installed, freshly machined square-edged orifice. The necessary adjustments were made to ensure agreement within +/- 1% over the velocities of interest between 12-18 ft/sec.

The fixed-speed clear water tests were run to compare the pump performance to that published on multi-speed sales curve # E17A-02.

In general for the tests listed above, the loop was started up on clear water, all air was removed through various vents and the tank, all transducers were purged to ensure that lines did not leak or contain air, and all instrumentation readings were checked against the respective backup before proceeding.

On December 13th, all the necessary preparation was believed to be complete, enabling the beginning of phosphate matrix slurry testing. It was decided to test the PCS matrix first, followed by the IMC and Cargill materials.

Degradation was to be expected when conducting closed loop testing; therefore, to help in quantifying the transformation of the solids over time, samples were taken at the beginning and end of each test for comparison with original samples of the as-delivered material. In addition, once the critical data points were collected, several were repeated at the end of the respective test to observe the effect of time delay on the material.

Information on the three phosphate matrixes will be provided in subsequent sections of this report.

Various NPSHR tests were carried out on the three different materials with the help of the sealed tank and vacuum pump. The high NPSH values recorded suggested that entrained air due to the loading process had contributed to premature cavitation and loss of pump performance for the initial series of tests. In later tests, the slurry was loaded and allowed to set in the system overnight. This enabled the entrained air to form pockets in the top of the pipeline. These pockets were then vented the following morning prior to conducting the NPSHR test. This method was implemented for the final matrix sample provided by Cargill, which gave values that were closer to those obtained on water.

After all slurry testing was complete, final water calibration tests were performed to confirm that the system characteristics remained the same throughout the testing. These tests included a repeat variable speed, fixed speed and NPSHR water test. These tests agreed rather well with the initial tests and therefore the system was considered to have remained consistent.

UNIVERSITY OF FLORIDA WORK PROCEDURES

The special technologies and tests carried out at the University of Florida with regard to the rheological work are detailed in Appendix E.

PRIMARY RESULTS

The matrix slurries were pumped at concentrations of up to about 60w%. The Cargill matrix was also used for the NPSH test. The applied test procedure with quick measurements up to high-solids concentrations mostly meant average exposure times and pump passages that are representative. However, due to the limited loading capacity final data were collected at average exposure times that were unrealistically long. Samples taken out showed that larger particles were to some extent embedded in clay lumps, also after a considerable exposure time in the loop.

Resulting particle size distributions of as-delivered solids and samples taken out at the conclusion of the respective 60w% tests are shown in Table 3.

Table 3. Measured Particle Size Distributions.

Product:	PCS		IMC		Cargill	
Sample Description:	Original	Final	Original	Final	Original	Final
d_{max} µm	1,800	1,800	6,000	6,000	20,000	6,000
d_{85} µm	400	490	1,420	1,580	4,940	1,340
d_{50} µm	250	275	250	245	530	245
% < 100 µm	13	13	25	28	22	28
% < 40 µm	10	12	16	21	17	21

Matrix products are often roughly characterized with respect to the content of particles less than 100 µm and the portion larger than 1,000 µm. The coarser fraction may contain particles with sizes of up to 20,000 µm. The portion less than 100 µm is a mixture of, in addition to quartz, different finely divided minerals; for example apatite, dolomite and montmorillonite, forming phosphatic clay (El-Shall and Zhang 2004).

Tendencies of deposition of particles on the bottom of the pipe were indicated for velocities below about 10 ft/sec, mainly for low-solids concentrations. Considering worst deposition and conditions, then the velocity in a 19" pipeline should exceed 15 ft/sec (Wilson and others 1997). However, with solids concentrations in excess of 40w%, operating at 13 ft/sec seems feasible in applications. Velocities above about 18 ft/sec are rarely used; therefore the pipeline friction loss evaluations were focused on velocities in the 12-18 ft/sec range.

PIPELINE FRICTION LOSSES

Resulting friction losses, j, versus V for tested solids concentrations for the tested products are shown in Figures 5, 6 and 7. C_w is the solids concentration by weight and the longest exposure times in the loop have been denoted "final."

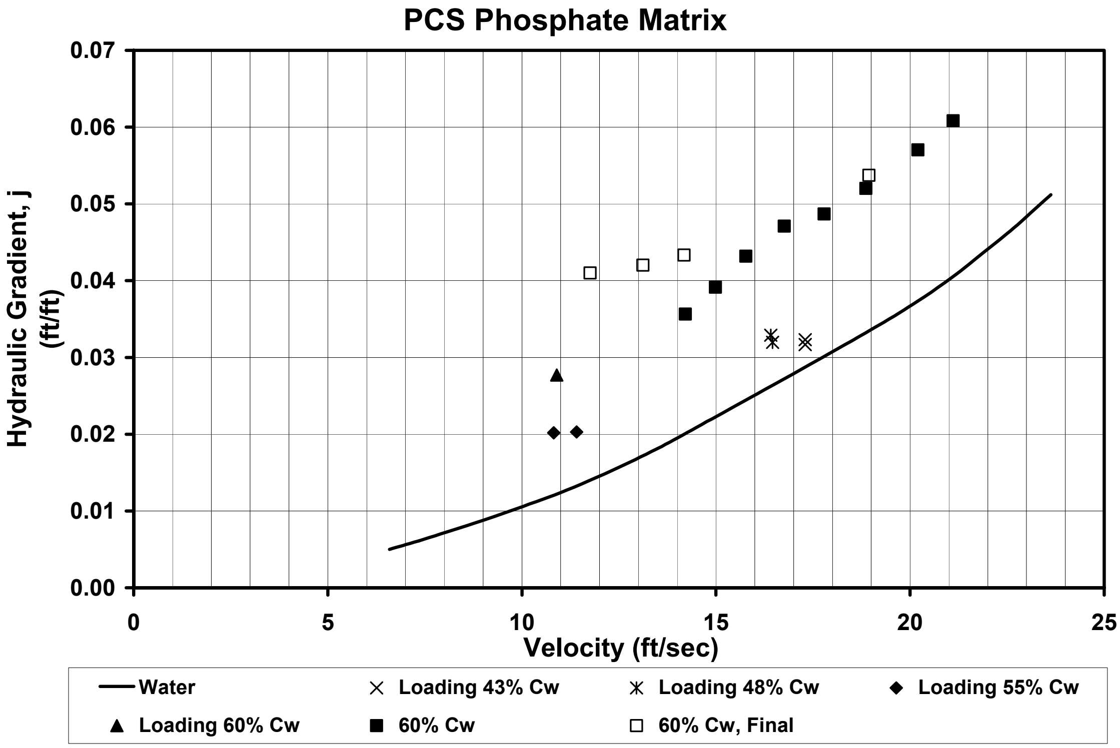


Figure 5. Friction Losses Versus Velocity for the PCS Matrix.

It follows from Figure 5 for a Cw of about 40w% that the losses are close to the water curve when expressed in ft of slurry, i.e., the so-called equivalent fluid model (Wilson and others 1997). The losses then increase up to about 0.04 ft/ft at 15 ft/sec. for 60w%. The behavior at low and moderate concentration can be considered to be turbulent; however, the 60w% slurry behaves in a laminar-like way, particularly after a long exposure time.

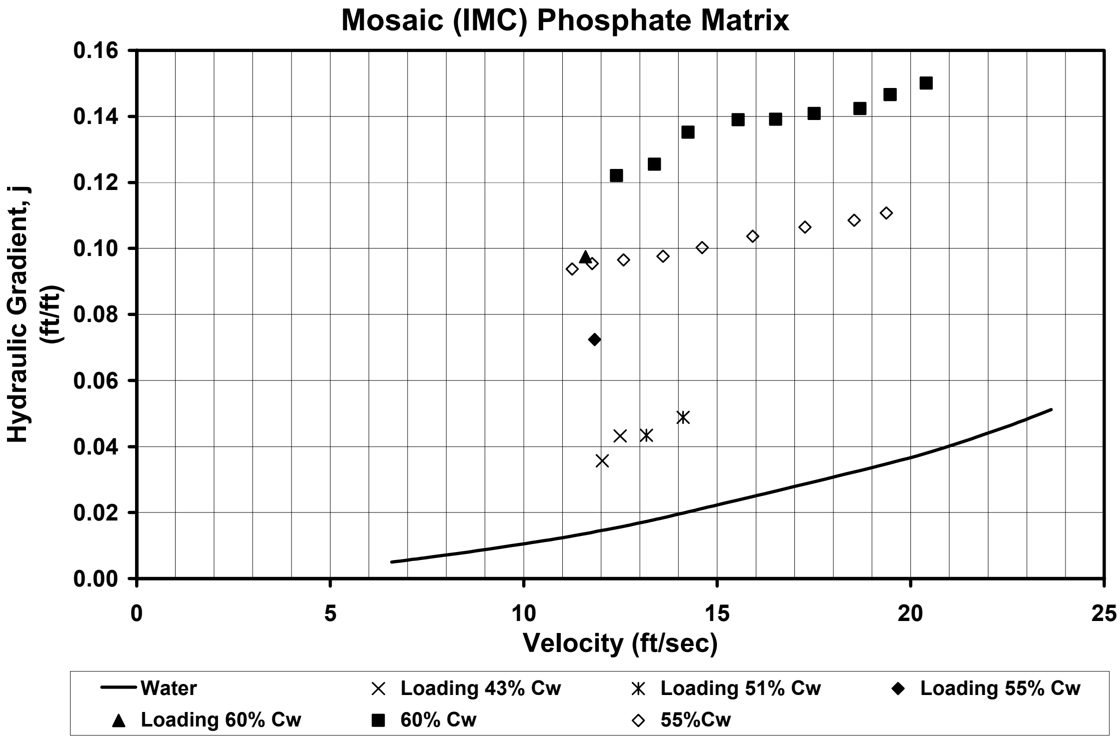


Figure 6. Friction Losses Versus Velocity for the IMC Matrix.

The IMC material in Figure 6 with a large content of clay and also coarser particles had a much larger friction loss than the partly sand-like PCS slurry in Figure 5. The loss-gradient, j, was about two times the corresponding water losses already at about 40w%. It was about 5 times larger than the water losses at 60w%, about 0.1 ft of slurry per ft of pipe at 15 ft/sec, which is about 2.5 times larger than for the matrix in Figure 5. A similar laminar-like behaviour as in Figure 5 can also be recognized at the highest concentrations. It follows from Figures 5 and 6 that losses were about 20% higher for slurries that have been exposed for a long time in the loop. Because of a pressure tap clogging problem, the 60w%-values may correspond to about 62w%.

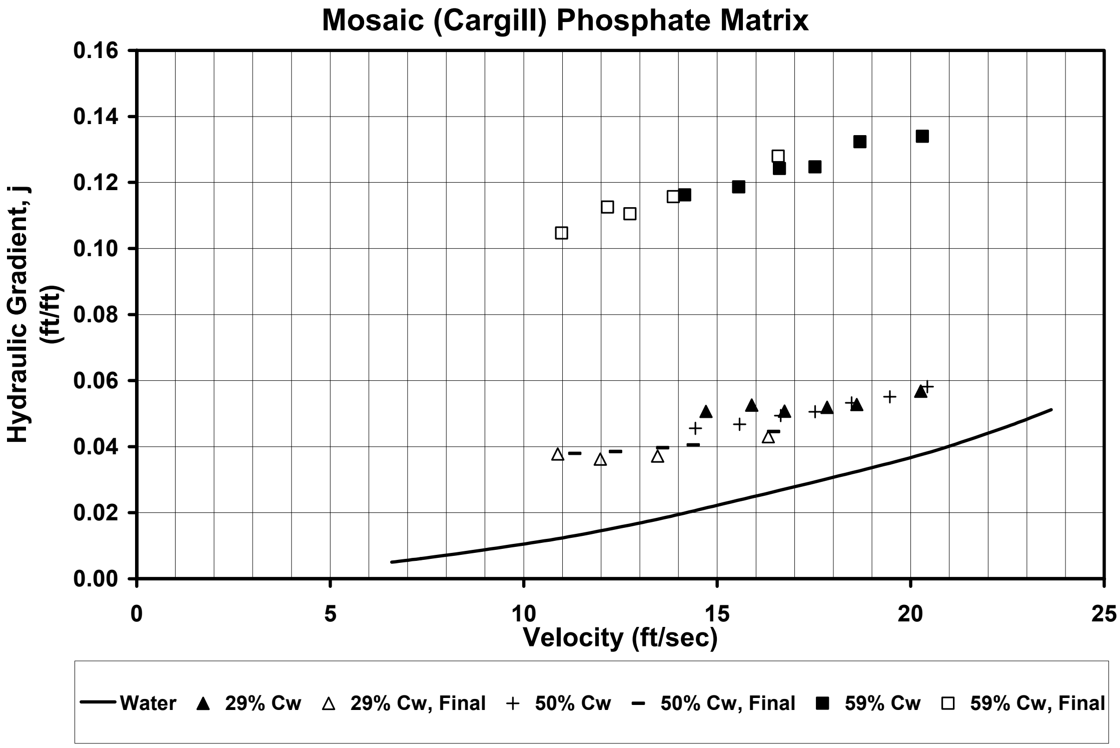


Figure 7. **Friction Losses Versus Velocity for the Cargill Matrix.**

The Cargill matrix slurries in Figure 7 show partly a similar loss-behavior as the IMC product with j about two times the water values at about 50w% and about 5 times at 60w%. Generally the effects of exposure time seem to be smaller for this matrix. On the other hand, losses in ft of slurry per ft of pipe seem to be similar at about 30 and 50w%. This product has been investigated differently from the others because it was used for suction performance testing. The 30w% slurry was exposed a long time in the loop and matrix was then added to about 50w% for another suction test. Thereafter solids were added to the highest concentrations.

ENERGY CONSUMPTION TO OVERCOME PIPELINE FRICTION LOSSES

The specific energy consumption expressed as the power required to overcome friction losses in a horizontal pipeline divided by the mass flow rate of dry solids (hp-hr/ton-mile) was introduced (e_p) in Equation 8, as a measure of the energy effectiveness. The specific energy consumption versus the mass flow rate based on the experimental data in Figures 5, 6 and 7 are shown in Figures 8, 9 and 10 for velocities less than about 18 ft/sec and with low velocities of about 11 and 12 ft/sec within parentheses.

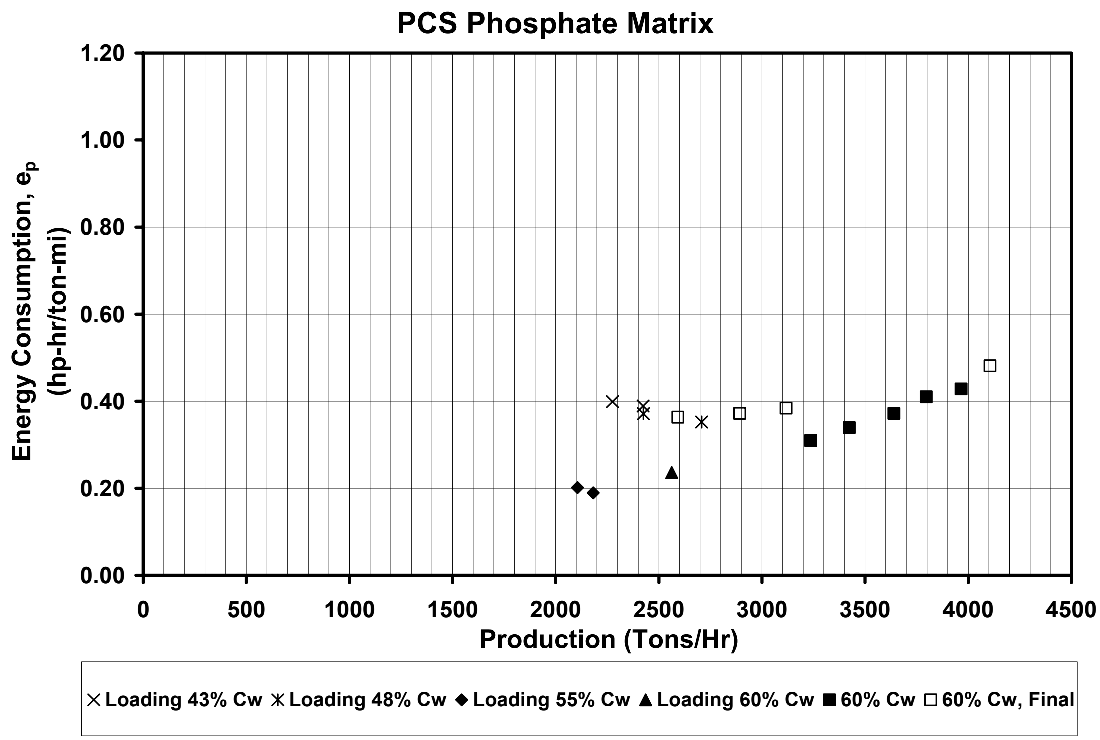


Figure 8. Specific Energy Consumption (hp-hr/ton-mile) Versus the Capacity of Dry Solids per Hour (ton/hr) for the PCS Matrix.

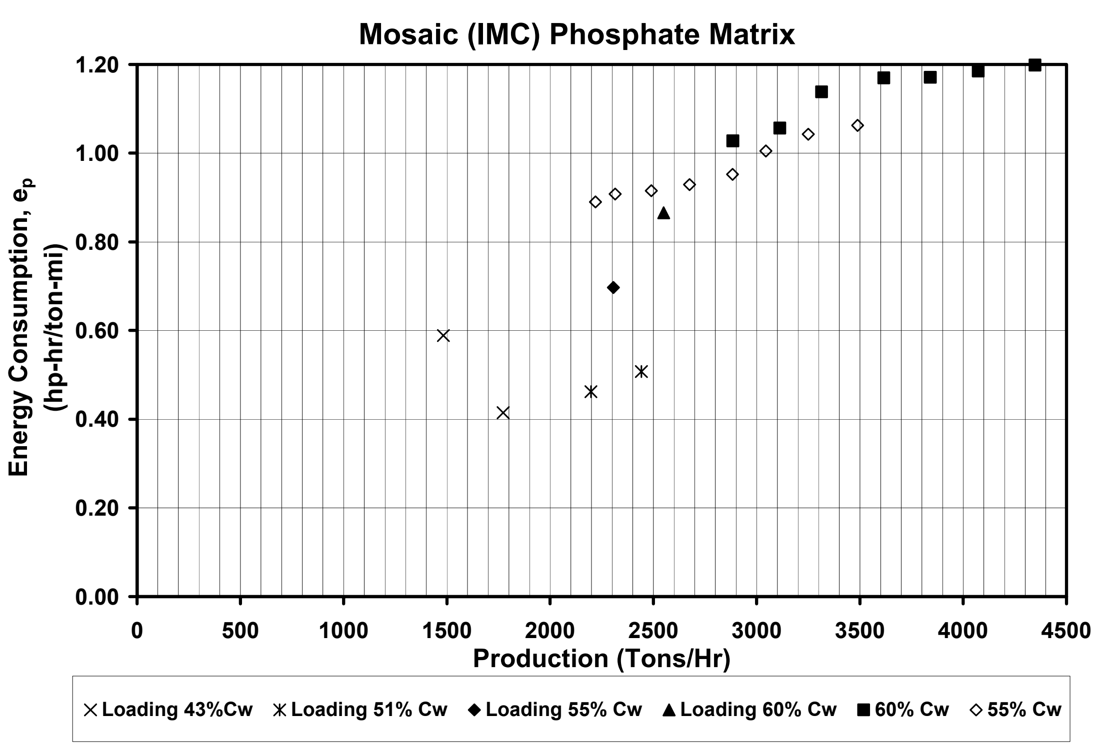


Figure 9. Specific Energy Consumption (hp-hr/ton-mile) Versus the Capacity of Dry Solids per Hour (ton/hr) for the IMC Matrix.

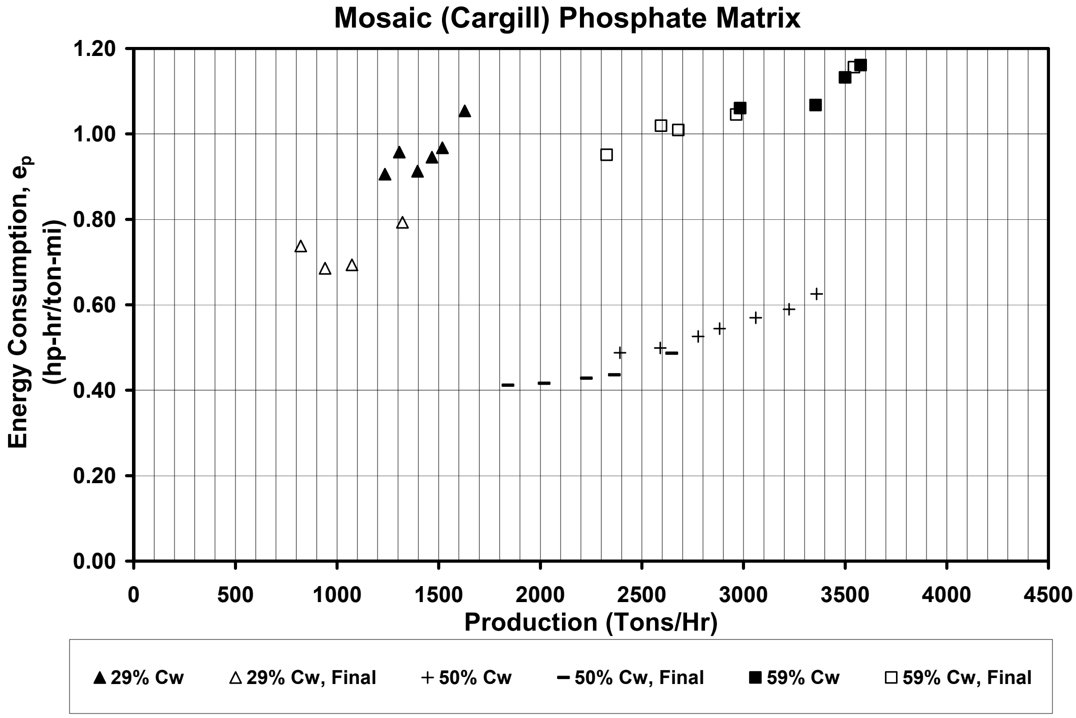


Figure 10. Specific Energy Consumption (hp-hr/ton-mile) Versus the Capacity of Dry Solids per Hour (ton/hr) for the Cargill Matrix.

It follows for the PCS matrix in Figure 8 that a high concentration of about 60w% gives both a low specific energy consumption (about 0.3 hp-hr/ton-mile) and a high capacity of over 3000 tons/hr. The e_p value can be expected to be fairly stable down to concentrations of 40w%, when it rises and corresponds to capacities less than about 2500 tons/hr.

The high-friction IMC matrix (Figure 9) has e_p-values that are more than double the PCS values. Concentrations of 45 to 55w% may here correspond to comparatively low energy consumption at about 2500 tons/hr. The indication for the Cargill matrix in Figure 10 is that 50w% corresponds to comparatively low e_p, while about 60w% means a doubling.

EFFECTS OF SOLIDS ON PUMP HEAD AND EFFICIENCY

Pump solids effect results were mainly obtained for flow rates of 60 to 100% of the flow rates corresponding to the best efficiency point (BEP). Rotary speeds varied mainly from 125 to 200 rpm. The effect of slurry on the head was practically negligible, also for the highest concentration investigated. The effect on the efficiency with the three slurries is shown in Figures 11, 12 and 13. The observed dependence with the flow rate can mainly be related to the scaling of various rotary speeds to an average value. Therefore, an average constant reduction factor is only evaluated at this stage.

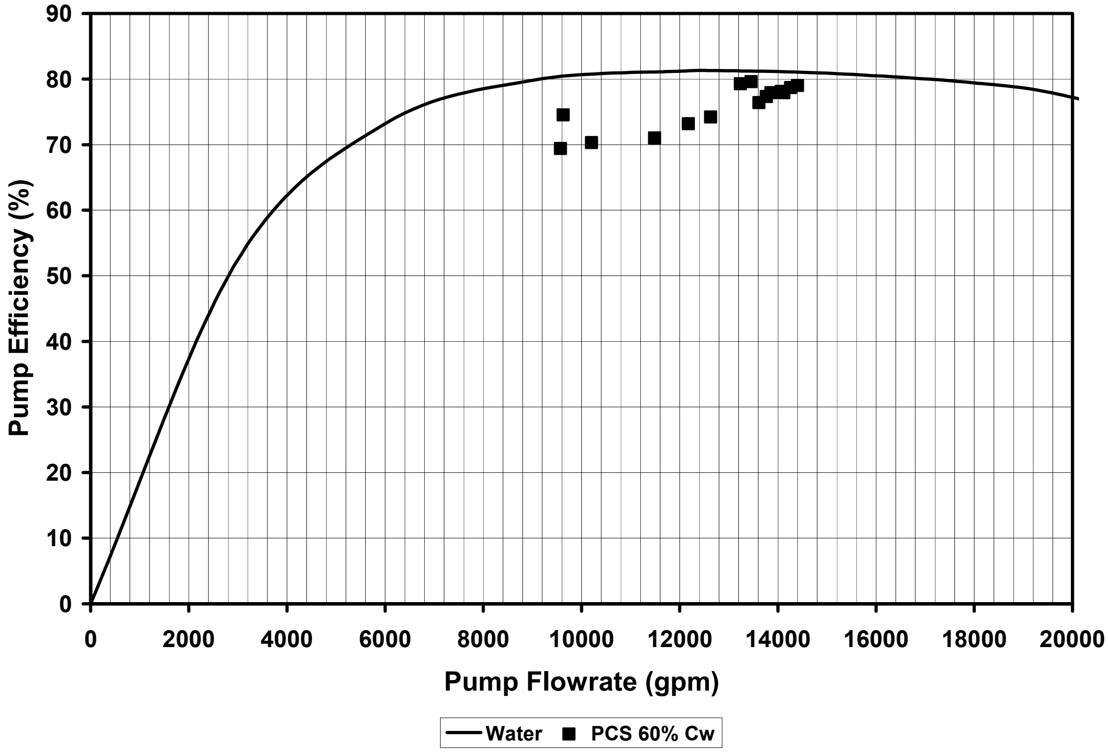


Figure 11. Effect of Solids on the Efficiency for the PCS Product (Pump @ 150rpm).

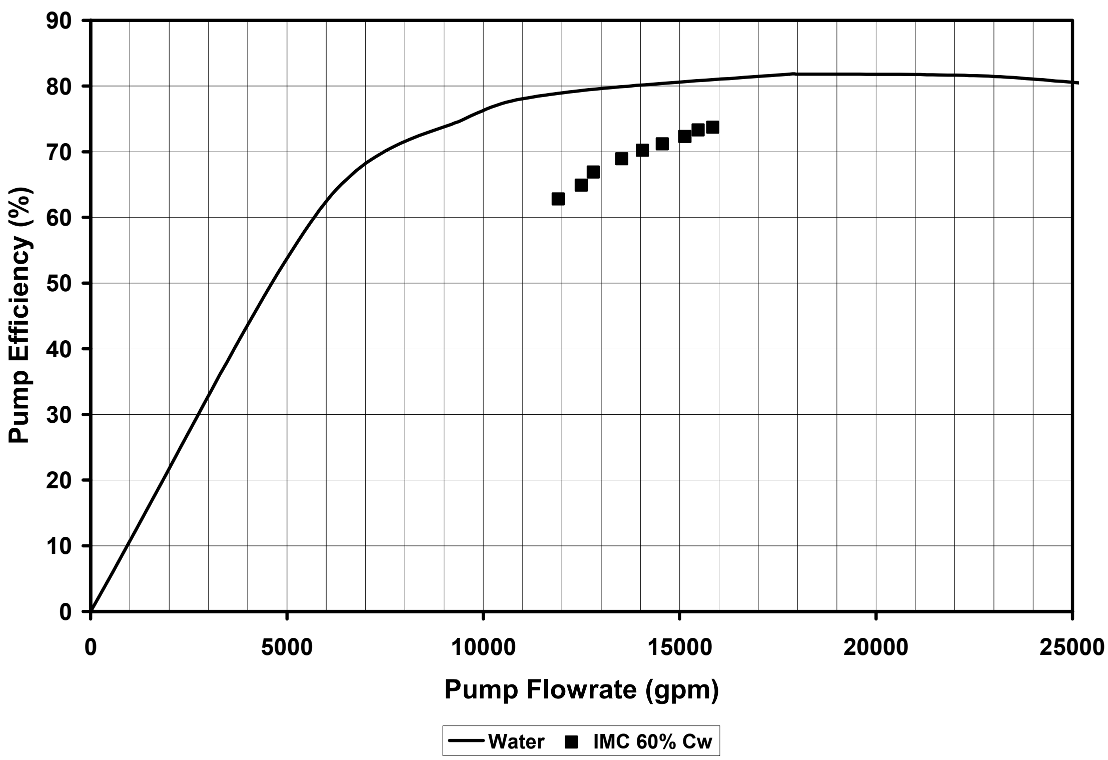


Figure 12. Effect of Solids on the Efficiency for the IMC Product (Pump @ 225 rpm).

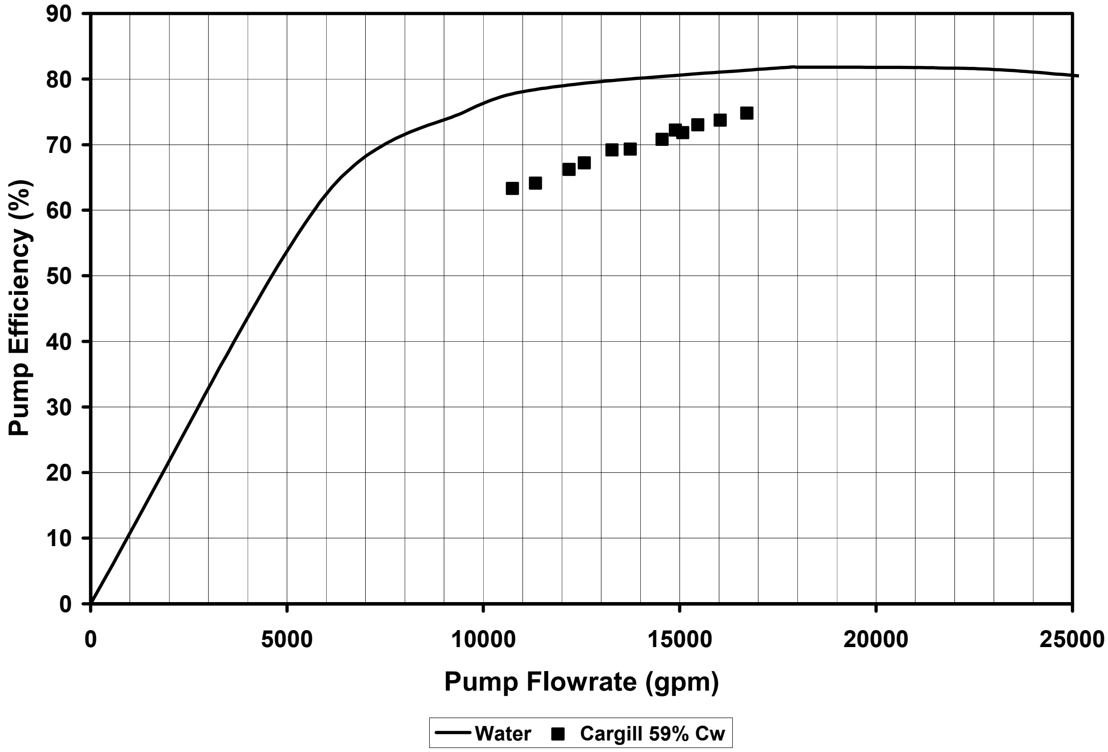


Figure 13. Effect of Solids on the Efficiency for the Cargill Product (Pump @ 225 rpm).

It was found from Figures 11, 12 and 13 that the average reductions in efficiency R_η (see Figure 1, page 8) were about 8% for the PCS product and 12.5% for IMC and Cargill, when pumped at 60w%. Data for lower concentrations confirm preliminary thoughts that R_η can approximately be related linearly to the solids concentration by volume.

EFFECTS OF SOLIDS ON PUMP CAVITATION

Field experiences with the newly designed pit pump mentioned in the Introduction have shown that it would allow cavitation-free operation at high solids concentrations in the pit. The new pit pump has comparatively lower NPSHR in water service than pit pumps normally used. Experimentally obtained data evaluated directly in terms of NPSHR in ft of slurry are shown in Figure 14 for Cargill matrix slurries and compared with NPSHR for water for the new pump and a normally used pit pump.

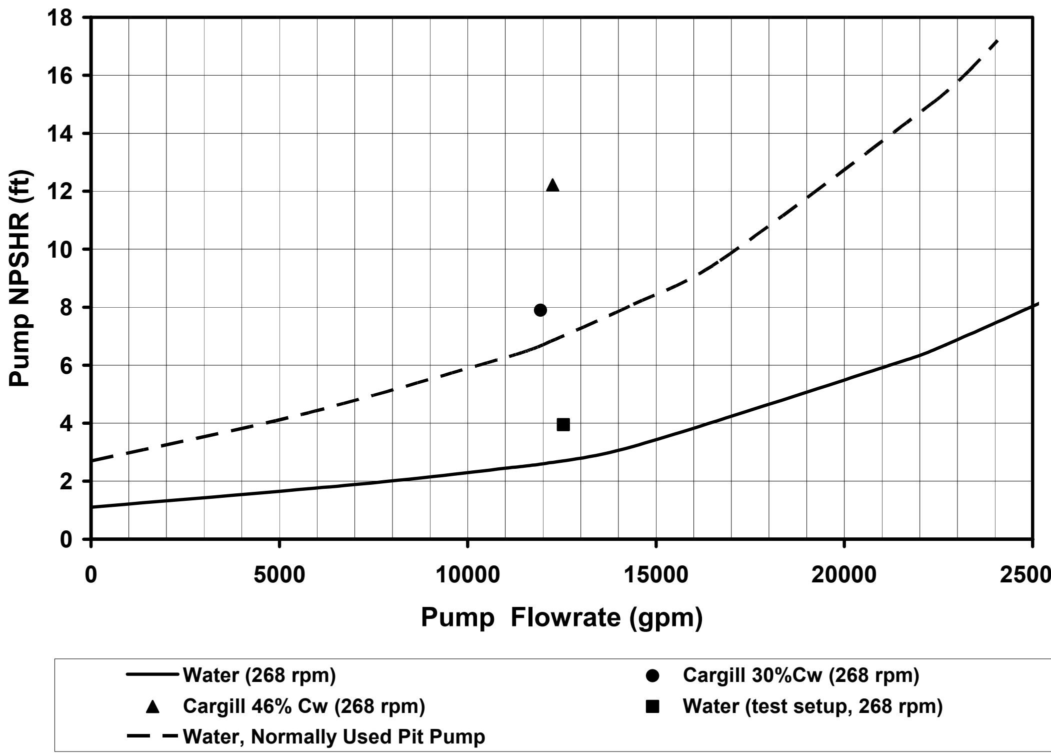


Figure 14. Experimentally Obtained Suction Performance Data Evaluated Directly in Terms of NPSHR in Ft of Slurry for Cargill Matrix Slurries at 30 and 46w%. Comparison with NPSHR for Water for the New Pump and a Normally Used Pit Pump.

It follows from Figure 14 that the slurry NPSHR values are higher than the corresponding water values for the pump used and that the values observed were affected by the air content. However, the much better suction performance for water for the new pump roughly compensates for the measured effect of slurry on the NPSHR.

University of Florida rheological work primary results are shown in Appendix E.

DISCUSSION OF RESULTS

PIPELINE FRICTION LOSSES

The resulting specific energy consumptions (hp-hr/ton-mile) to overcome friction losses in a horizontal pipeline can be summarized as follows. Values of 0.3 were obtained for the low-friction loss product in Figure 8 when pumped at about 60w%, corresponding to up to 3200 tons/hr. With the high-friction loss matrixes in Figures 9 and 10, values of 0.5 to 0.7 were obtained for 50 to 55w% (about 2300 tons/hr). For 60w% at 3200 tons/hr, the value exceeded 1 hp-hr/ton-mile. A similar pattern was found for the third product. The specific energy consumption to overcome pipeline frictional resistance when pumping the matrix is the dominating measure of the energy-effectiveness. The results show that the cost-effectiveness of using high solids concentrations will also be related to the higher capacity of dry solids, less use of gun water, and to comparatively lower capital costs per ton of solids.

The friction loss evaluations were focused on operating data obtained at comparatively short exposure times during the loading of solids. Figures 5 to 7 showed that the slurries behaved in a laminar-like way for the highest solids concentrations, particularly for long exposure times in the loop.

Non-settling, highly viscous slurries can be represented for scaling purposes by a pipe wall shear stress τ and the parameter 8V/D. The highest concentration slurries in Figures 5 to 7 are shown in terms of the introduced parameters in Figure 15.

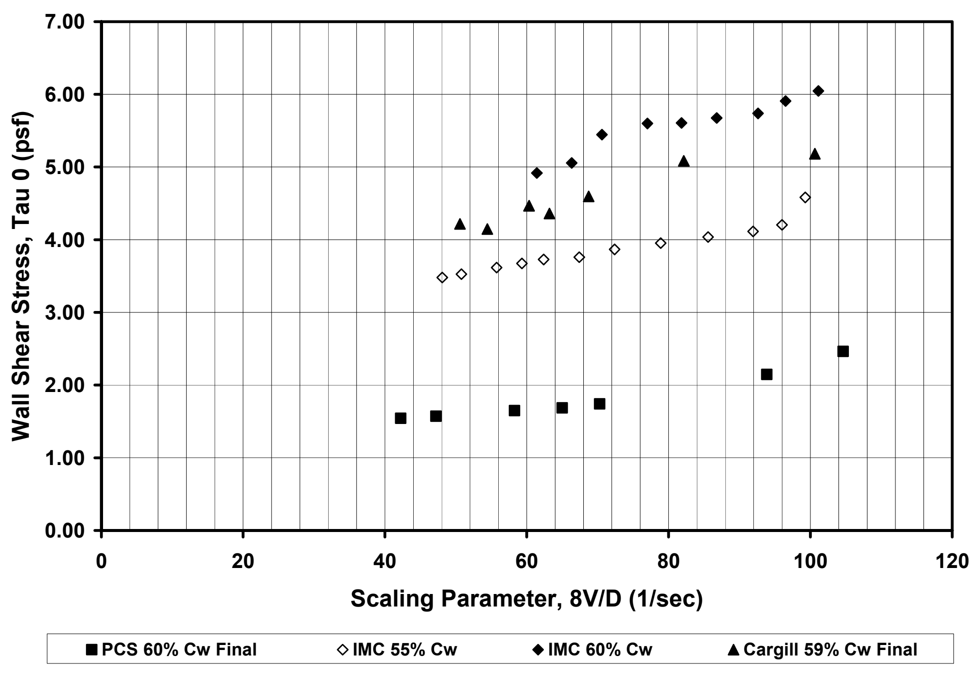


Figure 15. Pipe Wall Shear Stress Versus the Viscous Scaling Parameter 8V/D for the 60w% Data in Figures 5, 6, and 7.

The results shown in Figure 15 represent a highly non-Newtonian behaviour with a yield stress, here approximately estimated by extrapolating the curves back to the vertical axis. Yield values for the three products were here estimated at 1.5, 3 and 5 psf. The yield stress is defined as the minimum stress required to cause the solid-liquid mixture to flow. The slopes in Figure 15 expressing the increase in shear stress with the scaling parameter are 0.2 to 0.3. For the 55w% IMC matrix and the 60w% PCS slurry, tendencies of higher slopes can be seen at 8V/D values of 95 and 80, respectively, corresponding to velocities of 18-19 ft/sec. This could indicate a transition from laminar-like to more turbulent behaviour.

The laminar-like behaviour in Figure 15 for the highest concentrations, is similar to results by Whitlock and others (2002) in a 3" pipe loop for a 17w%-phosphate clay slurry to which a 135 micron sand was successively added (up to about 60w%) to increase the consistency. Thus, the indication is that the clay content in the tested slurries has a dominating influence on the behaviour. However, it was also observed for all tests that larger particles were moving in a partly sliding manner along the bottom of the pipe.

EFFECTS OF SOLIDS ON PUMP HEAD AND EFFICIENCY

It is generally recognized from laboratory and field measurements that the effect of solids in phosphate matrix slurries on the head and efficiency of the large pumps normally employed is limited to a few percent when operating at concentrations of 35 to 45w%. It has been found in large dredging systems that solids affect the pump performance when pumping various sands at C_w values of over 70% (Whitlock and others 2004). The pumps used had impeller diameters of about 100". The corresponding pipeline friction losses in 40" diameter pipelines also showed a reduction when increasing the concentration up to 70w%.

Pump solids effects for settling type of slurries have roughly been found to be proportional to the inverse of the pump impeller size (Wilson and others 2004). That is, a smaller pump is affected more than a larger pump. In this perspective, the field experience reported above with negligible solids effects for very high concentrations has set an upper limit.

For the tests carried out here, the solids effect on head was found to be negligible in the test carried out with a 62" impeller pump. The reduction in efficiency R_η was 9% (ER=0.91) for the PCS slurries and 12.5% (ER=0.875) for the IMC and Cargill products, respectively, when pumped at 60w%.

Assuming a domination of viscous behaviour (Figure 15), then comparisons can be made with the experimental results mentioned above (Whitlock and others 2002) with a fine sand added to a phosphate clay, pumped in a 12" impeller pump resulting in a reduction in efficiency of about 15% at 60w%. Scaling with a type of pump Reynolds number (Wilson and others 1997) indicates that the reduction in efficiency in the large pump used here should be some percent lower than the 15% reduction with the smaller pump.

EFFECT OF SOLIDS ON PUMP CAVITATION

The suction performance results for the new pit pump in Figure 14 support field experience with practically cavitation-free pit pump operation at occasionally very high solids concentrations. The observed effect of solids on the NPSHR is roughly compensated for by the much better NPSHR with water compared to normally used pit pumps. The air content of the slurry has a significant effect. Recent information in the literature for small pumps indicates that the suction performance may be affected for laminar-like flowing, highly non-Newtonian slurries (Roudnev 2004).

The effect of solids and possible influence of operation close to cavitation on the efficiency may only influence the total energy cost in a matrix pipeline pumping system by about 5% (Addie and Whitlock 1998).

TOTAL SYSTEM EFFECTIVENESS

With the pit at a lower evaluation than the discharge end of the pipeline, then the pumps also have to overcome the lifting here expressed as an overall slope, s. In order to include lifting in the relationships, j has to be replaced by (j + s) in Equations 6, 8 and 11. With typical elevation changes of 80 to 100 ft and pipeline lengths of 10 to 15 miles, s may vary from 0.1 to 0.2%. It follows from Figures 5 to 7 that the losses, j, may vary from 0.03 to 0.08 in pumping system handling slurries with concentrations of 40 to 50w%, respectively. This means that the lifting stands for less than 5% of the total power requirement. With higher solids concentrations, the influence of lifting will be even less.

Average reductions of 9 and 12% in pump efficiency were found at 60w% for the low- and high-friction loss slurries, respectively. It was also indicated that the reductions approximately increased in direct proportion with the volumetric solids concentration corresponding to an increase from 40 to 60w%. Assuming a pump efficiency of 83% (η) and 90% efficiency in motor and drives (η_m), then the total efficiency in Equation 9 equals about 75%.

$$\eta_T = \eta_M \cdot \eta \tag{9}$$

With the definition of R_η, then it follows (Equation 10) that

$$\eta_T = \eta_M \cdot \eta_O (1 - R_\eta) \tag{10}$$

equals about 71, 68, and 66% for 40, 50, and 60w%, respectively, for the high-friction loss products with R_η about 12% at 60w%.

The system or total specific energy consumption, e_T, was expressed in the following way in Equation 11:

$$e_T = \frac{e_p}{\eta_T} = \frac{e_p}{\eta_M \cdot \eta_O (1 - R_\eta)} \tag{11}$$

Inserting the resulting efficiency values from equation 10 here show that e_T is 1.41, 1.47 and 1.52 times larger than the value of e_p

$$e_p = 5.33 \cdot \frac{\rho \cdot j}{\rho_S \cdot C} \tag{8}$$

expressing the energy consumption to overcome pipeline friction per mass unit of dry solids in a horizontal pipeline.

Microsoft Excel® spreadsheets have been developed based on smoothed best-fit representations of the experimental results (e_p and j) for each of the three different types of slurries. These are included as Appendices F, G, and H. The basis of the model developed for this purpose is presented in Appendix I. The plots for the specific energy consumption versus dry solids transport rate are included here as Figures 16, 17, and 18 for the PCS, Cargill, and IMC types along with additional plots 19, 20, and 21 including (for the same respective types of slurries) lines of constant gun water.

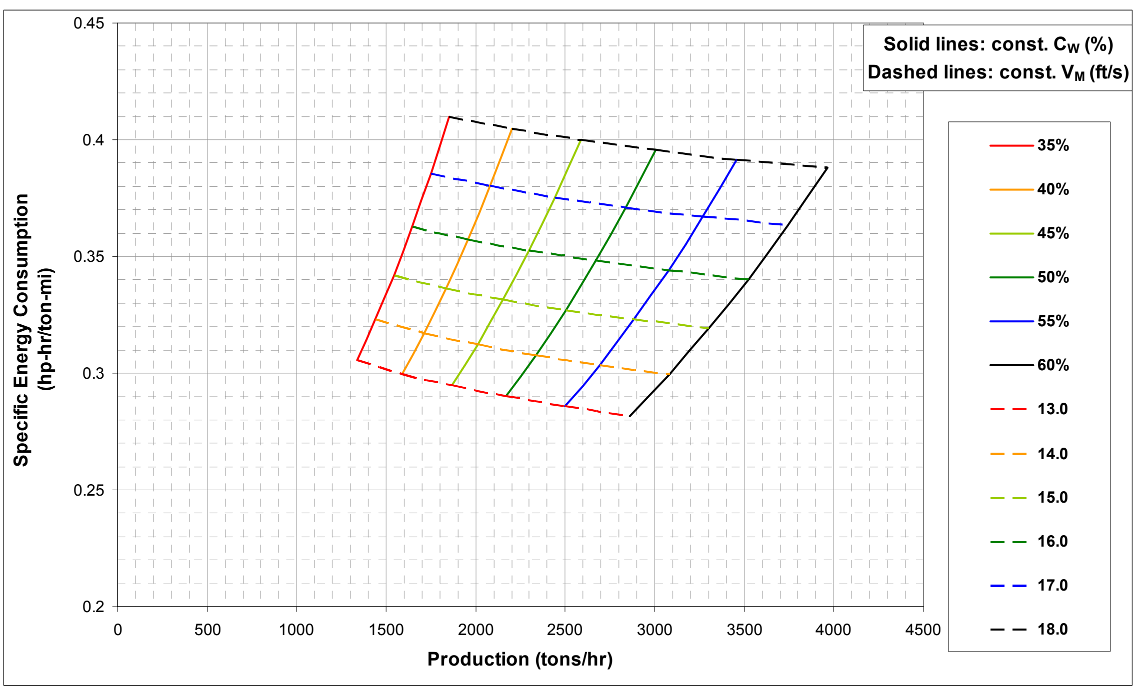


Figure 16. PCS Matrix Energy in 19.25” Diameter Pipe.

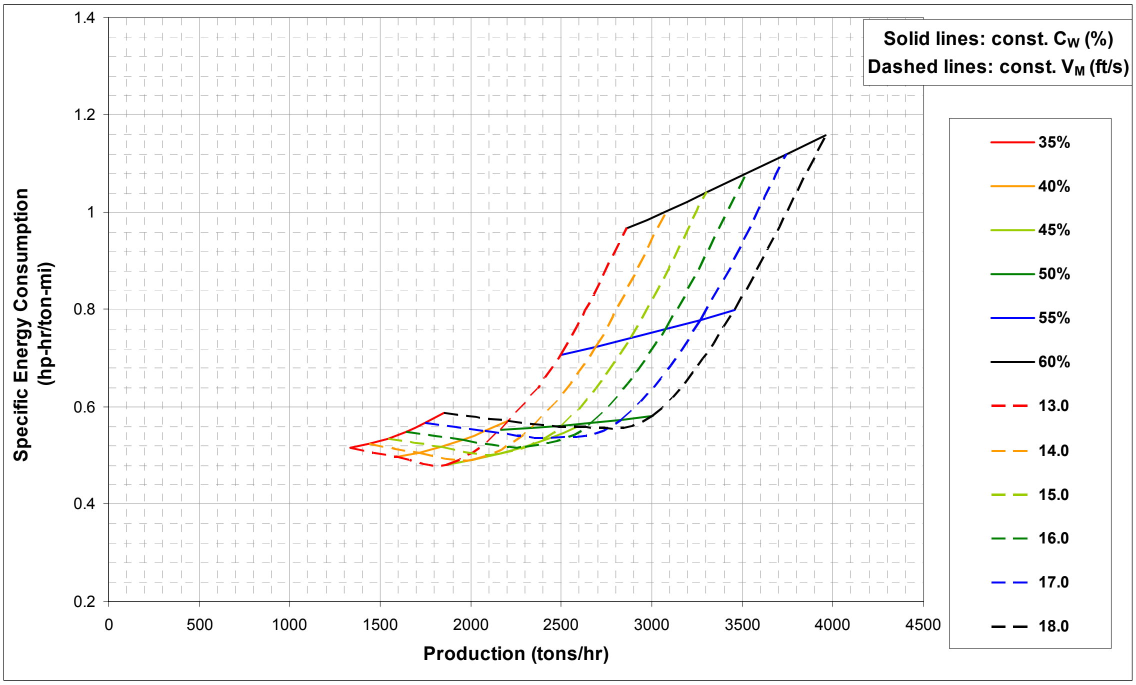


Figure 17. Cargill Matrix Energy in 19.25" Diameter Pipe.

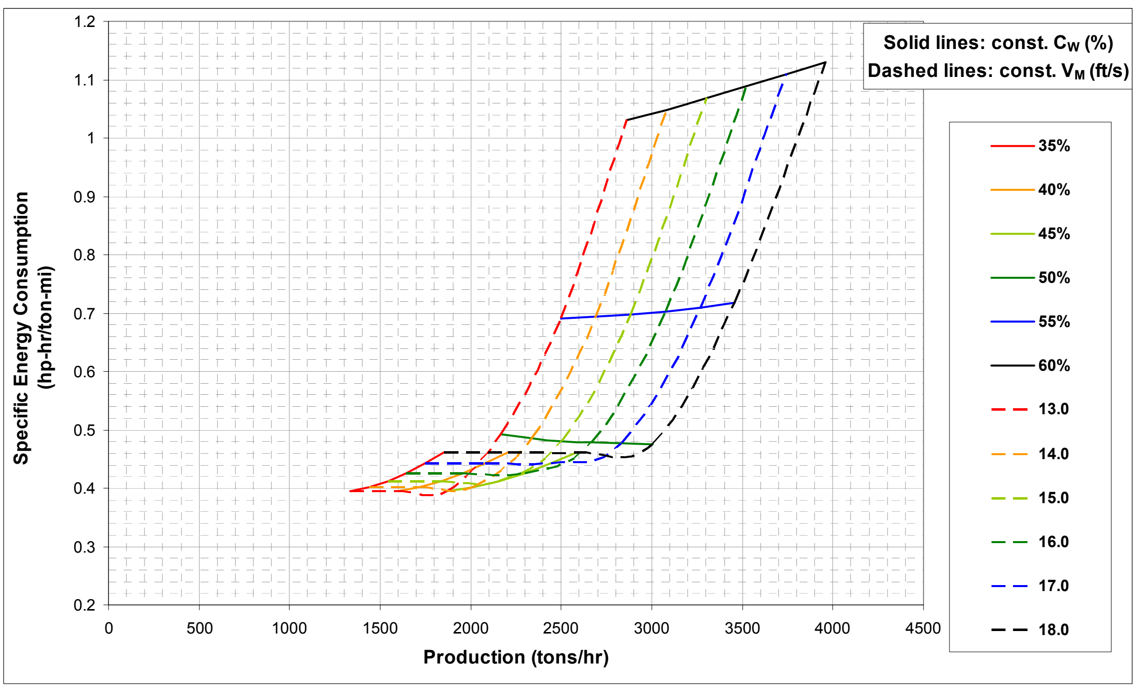


Figure 18. IMC Matrix in 19.25" Diameter Pipe.

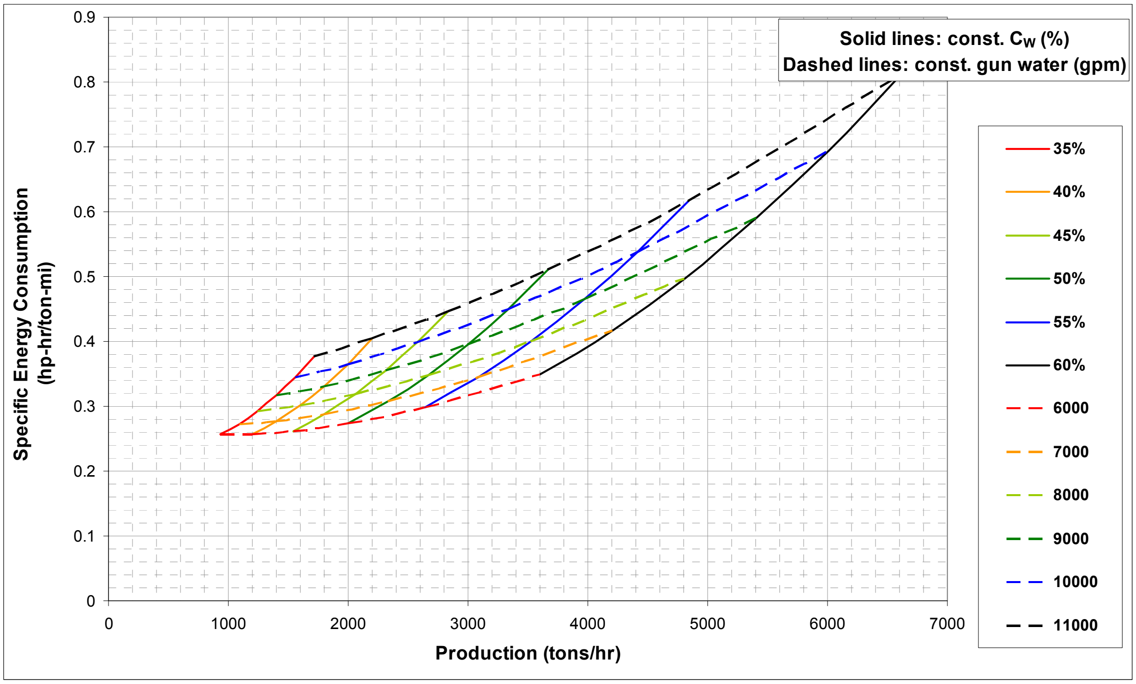


Figure 19. PCS Matrix and Gun Water in 19.25" ID Pipe.

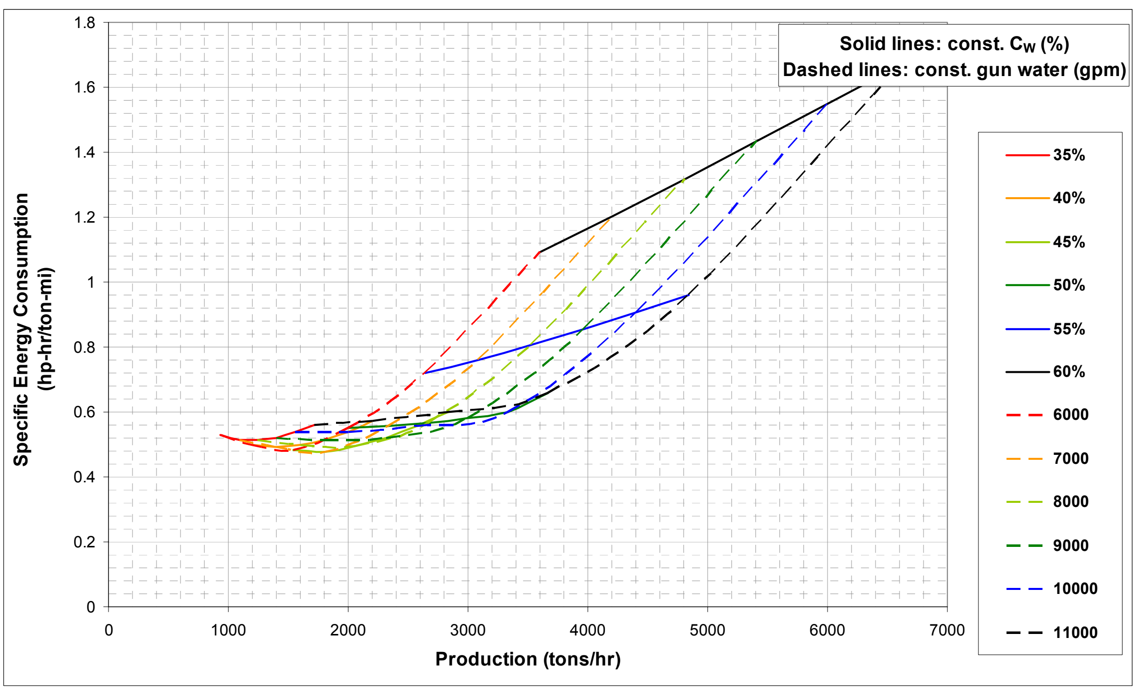


Figure 20. Cargill Matrix and Gun Water in 19.25" ID Pipe.

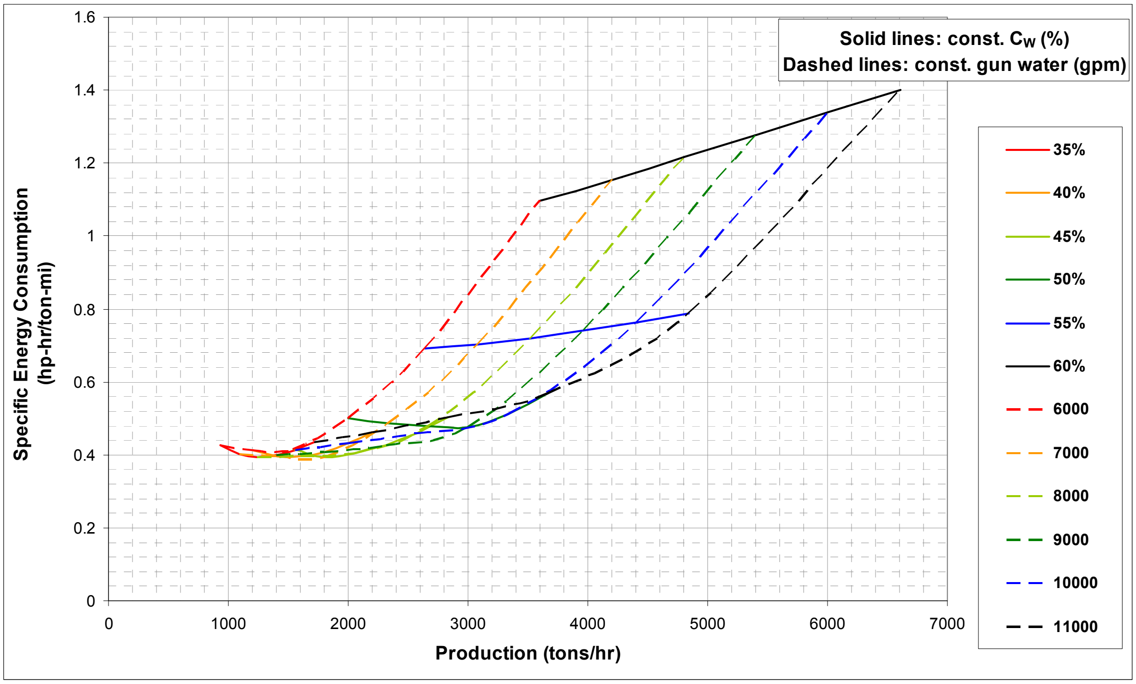


Figure 21. IMC Matrix and Gun Water in 19.25" ID Pipe.

Figures 22, 23, and 24 for the same cases (PCS, Cargill, and IMC) and respective data show the horizontal pipe friction at different pipeline velocities and concentrations.

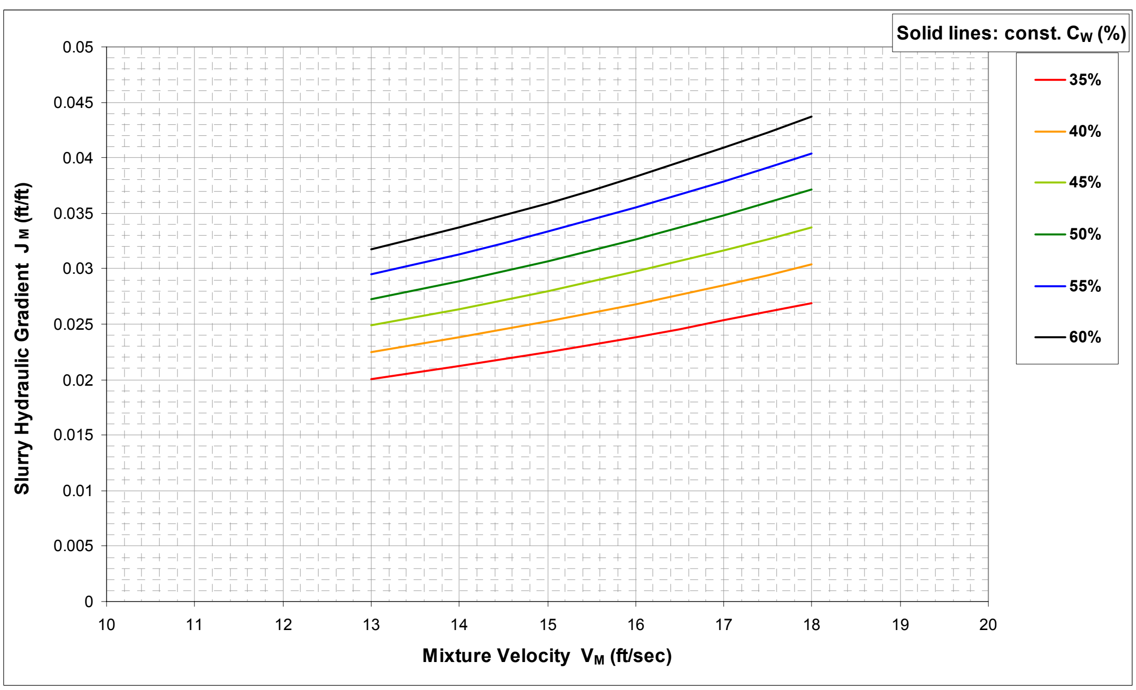


Figure 22. PCS Matrix 19.25" ID Pipe Head Loss.

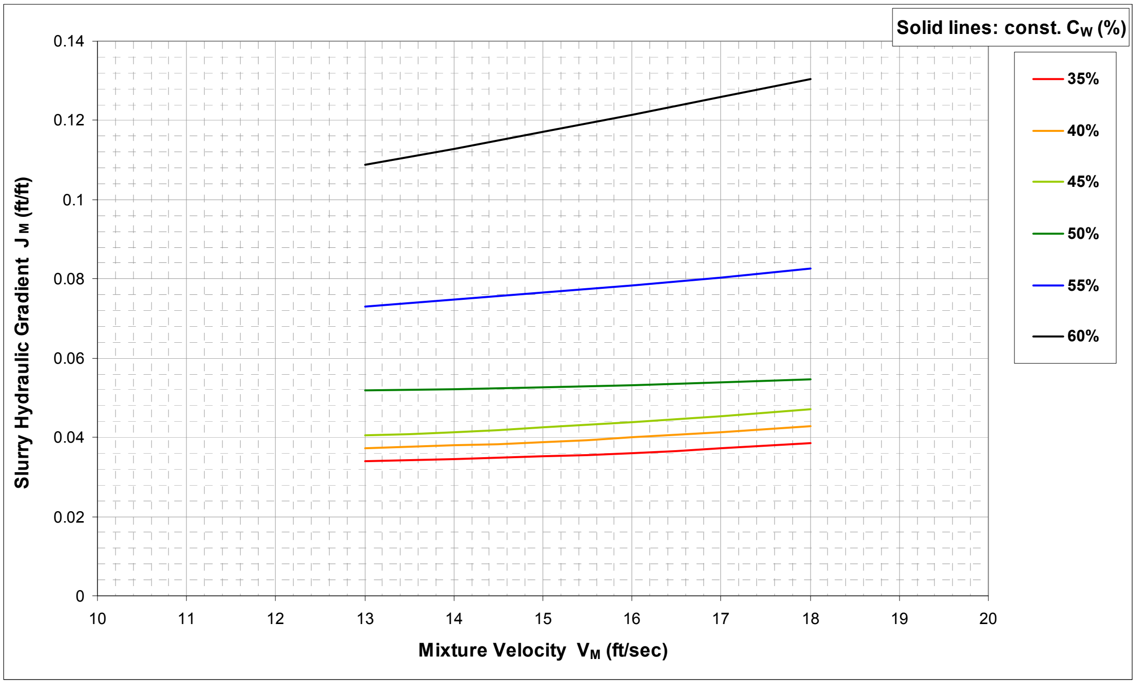


Figure 23. Cargill Matrix 19.25" ID Pipe Head Loss.

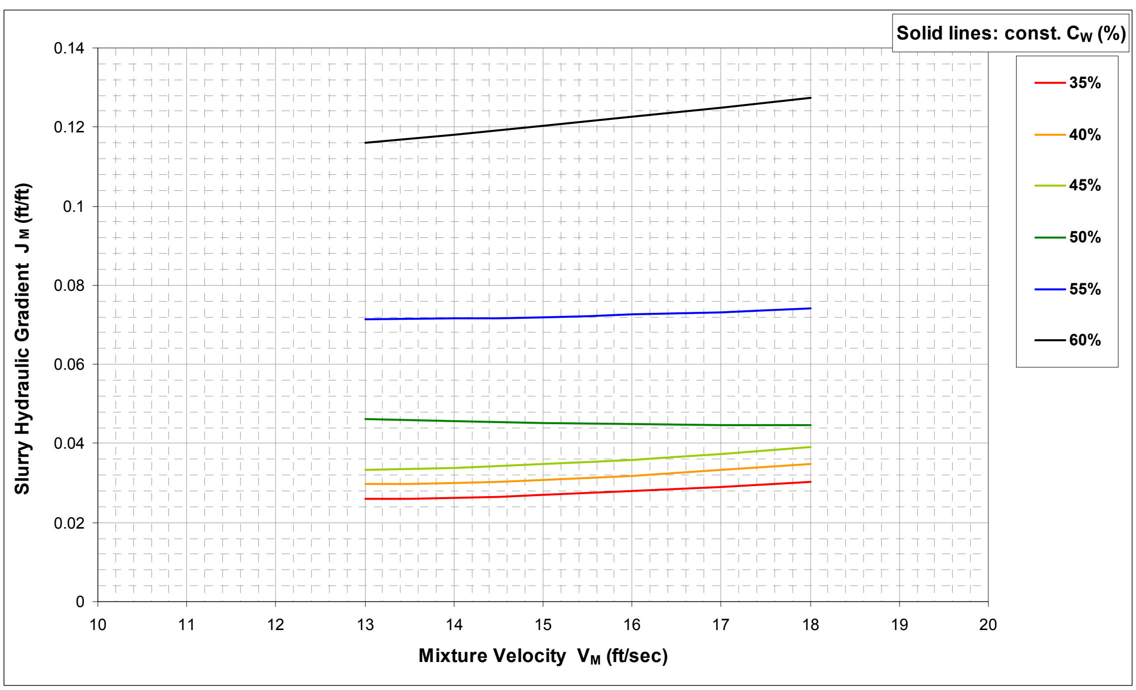


Figure 24. IMC Matrix 19.25" ID Pipe Head Loss.

The plots, Figures 16 through 24 above, provide a means of selecting the most energy-efficient operating point and determining the necessary pump head for each of the three types of matrix.

Plots for the 17.25" and 21.25" diameter pipeline cases can be obtained by altering the pipeline diameter (field E12) in the Excel® spreadsheets of Appendices F, G, and H, respective slurry type.

In the case of the PCS type and Figure 16, for example, the highest tonnages and concentrations, as might be expected, provide the lowest cost per ton. Figure 17 associated with this shows that to achieve this, gun water must be able to be reduced. Figure 22 shows the pipeline head needed at different operating velocities and concentrations associated with the different operating points.

In the case of the Cargill type, Figure 17 shows that operation at concentrations in the range of 45 to 50w% is optimal and that operation at high concentrations of 60w% is energy-inefficient. Figure 20 shows the gun water flow that goes with this, while Figure 23 shows the necessary pump head. The IMC plots Figures 18, 21, and 24 show similar trends to the Cargill plots.

The effect of elevation changes and pump solids effects has not been included in the results given in Table 4. Mechanism-oriented modelling techniques for friction losses for these types of slurries with both coarse and very fine particles which appear to move as laminar-like flows (Thomas and others 2004) are included in the GIW Excel® model (see Appendix I), and further development of this model may be a suitable continuation of the present work.

EFFECT OF SLURRY PROPERTIES

The combination of the finest particles and the liquid forms a carrier fluid which takes on viscous properties. For turbulent flow in a pipeline pumping environment, characteristic dimensions are related mainly to the boundary layers. It is then relevant to consider that the mixture of particles smaller than about 40 microns and the liquid can be given viscous properties that influence the motion of coarser particles through hydrodynamic and mechanical forces.

The question is then whether it is possible to relate the power requirement or pipeline friction losses directly to the apparent viscosity of a matrix slurry. Because the maximum particle sizes in the matrix exceed several thousand microns, and thus are too large for their test apparatus, Zaman (2005) studied the resistance to flow for slurries with particles less than 106 microns in their laboratory-scale viscometric equipment. The results were evaluated in terms of apparent viscosities. Values for solids concentration of up to 25w% (about 10% by volume) were investigated in a cone and plate viscometer and yield stresses were determined in a vane type of meter. Yield values of up to 300 Pa were obtained.

A pipeline friction loss model by Wilson and Sellgren (2001) based on a carrier fluid with particles smaller than 40 microns was applied here to the viscous data for the 106-micron measurements. In the model, the mass fraction, X_f, of solids smaller than 106 microns from the particle size distribution is here considered as forming the carrier fluid. The remaining fraction ($1-X_f$) is then here divided at 215 microns into a pseudo-homogeneous and a heterogeneous portion. The carrier fluid and the pseudo-homogeneous fraction, from 106 to 215 microns, is considered to combine with the carrier fluid to form an equivalent fluid for which the friction loss in ft of slurry is equivalent to the loss in ft of carrier fluid. Parameters representing the heterogeneous fraction are given by Wilson and Sellgren (2001) or Wilson and others (1997).

Comparison with measured GIW pipeline friction loss data for the three matrix products showed that a possible correlation existed for the highest concentrations with the more viscous IMC and Cargill matrixes. The IMC pipeline results indicated that the exposure time in the loop generated more fine material, which increased the losses at concentrations of 55 and 60w%. The fine particle fraction (< 106 microns) may have increased from 23 to 28% (about 20%) for an increase of about 25% in the losses at 14.5 ft/s in the 19.2"-diameter pipeline.

The apparent viscosity required in the model described above to fit the full-scale pipeline loop results is denoted μ_f. The resulting laboratory-scale cone-and-plate data reported by Zaman (2005) at a shear rate in the range of 100 s^{-1} is denoted μ_l. The full-scale pipeline loop friction losses and modelled results based on μ_f are compared to the measured μ_l in a laboratory viscometer in Table 4.

Table 4 lists measured and modelled friction loss gradients (j) related to variations in the content of particles smaller than 106 microns, X_f. The apparent viscosity μ_f refers to the viscosity required to have the friction loss model described above fit with measured pipeline loop results at 14.5 ft/s in a 19.2"-diameter pipe. The apparent viscosity from laboratory cone-and-plate measurements for mixtures with particles smaller than 106 microns is denoted μ_l . C is concentration by volume.

Table 4. Comparison of Test Parameters.

w%	C %	X_f %	C for X_f	j Ft Slurry	μ_f Pa.s	μ_l Pa.s
55	31.6	23	7.3	0.078	0.1	0.5
		28	8.9	0.100	0.7	1.2
60	36.1	23	8.3	0.105	0.7	1.0
		28	10.1	0.130	1.9	2.0

It follows from Table 4 that the apparent viscosities required to model the friction losses agree reasonably well at the highest concentration with the values evaluated from resistance measurements in a cone-and-plate viscometer for a mixture with particles smaller than 106 microns. With the lower concentrations, the viscosities used for model agreement are considerably lower than the laboratory scale measurements. The pipeline friction loss model may not be suitable here because is based on viscous parameters for much smaller particles, below 40 microns.

An updated and improved version of the modelling approach by Wilson & Sellgren (2001) has been incorporated in the GIW XL model. The basis of this model has been outlined in Appendix I. The fluid component of the hydraulic gradient is calculated for both laminar and turbulent flow, and the larger of the two is selected. The coefficients in this model are determined statistically by a least-square calibration process based on the data from the GIW pipe tests.

A very important output has been the plots of SEC (specific energy consumption, in hp-hr/ton-mile), which is a measure of energy-effectiveness. Results for different conditions are shown in the plots reported earlier. It was noted that there were two distinct patterns of behaviour; for the PCS slurry, which had low fines fraction, the behaviour was similar to that of a typical sand-water slurry travelling in turbulent flow. The values of SEC bunched in a narrow range between 0.3 and 0.4 for all tests up to 60w% (the maximum observed).

Different behaviour was found for high-friction-loss matrix (the IMC and Cargill slurries), particularly at high solids concentrations, where the flow appeared to be essentially laminar, combined with a sliding bed of solids, similar to that reported by Thomas and others (2005). At concentrations up to 50w%, SEC was somewhat higher than the PCS case, around 0.4 to 0.6. However, for the high-friction-loss matrix, SEC values near 0.7 were obtained for 55w%, and at 60w% SEC had risen to a value exceeding 1 hp-hr/ton-mile.

For a material that approximates Bingham-plastic behaviour, the transition velocity between laminar and turbulent flow (V_T) is determined principally by the yield stress τ_y , using the relationship $V_T \approx 20\sqrt{(\tau_y/\rho)}$ in consistent units (Wilson and others 1997, Chapter 4). Measured values of τ_y are plotted against weight concentration of fine solids on Fig. 17 of Zamen (2005), which shows that τ_y varies with concentration to a power of about 5. The highest fine-solids concentration, corresponding to the IMC and Cargill slurries, give values of V_T (calculated by the relationship mentioned above) in excess of 20 ft/s. Scaling down to the lower fine solid for the PCS slurry by the 5th power law gives V_T below 5 ft/s. In other words, predictions based on the measured values of τ_y show laminar flow for high concentrations of IMC and Cargill slurries, and turbulent flow for the PCS slurry at all concentrations tested; these predictions are in full accord with the GIW pipeline test results and the XL model.

The change of the percentage of fine particles in the mixture has been discussed earlier. Questions still arise, however, and it is suggested that further work should investigate this in a real pipeline recording pipeline friction after the first pump in the pipeline and then the last one, in order to quantify any change.

CONCLUSIONS

The evaluations were focused on operating data obtained at comparatively low exposure times in the loop system. It was found that the slurries behaved in a laminar-like way for the highest solids concentrations with larger particles moving in a partly sliding manner along the bottom of the pipe. Samples showed that larger particles were to some extent embedded in clay lumps, even after a considerable exposure time in the loop.

The specific energy consumption (hp-hr/ton-mile), to overcome pipeline frictional resistance when pumping the matrix is a measure of the energy-effectiveness. Results for different conditions are shown on the plots presented earlier. Values of specific energy consumption (SEC) of 0.3 to 0.4 were obtained for the low friction loss product when pumped up to 60w% (corresponding to up to 3200 tons/hr). With the high friction loss matrix, and concentrations up to 50w%, SEC was somewhat higher, around 0.4 to 0.6. However, for the high-friction-loss matrix, SEC was near 0.7 for 55w% (about 2300 tons/hr). For 60w% at 3200 tons/hr the value exceeded 1 hp-hr/ton-mile. The cost-effectiveness of using high-solids concentrations should therefore also be related to the higher capacity of dry solids, less use of water and to comparatively lower capital costs per ton of solids. Values for different conditions are shown in the plots reported earlier.

It was found that the reduction in pumping head due to the solids content was practically negligible for the pit pump used in the test. However, average reductions of 8 and 12% in efficiency were observed at a solids concentration of 60w% for the low- and high-friction-loss slurries, respectively. It was also indicated that the reductions approximately increased in direct proportion with the volumetric solids concentrations, corresponding to an increase from 40 to 60w%. The total pump efficiencies along the pipeline including pumps, gearboxes and motors for water pumping only may be about 75%. With pump solids effects included for 40, 50 and 60w%, then the corresponding slurry efficiencies are 71, 68 and 66%, respectively, for the high-friction-loss products. The corresponding system or total specific energy consumption in hp-hr/ton-mile is then 1.41, 1.47 and 1.52 times larger than the values to overcome pipeline friction losses discussed above.

Operation practically without cavitation has been proven in the field for concentrations sometimes of up to 60w%. The NPSHR tests carried out here for concentrations of over 45w% also indicated an improved suction performance that was affected by the air entrainment. The effect on the efficiency of solids and operation close to cavitation with a pit pump may only influence the total energy cost in a matrix pipeline pumping system by about 5%.

The University of Florida work showed that above a certain concentration, the pipe wall shear stress due to the carrier becomes significant. In the types of slurries where this occurred, it would seem to be the case in the pipeline also.

As noted earlier, the characteristics of two of the three slurry matrix samples were dominated by the properties of the carrier portion. The University of Florida sizing work for the most part confirmed the as-tested solids sizing, so we are confident this is a function of the samples used and not a test-rig effect. In the field, while heavily clayed matrix is not uncommon, it is more common for matrix to be the quickly settling type, bringing into question the representative nature of the samples selected. In reality, there is a wide range of geological types of matrix, and three samples can hardly expect to represent it. It is suggested, therefore, that further work might look at the geological range of types, to where the three types tested fit in with this, and where more test data (and modelling) might be needed.

As noted in the report, the time in the test loop and in the long pipelines now in service also causes changes to the slurry and its characteristics. It is recommended that this be investigated.

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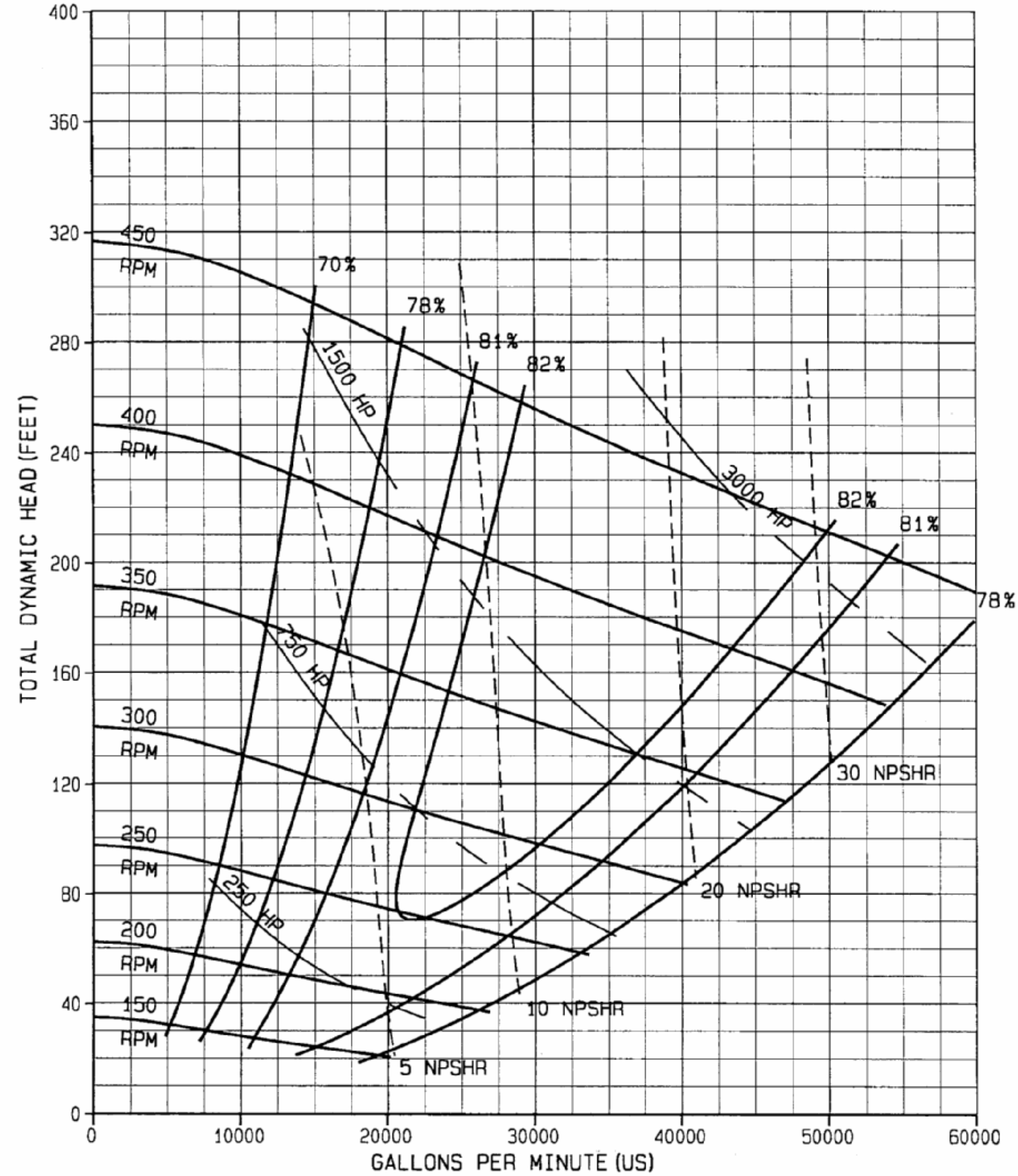
Appendix A

CLEAR WATER PERFORMANCE INFORMATION BY PUMP MANUFACTURER

Pump Type Model	Vane Diameter	Free Passage	
LSA 20x25-62 C16-3/8 /3ME 18-7/8	62.00"	10.2x10.4"	GIW Industries Inc. A KSB Company · KSB
Clear Water Performance The effects of specific gravity, viscosity and solids on performance with slurry must be accounted for. Alternate choice for frame size or seal type may also have some effects.	**Frame Size** 9K **Seal Type** K, F, M	**Curve Number** E 17A-02 TP Basis B 15A-02	

5518C Imp, 5521C Suct Liner W/ Diverter

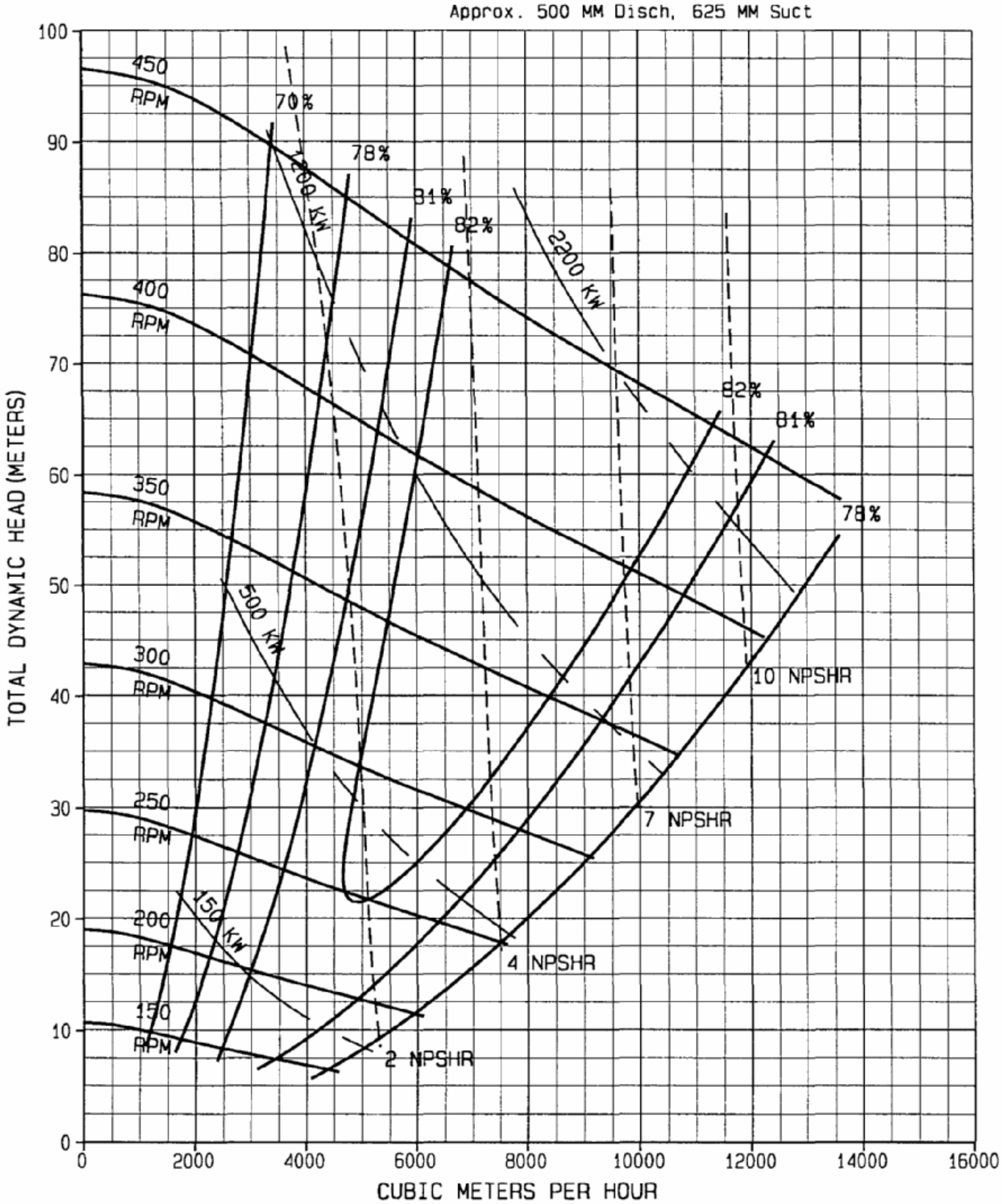


10-NOV-03 91880

Pump Type Model	Vane Diameter	Free Passage
LSA 20x25-62 C16-3/8 /3ME 18-7/8	1575 MM	260x264 MM
Clear Water Performance The effects of specific gravity, viscosity and solids on performance with slurry must be accounted for. Alternate choice for frame size or seal type may also have some effects.	**Frame Size** 9K **Seal Type** K, F, M	**Curve Number** E 17A-02 TP Basis B 15A-02

GIW Industries Inc.
A KSB Company

5518C Imp, 5521C Suct Liner W/ Diverter
Approx. 500 MM Disch, 625 MM Suct



10-NOV-03 9188D

```
                                SLYSEL
                          Version 20051020/20051012     GIW Industries, Inc.
Item # : 1                                              Grovetown, GA  USA
Reference: FIPR Project # 04-04-069                     Date: Oct-21-2005
Application: Clear Water Operation @ 150 RPM            Time: 10:41:57

-------- SELECTED PUMP with ALL VALUES SCALED to NEW SPEED & TURNDOWN ---------
C  20x25 LSA 62        C  16- 3/ 8/ 3ME  9       9188D    E 17A-02 B 15A-02
**************** PLEASE NOTE ALL DIAMETERS ARE IN INCHES ****************
RPM               150.0 | T/D RATIO (THEO)  1.000 | PERIPHERAL VEL  2434.7 SFPM
EFF. (SLURRY)      81.3 | FULL    IMP DIA   62.00 | THROAT     VEL    14.0 ft/s
EFF. (WATER)       81.3 | THEORET IMP DIA   62.00 | BRANCH     VEL    13.0 ft/s
NPSH RQD (ft)       2.1 | ACTUAL  IMP DIA   62.00 | SUCTION    VEL     8.3 ft/s
Conc. by WT (%)     0.0 | SOLIDS EFFECT HEAD 0.00%| SOLIDS EFFECT EFF     0.00%
Conc. by Vol(%)     0.0 | Max OPER PRES(psi)200.0 | SPHERE PASSAGE    10.2 in
Pump Ns (US)     1452.6 | Suction Ns (US)  9650.6 | ROTATION             RH

         Flow(GPM)   Head(ft)       Eff.     HP w/SGM    NPSHR(ft)
               0.0      35.2         0.0        36.1        0.3
            3300.0      34.0        55.6        50.9        0.5
MinQuote    6349.6      31.6        74.5        67.9        0.8
            6600.0      31.4        75.3        69.4        0.8
            9900.0      28.6        80.5        88.5        1.4
Duty/BEP   12700.0      26.4        81.3       103.9        2.1
           13200.0      26.0        81.2       106.5        2.3
120%Duty   15240.0      24.5        80.9       116.5        2.9
           16500.0      23.6        80.3       122.3        3.4
MaxQuote   19760.6      21.3        77.5       136.6        4.7

*Water performance guarantees for this pump may be specified in accordance with
 Hydraulic Institute HI 1.6-1994 Class B between flows   6350 to  19761 ( GPM)

* Note: Pump Solids Effect is based on a Settling Slurry
--------------------------------------------------------------------------------
Flow      :  12700.  GPM     Fluid  S.G. 0.998    Pump Service Class     :     1
Head      :    26.4  ft      Slurry S.G. 0.998    Abrasivity Correction :   1.0
Throughput:      0.0 tons/hr  Solids S.G. 2.650    D50 (microns)          :  200.
Large particles (>2300 microns): Semi-Rounded     D85 (microns)          :  460.
% of fine particles < 74 microns :  0.0           Largest Solid(microns):  2000.
Fluid pH  :      6.7                               Miller Number (G75)    :  112.
--------------------------------------------------------------------------------

Maximum allowable suction gauge pressure due to reverse axial thrust  50 psi

Motor Power (HP) =  150.
Pump Power (mechanical evaluation) (HP) =  104.
Impeller End Radial Loads (lbf) =   -8866.
Drive End Radial Loads (lbf) =    1248.
Thrust Loads (lbf) =    4362.

Drive End Radial Loads assume a direct coupled motor.

Impeller End Bearing with C90 (lbf) =  634000.   L10 life (khrs) >200
 Drive  End  Bearing with C90 (lbf) =  346000.   L10 life (khrs) >200
     Thrust Bearing with C90 (lbf) =  600000.   L10 life (khrs) >200

Shaft Deflection is = 0.006 (in) at   83.9 (in) from Drive End


Impeller Material         Impeller    Impeller    Impeller     Shaft
     (28G)                  (Dry)     (Carrier)   (Slurry)     (only)
Inertia (lbm-ft^2)       18246.4     21505.0     21505.0       255.1
```

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                              SLYSEL
                   Version 20051020/20051012     GIW Industries, Inc.
Item # : 2                                       Grovetown, GA  USA
Reference: FIPR Project # 04-04-069              Date: Oct-21-2005
Application: Clear Water Operation @ 225 RPM     Time: 10:44:02

-------- SELECTED PUMP with ALL VALUES SCALED to NEW SPEED & TURNDOWN ---------
C  20x25 LSA 62        C  16- 3/ 8/ 3ME  9        9188D    E 17A-02 B 15A-02
**************** PLEASE NOTE ALL DIAMETERS ARE IN INCHES ****************
RPM                225.0 | T/D RATIO (THEO)   1.000 | PERIPHERAL VEL  3652.1 SFPM
EFF. (SLURRY)       79.7 | FULL     IMP DIA   62.00 | THROAT     VEL    14.0 ft/s
EFF. (WATER)        79.7 | THEORET IMP DIA   62.00 | BRANCH     VEL    13.0 ft/s
NPSH RQD (ft)        2.4 | ACTUAL   IMP DIA   62.00 | SUCTION    VEL     8.3 ft/s
Conc. by WT (%)      0.0 | SOLIDS EFFECT HEAD 0.00%| SOLIDS EFFECT EFF     0.00%
Conc. by Vol(%)      0.0 | Max OPER PRES(psi)200.0 | SPHERE PASSAGE    10.2 in
Pump Ns (US)     1452.6 | Suction Ns (US)  9650.6 | ROTATION             RH
```

	Flow(GPM)	Head(ft)	Eff.	HP w/SGM	NPSHR(ft)
	0.0	79.3	0.0	120.8	0.8
	5900.0	75.5	61.7	181.9	1.3
MinQuote	9524.3	71.1	75.0	227.5	1.8
	11900.0	68.0	78.9	258.4	2.2
@Duty	12700.0	67.0	79.7	268.9	2.4
120%Duty	15240.0	63.8	81.3	301.6	3.2
	17800.0	60.8	81.8	333.3	4.2
@BEP	19048.7	59.3	81.8	348.0	4.8
	23700.0	54.3	81.2	399.0	7.0
MaxQuote	29640.8	47.8	78.1	457.6	10.5

```
*Water performance guarantees for this pump may be specified in accordance with
 Hydraulic Institute HI 1.6-1994 Class B between flows    9524 to  29641 ( GPM)

* Note: Pump Solids Effect is based on a Settling Slurry
--------------------------------------------------------------------------------
Flow       :  12700.  GPM     Fluid  S.G. 0.998     Pump Service Class     :     1
Head       :    67.0  ft      Slurry S.G. 0.998     Abrasivity Correction :   1.0
Throughput:      0.0 tons/hr  Solids S.G. 2.650     D50 (microns)          :  200.
Large particles (>2300 microns): Semi-Rounded       D85 (microns)          :  460.
% of fine particles < 74 microns :  0.0             Largest Solid(microns): 2000.
Fluid pH  :      6.7                                Miller Number (G75)    :  112.
--------------------------------------------------------------------------------

Maximum allowable suction gauge pressure due to reverse axial thrust 156 psi

Motor Power (HP) =  350.
Pump Power (mechanical evaluation) (HP) =  269.
Impeller End Radial Loads (lbf) =  -11911.
Drive End Radial Loads (lbf) =    1640.
Thrust Loads (lbf) =   13489.

Drive End Radial Loads assume a direct coupled motor.

Impeller End Bearing with C90 (lbf) =  634000.   L10 life (khrs) >200
 Drive  End  Bearing with C90 (lbf) =  346000.   L10 life (khrs) >200
      Thrust Bearing with C90 (lbf) =  600000.   L10 life (khrs) >200

Shaft Deflection is = 0.008 (in) at    83.9 (in) from Drive End
```

Impeller Material (28G)	Impeller (Dry)	Impeller (Carrier)	Impeller (Slurry)	Shaft (only)
Inertia (lbm-ft^2)	18246.4	21505.0	21505.0	255.1

SLYSEL
Version 20051020/20051012

GIW Industries, Inc.
Grovetown, GA USA
Date: Oct-21-2005
Time: 10:44:34

Item # : 3
Reference: FIPR Project # 04-04-069
Application: Clear Water Operation @ 268 RPM

-------- SELECTED PUMP with ALL VALUES SCALED to NEW SPEED & TURNDOWN ---------

C 20x25 LSA 62 C 16- 3/ 8/ 3ME 9 9188D E 17A-02 B 15A-02

**************** PLEASE NOTE ALL DIAMETERS ARE IN INCHES ****************

RPM	268.0	T/D RATIO (THEO)	1.000	PERIPHERAL VEL	4350.1 SFPM
EFF. (SLURRY)	77.5	FULL IMP DIA	62.00	THROAT VEL	14.0 ft/s
EFF. (WATER)	77.5	THEORET IMP DIA	62.00	BRANCH VEL	13.0 ft/s
NPSH RQD (ft)	2.8	ACTUAL IMP DIA	62.00	SUCTION VEL	8.3 ft/s
Conc. by WT (%)	0.0	SOLIDS EFFECT HEAD	0.00%	SOLIDS EFFECT EFF	0.00%
Conc. by Vol(%)	0.0	Max OPER PRES(psi)	200.0	SPHERE PASSAGE	10.2 in
Pump Ns (US)	1452.6	Suction Ns (US)	9650.6	ROTATION	RH

	Flow(GPM)	Head(ft)	Eff.	HP w/SGM	NPSHR(ft)
	0.0	112.5	0.0	203.6	1.1
	7100.0	107.0	62.2	307.7	1.9
MinQuote	11344.5	100.9	75.2	383.3	2.5
@Duty	12700.0	98.8	77.5	408.2	2.8
	14100.0	96.6	79.1	434.0	3.2
120%Duty	15240.0	94.9	80.1	455.0	3.5
	21200.0	86.2	82.0	561.4	6.0
@BEP	22689.1	84.2	82.1	586.3	6.7
	28200.0	77.0	81.5	671.7	10.0
MaxQuote	35305.5	67.9	78.3	770.9	14.9

*Water performance guarantees for this pump may be specified in accordance with Hydraulic Institute HI 1.6-1994 Class B between flows 11345 to 35306 (GPM)

* Note: Pump Solids Effect is based on a Settling Slurry

Flow : 12700. GPM	Fluid S.G. 0.998	Pump Service Class : 1
Head : 98.8 ft	Slurry S.G. 0.998	Abrasivity Correction : 1.0
Throughput: 0.0 tons/hr	Solids S.G. 2.650	D50 (microns) : 200.
Large particles (>2300 microns): Semi-Rounded		D85 (microns) : 460.
% of fine particles < 74 microns : 0.0		Largest Solid(microns): 2000.
Fluid pH : 6.7		Miller Number (G75) : 112.

Maximum allowable suction gauge pressure due to pump operating pressure 157 psi

Motor Power (HP) = 500.
Pump Power (mechanical evaluation) (HP) = 408.
Impeller End Radial Loads (lbf) = -14094.
Drive End Radial Loads (lbf) = 1851.
Thrust Loads (lbf) = 20684.

Drive End Radial Loads assume a direct coupled motor.

Impeller End Bearing with C90 (lbf) = 634000. L10 life (khrs) >200
Drive End Bearing with C90 (lbf) = 346000. L10 life (khrs) >200
Thrust Bearing with C90 (lbf) = 600000. L10 life (khrs) >200

Shaft Deflection is = 0.010 (in) at 83.9 (in) from Drive End

Impeller Material (28G)	Impeller (Dry)	Impeller (Carrier)	Impeller (Slurry)	Shaft (only)
Inertia (lbm-ft^2)	18246.4	21505.0	21505.0	255.1

SLYSEL

Version 20051020/20051012 GIW Industries, Inc.

Item # : 4 Grovetown, GA USA

Reference: FIPR Project # 04-04-069 Date: Oct-21-2005

Application: Clear Water Operation @ 330 RPM Time: 10:46:05

-------- SELECTED PUMP with ALL VALUES SCALED to NEW SPEED & TURNDOWN ---------

C 20x25 LSA 62 C 16- 3/ 8/ 3ME 9 9188D E 17A-02 B 15A-02

**************** PLEASE NOTE ALL DIAMETERS ARE IN INCHES *****************

RPM	330.0	T/D RATIO (THEO)	1.000	PERIPHERAL VEL	5356.4 SFPM
EFF. (SLURRY)	77.0	FULL IMP DIA	62.00	THROAT VEL	16.5 ft/s
EFF. (WATER)	77.0	THEORET IMP DIA	62.00	BRANCH VEL	15.3 ft/s
NPSH RQD (ft)	4.0	ACTUAL IMP DIA	62.00	SUCTION VEL	9.8 ft/s
Conc. by WT (%)	0.0	SOLIDS EFFECT HEAD	0.00%	SOLIDS EFFECT EFF	0.00%
Conc. by Vol(%)	0.0	Max OPER PRES(psi)	200.0	SPHERE PASSAGE	10.2 in
Pump Ns (US)	1452.6	Suction Ns (US)	9650.6	ROTATION	RH

	Flow(GPM)	Head(ft)	Eff.	HP w/SGM	NPSHR(ft)
	0.0	170.5	0.0	378.6	1.7
	8700.0	162.4	62.3	571.3	2.8
MinQuote	13969.0	152.9	75.5	713.0	3.8
@Duty	15000.0	151.0	77.0	741.6	4.0
	17400.0	146.4	79.4	808.4	4.8
120%Duty	18000.0	145.3	79.9	825.1	5.0
	26100.0	130.7	82.3	1044.1	9.1
@BEP	27938.0	127.6	82.4	1090.6	10.2
	34800.0	116.7	81.8	1251.1	15.2
MaxQuote	43473.2	102.9	78.6	1434.0	22.6

*Water performance guarantees for this pump may be specified in accordance with Hydraulic Institute HI 1.6-1994 Class B between flows 13969 to 43473 (GPM)

* Note: Pump Solids Effect is based on a Settling Slurry

Flow : 15000. GPM	Fluid S.G. 0.998	Pump Service Class :	1
Head : 151.0 ft	Slurry S.G. 0.998	Abrasivity Correction :	1.0
Throughput: 0.0 tons/hr	Solids S.G. 2.650	D50 (microns) :	200.
Large particles (>2300 microns): Semi-Rounded		D85 (microns) :	460.
% of fine particles < 74 microns : 0.0		Largest Solid(microns):	2000.
Fluid pH : 6.7		Miller Number (G75) :	112.

Maximum allowable suction gauge pressure due to pump operating pressure 135 psi

Motor Power (HP) = 900.
Pump Power (mechanical evaluation) (HP) = 742.
Impeller End Radial Loads (lbf) = -17976.
Drive End Radial Loads (lbf) = 2249.
Thrust Loads (lbf) = 31845.

Drive End Radial Loads assume a direct coupled motor.

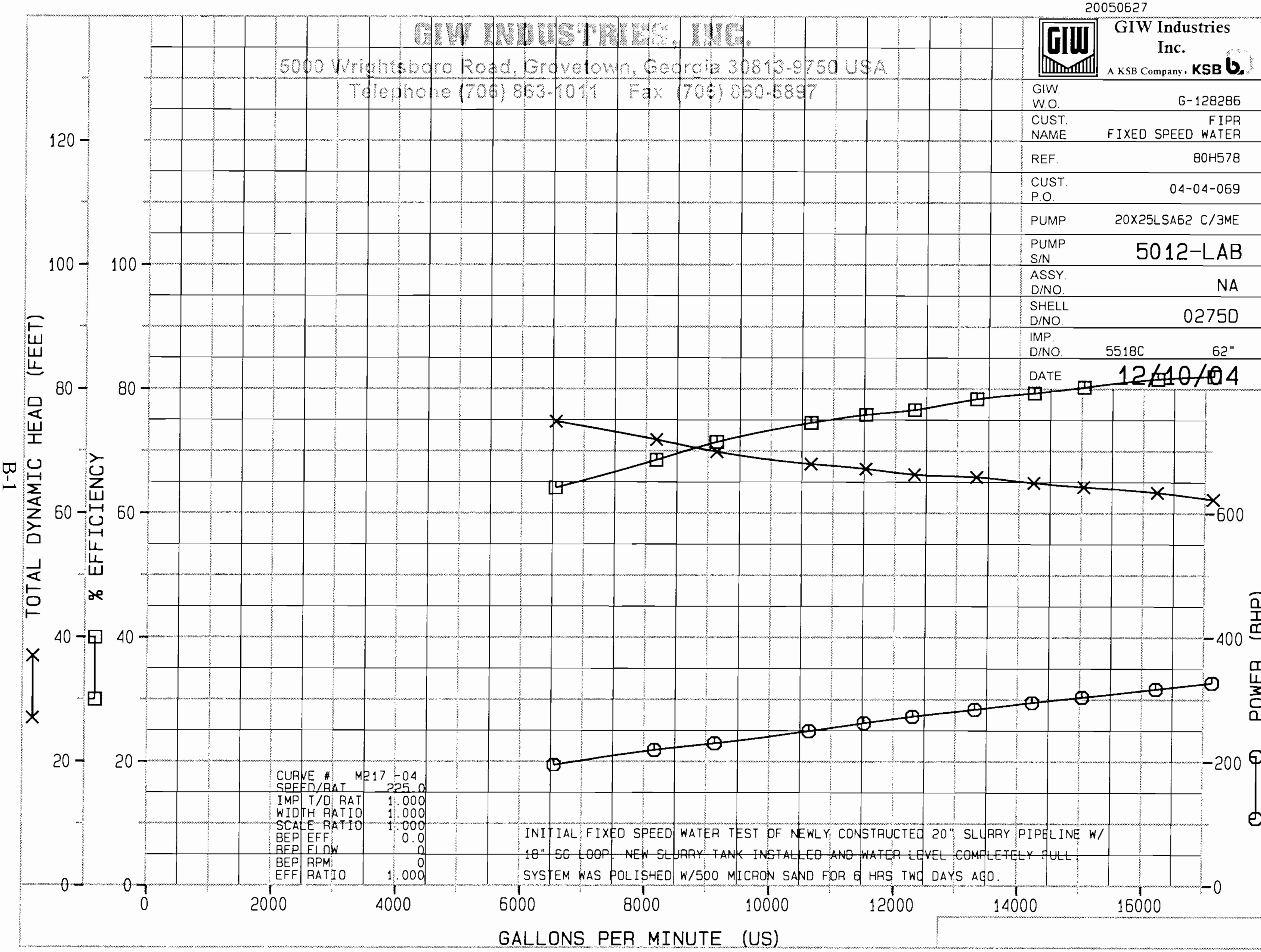
Impeller End Bearing with C90 (lbf) = 634000. L10 life (khrs) >200
Drive End Bearing with C90 (lbf) = 346000. L10 life (khrs) >200
Thrust Bearing with C90 (lbf) = 600000. L10 life (khrs) >200

Shaft Deflection is = 0.012 (in) at 83.9 (in) from Drive End

Impeller Material (28G)	Impeller (Dry)	Impeller (Carrier)	Impeller (Slurry)	Shaft (only)
Inertia (lbm-ft^2)	18246.4	21505.0	21505.0	255.1

Appendix B

RAW TEST DATA AND PLOTS


20050627
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW Industries Inc.
A KSB Company. KSB
GIW. W.O. G-128286
CUST. NAME FIPR FIXED SPEED WATER
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/10/04
TOTAL DYNAMIC HEAD (FEET)
% EFFICIENCY
POWER (BHP)
GALLONS PER MINUTE (US)
CURVE # M217 -04
SPEED/RAT 225.0
IMP T/D RAT 1.000
WIDTH RATIO 1.000
SCALE RATIO 1.000
BEP EFF 0.0
BEP FLOW 0
BEP RPM 0
EFF RATIO 1.000
INITIAL FIXED SPEED WATER TEST OF NEWLY CONSTRUCTED 20" SLURRY PIPELINE W/
18" SC LOOP. NEW SLURRY TANK INSTALLED AND WATER LEVEL COMPLETELY FULL.
SYSTEM WAS POLISHED W/500 MICRON SAND FOR 6 HRS TWO DAYS AGO.

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE	RDG	SOURCE	INSTRUMENT
1	NULL	SUCTION	#1	YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2	YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3	ROSEMOUNT 4 12'H2O 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4	ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5P		FLOWORIFICE	#5	ROSEMONT 6 239'H2O 1E1 07093B 1.000
6P		DIFHEAD	#6	ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.		FLOWORIFICE	#7	ROSEMOUNT 5 60'H2O 1E2 07093B 1.000
8.		FLOWBEND	#8	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
9.		LOSS 20	#9	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
10.		FLOWBEND	#10	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
11.		FLOWBEND	#11	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
12S		LOSS 20"	#12	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
13P		LOSS 20"	#13	ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14	ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15.	NULL	FLOWORIFICE	#15	ROSEMOUNT 5 60'H2O 1E2 01164E 0.000
16S		DISCHARGE	#16	ROSEMONT 7 692'H2O 1E1 07093B 1.000
17		SUCTION	#17	ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P		TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23	RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25S		FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO T217 -04 DATE 12/10/04

PUMP TEST DATA FOR	FIPR
	FIXED SPEED WATER
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

13.25 INS DIA ORIFICE IN 19.25 INS PIPE
1 FT H2O = 2382.8 US GPM USING HIS
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.60"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 50.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

NO	FLOW MEASUREMENT: FLOW Q: GPM	VELOCITY: FT/S	HEAD MEASUREMENT: DISCH: PSI	SUCTN: " HG	TOT HD: H FT	S.G.	DRIVER POWER: INPUT: KW	OUTPUT: BHP	SPEED: N: RPM	PUMP: OUTPUT: WHP	EFF: n %	TEMP: Tm: F	SCALED PERFORMANCE: FLOW: GPM	HEAD: FT	POWER: BHP	EFF: %	TIME: t: H.MM	ORI239: S 5: *1.000	ORI60: S 7: *1.000
1	17129.1	18.65	26.71	2.68	62.30	.998	0.0	327.7	225.0	269.1	82.1	83.3	17128.	62.3	327.6	82.1	11.39	17129.	17148.
2	16245.8	17.69	27.38	2.53	63.62	.999	0.0	319.2	225.4	260.8	81.7	83.7	16219.	63.4	317.6	81.7	11.44	16246.	16289.
3	15033.9	16.37	28.04	2.61	64.35	1.00	0.0	304.9	225.1	245.0	80.4	84.2	15028.	64.3	304.5	80.4	11.48	15034.	15081.
4	14253.2	15.52	28.64	2.60	65.21	1.01	0.0	297.6	225.4	236.3	79.4	84.3	14225.	65.0	295.9	79.4	11.49	14253.	14306.
5	13309.2	14.49	29.21	2.58	66.02	1.01	0.0	285.6	225.2	224.0	78.5	84.4	13296.	65.9	284.7	78.5	11.51	13309.	13361.
6	12307.7	13.40	29.75	2.53	66.43	1.02	0.0	274.1	225.2	210.2	76.7	84.7	12295.	66.3	273.3	76.7	11.53	12308.	12362.
7	11531.7	12.56	30.34	2.58	67.38	1.02	0.0	263.7	225.3	200.1	75.9	84.8	11516.	67.2	262.6	75.9	11.54	11532.	11578.
8	10648.2	11.59	30.82	2.53	68.17	1.02	0.0	251.0	225.3	187.2	74.6	85.0	10634.	68.0	250.0	74.6	11.56	10648.	10694.
9	9123.4	9.93	31.73	2.55	69.90	1.02	0.0	229.8	224.9	164.3	71.5	85.1	9126.	69.9	230.0	71.5	11.59	9123.4	9172.4
10	8157.9	8.88	32.58	2.53	71.93	1.02	0.0	219.5	225.1	150.6	68.6	85.2	8155.	71.9	219.2	68.6	12.00	8157.9	8206.4
11	6537.7	7.12	33.81	2.48	74.82	1.01	0.0	194.9	225.0	125.0	64.1	85.4	6537.	74.8	194.9	64.1	12.03	6537.7	6590.0

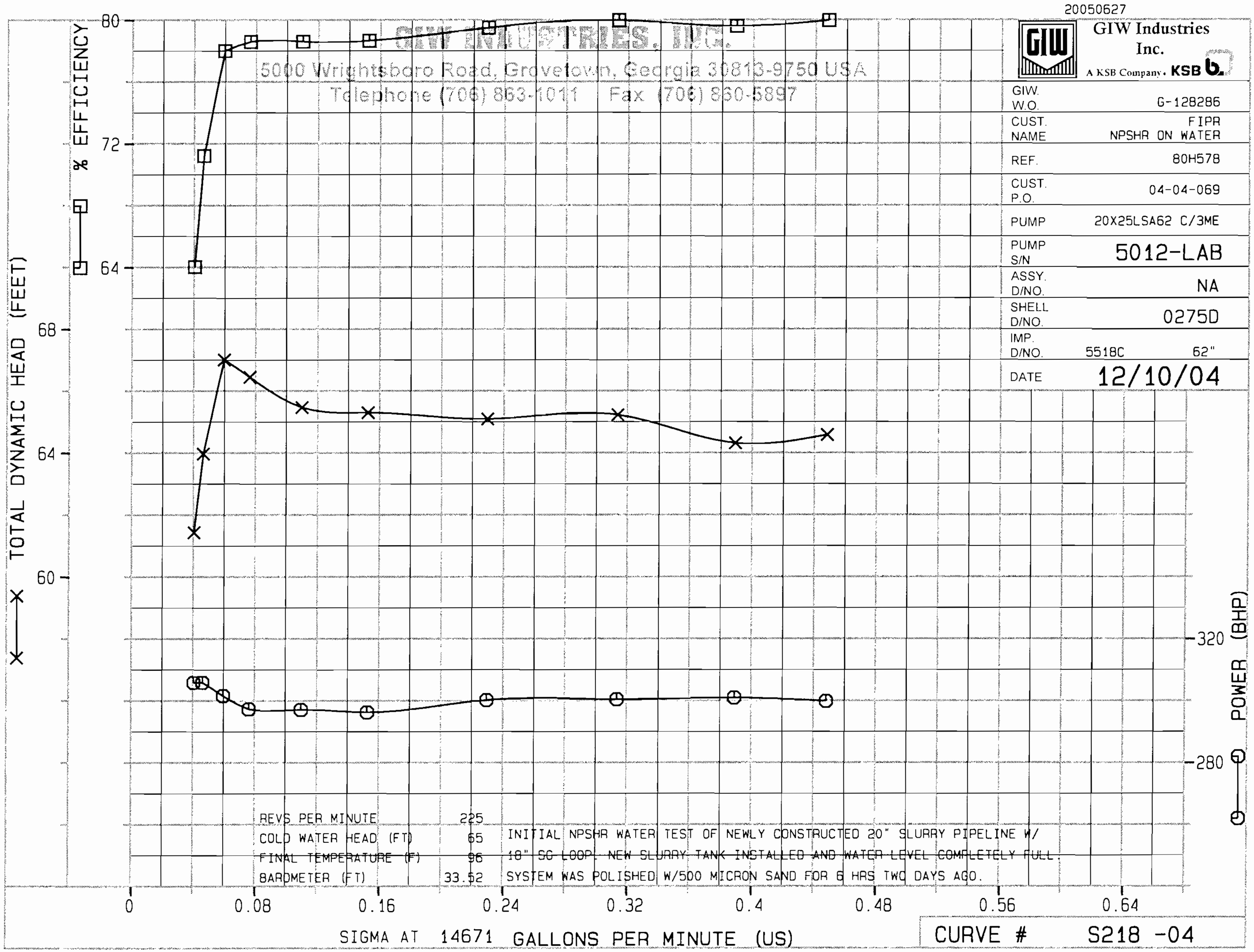
TESTED BY LEE WHITLOCK DATE 12/10/04

WITNESSED BY GRAEME ADDIE FOR FIPR

COMMENTS: INITIAL FIXED SPEED WATER TEST OF NEWLY CONSTRUCTED 20" SLURRY PIPELINE W/ 18" SG LOOP. NEW SLURRY TANK INSTALLED AND WATER LEVEL COMPLETELY FULL. SYSTEM WAS POLISHED W/500 MICRON SAND FOR 6 HRS TWO DAYS AGO.

Version: 20050627

T217 -04 12/10/04


20050627
GIW Industries Inc.
A KSB Company
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW. W.O. G-128286
CUST. NAME FIPR NPSHR ON WATER
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/10/04
% EFFICIENCY
TOTAL DYNAMIC HEAD (FEET)
POWER (BHP)
REVS PER MINUTE 225
COLD WATER HEAD (FT) 65
FINAL TEMPERATURE (F) 96
BAROMETER (FT) 33.52
INITIAL NPSHR WATER TEST OF NEWLY CONSTRUCTED 20" SLURRY PIPELINE W/
18" SC LOOP. NEW SLURRY TANK INSTALLED AND WATER LEVEL COMPLETELY FULL.
SYSTEM WAS POLISHED W/500 MICRON SAND FOR 6 HRS TWO DAYS AGO.
SIGMA AT 14671 GALLONS PER MINUTE (US)
CURVE # S218 -04

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO S218 -04   DATE 12/10/04

PUMP TEST DATA FOR   FIPR
NPSHR ON WATER

PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

INSTRUMENTATION

CH	USE RDG	SOURCE	INSTRUMENT
1	NULLSUCTION	#1	YOKOGAWA-30-30 H20-1E2 06011B 0.000
2S	NULLLOSS 20"	#2	YOKOGAWA -4-8' H20-1E2 12040B 0.000
3	AVE S.G.U-SECUP	#3	ROSEMOUNT 4 12'H20 1E2 07093B 0.500
4	AVE S.G.U-SECDN	#4	ROSEMONT4 -4-8'H20-1E2 07134B 0.500
5P	FLOWORIFICE	#5	ROSEMONT 6 239'H20 1E1 07093B 1.000
6P	DIFHEAD	#6	ROSEMONT 6 236'H20 1E1 07093B 1.000
7.	FLOWORIFICE	#7	ROSEMOUNT 5 60'H20 1E2 07093B 1.000
8.	FLOWBEND	#8	ROSEMOUNT 5 24'H20 1E2 07093B 1.000
9.	LOSS 20	#9	ROSEMOUNT 5 24'H20 1E2 07093B 1.000
10.	FLOWBEND	#10	ROSEMOUNT 4 12'H20 1E2 07134B 1.000
11.	FLOWBEND	#11	ROSEMOUNT 4 12'H20 1E2 07134B 1.000
12S	LOSS 20"	#12	ROSEMOUNT 4 12'H20 1E2 07134B 1.000
13P	LOSS 20"	#13	ROSEMONT4 -4-8'H20-1E2 01164E 1.000
14.	NULLDISCHARGE	#14	ROSEMOUNT 5 24'H20 1E2 07134B 0.000
15.	NULLFLOWORIFICE	#15	ROSEMOUNT 5 60'H20 1E2 01164E 0.000
16S	DISCHARGE	#16	ROSEMONT 7 692'H20 1E1 07093B 1.000
17	SUCTION	#17	ROSE. 5 -30-30'H20-1E2 07093B 1.000
18P	TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S	TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P	BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21	RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S	BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULLTEMPAMBIENT	#23	RTD7 100OHM F 1E1 04088B 0.000
24P	NULLBHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25S	FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULLBHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULLFLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULLFLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULLFLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULLBHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULLRPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULLBHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

TEST CONSTANTS

13.25 INS DIA ORIFICE IN 19.25 INS PIPE
1 FT H2O = 2382.8 US GPM USING HIS
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.60"
G = 32.14 FT/S/S

TEST RESULTS

NO	FLOW MEASUREMENT: FLOW Q GPM	VELOCITY FT/S	HEAD MEASUREMENT: DISCH PSI	SUCTN " HG	TOT HD H FT	S.G.	DRIVER POWER: INPUT KW	OUTPUT BHP	SPEED: N RPM	PUMP: OUTPUT WHP	EFF n %	TEMP: Tm F	CAVITATION: NPSH FT	SIGMA	SCALED PERFORMANCE: FLOW GPM	HEAD FT	POWER BHP	EFF %	TIME: t H.MM	ORI239: S 5 *1.000
1	14671.4	15.97	25.12	-3.68	64.59	1.00	0.0	300.0	224.7	239.9	80.0	94.2	28.9	0.448	14694.	64.8	301.4	80.0	14.01	14671.
2	14582.8	15.88	23.60	-7.10	64.33	1.01	0.0	301.1	225.0	239.7	79.6	94.5	25.1	0.389	14582.	64.3	301.0	79.6	14.03	14583.
3	14601.6	15.90	21.57	-11.32	65.24	1.00	0.0	300.6	225.1	240.4	80.0	94.7	20.2	0.313	14596.	65.2	300.2	80.0	14.04	14602.
4	14453.3	15.74	19.32	-16.18	65.11	1.01	0.0	300.4	225.2	238.8	79.5	94.9	14.8	0.229	14443.	65.0	299.7	79.5	14.07	14453.
5	14051.0	15.30	17.37	-20.53	65.31	1.01	0.0	296.4	225.4	233.2	78.7	95.2	9.8	0.152	14023.	65.1	294.6	78.7	14.09	14051.
6	14148.7	15.40	16.10	-22.81	65.48	.999	0.0	297.2	224.7	233.7	78.6	95.5	7.1	0.109	14170.	65.7	298.6	78.6	14.12	14149.
7	13962.3	15.20	15.61	-24.67	66.46	.998	0.0	297.4	224.6	233.8	78.6	95.6	4.9	0.076	13988.	66.7	299.1	78.6	14.14	13962.
8	13878.2	15.11	15.49	-25.71	67.02	1.00	0.0	301.7	224.8	235.4	78.0	95.7	3.8	0.059	13891.	67.1	302.5	78.0	14.14	13878.
9	13411.6	14.60	13.95	-26.49	63.99	1.01	0.0	306.0	225.4	218.0	71.2	95.8	3.0	0.046	13385.	63.7	304.2	71.2	14.15	13412.
10	12588.2	13.71	12.83	-26.63	61.45	1.00	0.0	306.0	225.4	196.0	64.1	95.9	2.6	0.040	12563.	61.2	304.2	64.1	14.16	12588.

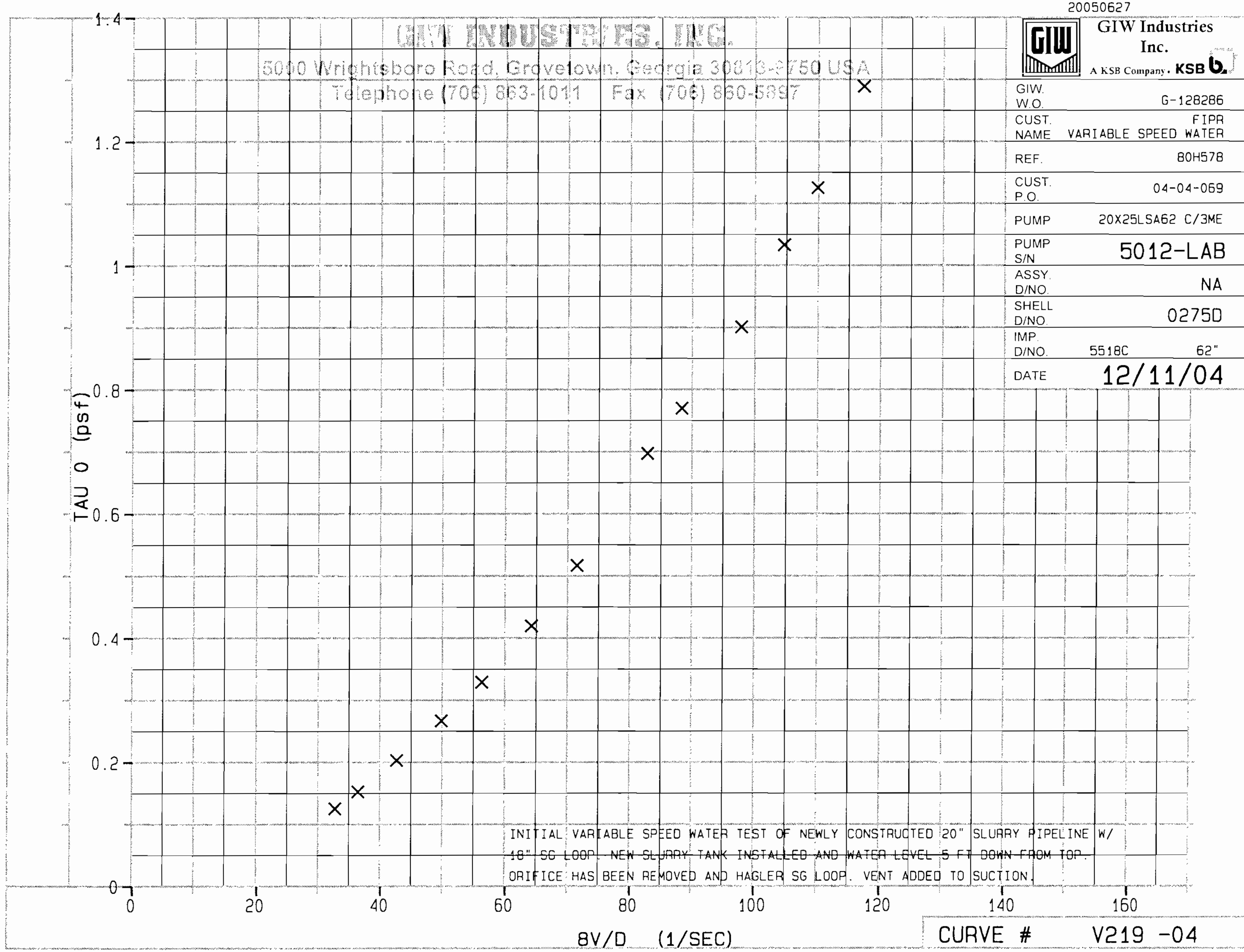
TESTED BY LEE WHITLOCK DATE 12/10/04

WITNESSED BY L.ENCARNCION FOR FIPR

COMMENTS: INITIAL NPSHR WATER TEST OF NEWLY CONSTRUCTED 20" SLURRY PIPELINE W/ 18" SG LOOP. NEW SLURRY TANK INSTALLED AND WATER LEVEL COMPLETELY FULL. SYSTEM WAS POLISHED W/500 MICRON SAND FOR 6 HRS TWO DAYS AGO.

Version: 20050627

S218 -04 12/10/04


20050627
GIW Industries Inc.
A KSB Company. KSB
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-2750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW. W.O. G-128286
CUST. NAME FIPR VARIABLE SPEED WATER
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/11/04
TAU 0 (psf)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
8V/D (1/SEC)
0
20
40
60
80
100
120
140
160
INITIAL VARIABLE SPEED WATER TEST OF NEWLY CONSTRUCTED 20" SLURRY PIPELINE W/
18" SG LOOP. NEW SLURRY TANK INSTALLED AND WATER LEVEL 5 FT DOWN FROM TOP.
ORIFICE HAS BEEN REMOVED AND HAGLER SG LOOP. VENT ADDED TO SUCTION.
CURVE # V219 -04

PUMP DETAIL

PUMP 20X25LSA62 C/3ME

SERIAL NUMBER 5012-LAB
ASSEMBLY DRAWING NO NA
SHELL DRAWING NO 0275D
IMPELLER DRAWING NO 5518C
IMPELLER DIAMETER 62"
OUTLET ANGLE
OUTLET WIDTH
ROTATION CLOCKWISE
HYDROSTATIC PRESS. STD

DRIVER DETAIL

TYPE VARIABLE SPEED DRIVE
MAKE GENERAL ELECTRIC
SERIAL NO 5511957
FRAME SIZE 5368480
RPM = 450 BHP = 2450.
4160 VOLTS 3 PHASE 60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO 225.000

IMP TURN DOWN RATIO 1.000
MERIDINAL WIDTH RATIO 1.000
SCALE RATIO 1.000
BEP REF 0.GPM, 0.RPM
EFFICIENCY 0.0% BY 1.000

CH	USE	RDG	SOURCE	INSTRUMENT
1	NULL	SUCTION	#1	YOKOGAWA-30-30 H20-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2	YOKOGAWA -4-8' H20-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3	ROSEMONT 4 12'H20 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4	ROSEMONT4 -4-8'H20-1E2 07134B 0.500
5S		DISCHARGE	#5	ROSEMONT 6 239'H20 1E1 07093B 1.000
6P		DIFHEAD	#6	ROSEMONT 6 236'H20 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7	ROSEMONT 5 60'H20 1E2 07093B 0.000
8.		FLOWBEND	#8	ROSEMONT 5 24'H20 1E2 07093B 1.000
9.		LOSS 20	#9	ROSEMONT 5 24'H20 1E2 07093B 1.000
10S		FLOWBEND	#10	ROSEMONT 4 12'H20 1E2 07134B 1.000
11.		FLOWBEND	#11	ROSEMONT 4 12'H20 1E2 07134B 1.000
12S		LOSS 20"	#12	ROSEMONT 4 12'H20 1E2 07134B 1.000
13P		LOSS 20"	#13	ROSEMONT4 -4-8'H20-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14	ROSEMOUNT 5 24'H20 1E2 07134B 0.000
15.	NULL	FLOWORIFICE	#15	ROSEMOUNT 5 60'H20 1E2 01164E 0.000
16S	NULL	DISCHARGE	#16	ROSEMONT 7 692'H20 1E1 07093B 0.000
17		SUCTION	#17	ROSE. 5 -30-30'H20-1E2 07093B 1.000
18P		TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23	RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO V219 -04 DATE 12/11/04

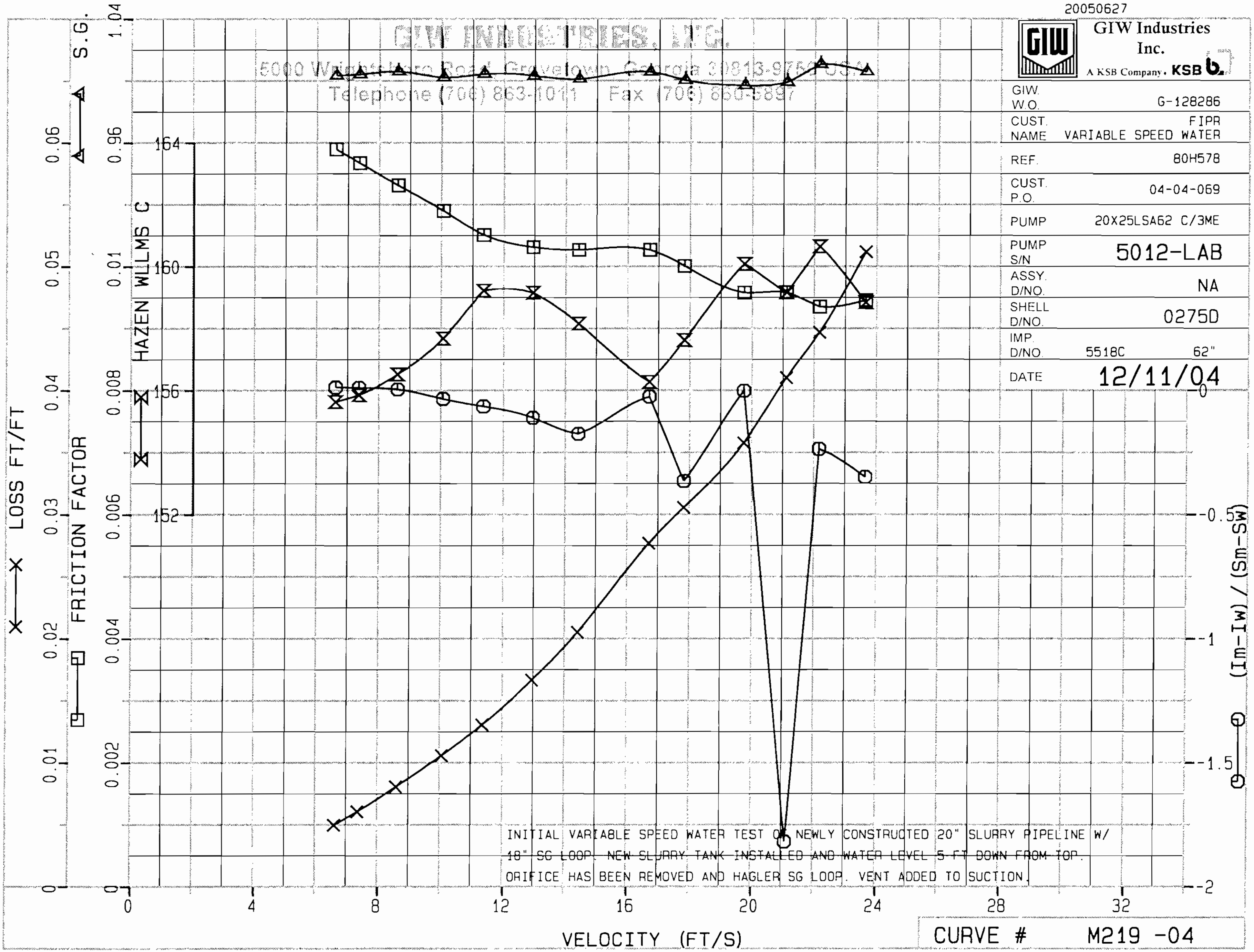
PUMP TEST DATA FOR FIPR
------------------ VARIABLE SPEED WATER
PROJECT 80H578
GIW WORK ORDER NO G-128286
CUSTOMER ORDER NO 04-04-069

TEST CONSTANTS
1 FT H20 = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6502.29
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.40"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 50.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M129 -98 E/D=.000015
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

NO	VELOCITY Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME CONC. Cv %	WEIGHT CONC. Cw %	MASS Ms TON/HR	PIPELINE LOSSES Im FT/FT	Iw FT/FT	dp/dx psf	Tau 0 psf	8V/D 1/SEC	Tau 0 ln psf	8V/D ln 1/SEC	TIME t HH.MM
1	23.63	21700.6	77.3	0.998	1.006	0.5	1.3	69.5	0.0512	0.0540	3.1957	1.2896	117.10	0.2543	4.7630	15.02
2	22.15	20342.8	77.5	0.998	1.011	0.8	2.0	105.4	0.0447	0.0477	2.7906	1.1261	109.77	0.1188	4.6984	15.04
3	21.09	19366.7	77.7	0.998	0.999	0.1	0.2	10.3	0.0411	0.0435	2.5623	1.0340	104.50	0.0334	4.6492	15.07
4	19.72	18109.4	77.7	0.998	0.997	0.0	-0.1	-5.6	0.0358	0.0383	2.2343	0.9016	97.719	-.1035	4.5821	15.09
5	17.80	16349.9	77.8	0.998	1.001	0.2	0.4	17.2	0.0306	0.0316	1.9096	0.7706	88.225	-.2606	4.4799	15.10
6	16.68	15321.6	77.9	0.998	1.006	0.5	1.3	49.0	0.0277	0.0279	1.7296	0.6980	82.676	-.3596	4.4149	15.13
7	14.40	13224.7	77.9	0.998	1.001	0.2	0.6	18.3	0.0206	0.0212	1.2828	0.5177	71.361	-.6584	4.2678	15.15
8	12.93	11879.0	77.9	0.998	1.003	0.3	0.9	26.2	0.0167	0.0173	1.0417	0.4204	64.100	-.8666	4.1604	15.18
9	11.34	10412.8	77.9	0.998	1.005	0.4	1.1	27.8	0.0131	0.0135	0.8167	0.3296	56.188	-1.110	4.0287	15.20
10	10.04	9219.8	77.9	0.998	1.002	0.3	0.7	16.4	0.0106	0.0108	0.6624	0.2673	49.750	-1.319	3.9070	15.22
11	8.59	7886.1	77.9	0.998	1.006	0.5	1.3	26.5	0.0081	0.0080	0.5050	0.2038	42.554	-1.591	3.7508	15.23
12	7.34	6737.3	77.9	0.998	1.004	0.4	1.0	17.5	0.0061	0.0060	0.3796	0.1532	36.355	-1.876	3.5933	15.25
13	6.59	6054.4	77.8	0.998	1.004	0.4	0.9	14.1	0.0050	0.0049	0.3121	0.1260	32.670	-2.072	3.4864	15.26

TESTED BY LEE WHITLOCK DATE 12/11/04 COMMENTS: INITIAL VARIABLE SPEED WATER TEST OF NEWLY CONSTRUCTED 20" SLURRY PIPELINE W/ 18" SG LOOP. NEW SLURRY TANK INSTALLED AND WATER LEVEL 5 FT DOWN FROM TOP.
WITNESSED BY L.ENCARNACIO FOR FIPR ORIFICE HAS BEEN REMOVED AND HAGLER SG LOOP. VENT ADDED TO SUCTION.
Version: 20050627 V219 -04 12/11/04


20050627
GIW Industries Inc.
A KSB Company. KSB
GIW W.O. G-128286
CUST. NAME FIPR VARIABLE SPEED WATER
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/11/04
GIW INDUSTRIES, INC.
5000 Wrightsboro Road Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
S.G.
LOSS FT/FT
FRICTION FACTOR
HAZEN WLLMS C
(Im-Iw) / (Sm-Sw)
VELOCITY (FT/S)
INITIAL VARIABLE SPEED WATER TEST ON NEWLY CONSTRUCTED 20" SLURRY PIPELINE W/
18" SG LOOP. NEW SLURRY TANK INSTALLED AND WATER LEVEL 5 FT DOWN FROM TOP.
ORIFICE HAS BEEN REMOVED AND HAGLER SG LOOP. VENT ADDED TO SUCTION.
CURVE # M219 -04

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE RDG SOURCE	INSTRUMENT
1	NULLSUCTION	#1 YOKOGAWA-30-30 H20-1E2 06011B 0.000
2S	NULLLOSS 20"	#2 YOKOGAWA -4-8' H20-1E2 12040B 0.000
3	AVE S.G.U-SECUP	#3 ROSEMOUNT 4 12'H20 1E2 07093B 0.500
4	AVE S.G.U-SECDN	#4 ROSEMONT4 -4-8'H20-1E2 07134B 0.500
5S	DISCHARGE	#5 ROSEMONT 6 239'H20 1E1 07093B 1.000
6P	DIFHEAD	#6 ROSEMONT 6 236'H20 1E1 07093B 1.000
7.	NULLFLOWORIFICE	#7 ROSEMOUNT 5 60'H20 1E2 07093B 0.000
8.	FLOWBEND	#8 ROSEMOUNT 5 24'H20 1E2 07093B 1.000
9.	LOSS 20	#9 ROSEMOUNT 5 24'H20 1E2 07093B 1.000
10S	FLOWBEND	#10ROSEMOUNT 4 12'H20 1E2 07134B 1.000
11.	FLOWBEND	#11ROSEMOUNT 4 12'H20 1E2 07134B 1.000
12S	LOSS 20"	#12ROSEMOUNT 4 12'H20 1E2 07134B 1.000
13P	LOSS 20"	#13ROSEMONT4 -4-8'H20-1E2 01164E 1.000
14.	NULLDISCHARGE	#14ROSEMOUNT 5 24'H20 1E2 07134B 0.000
15.	NULLFLOWORIFICE	#15ROSEMOUNT 5 60'H20 1E2 01164E 0.000
16S	NULLDISCHARGE	#16ROSEMONT 7 692'H20 1E1 07093B 0.000
17	SUCTION	#17ROSE. 5 -30-30'H20-1E2 07093B 1.000
18P	TEMPTANK	#18 RTD TANK F 1E1 10204D 1.000
19S	TEMPAMBIENT	#19 RTD AMBIENT F 1E1 10204B 1.000
20P	BHP TRQ*RPM	#20 BENSFELD 30K FTLB1E-102122B 1.000
21	RPM TRQ BAR	#21 DAYTRONIC 300 RPM 1E1 02122D 1.000
22S	BHP TRQ BAR	#22 BENSFELD 3000HP 1E1 02122F 1.000
23S	NULLTEMPAMBIENT	#23 RTD7 100OHM F 1E1 04088B 0.000
24P	NULLBHP TRQ*RPM	#24 LEBOW DAY 166 FTLB1E1 12211B 0.000
25P	FLOW18" MAG	#25 18" F&P 32000 GPM 1E-111164B 1.000
26S	NULLBHP TRQ BAR	#26 LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULLFLOW3"MAG	#27 LOAD CELL 100LB 1E2 01101B 0.000
28S	NULLFLOWORIFICE	TECO# 6158 21.80 FPS 1E2 09256C 0.000
29.	NULLFLOW6"MAG	#29 6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULLBHP TRQ*RPM	#30 LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULLRPM TRQ BAR	#31 LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULLBHP TRQ BAR	#32 LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO M219 -04   DATE 12/11/04

PUMP TEST DATA FOR FIPR
------------------- VARIABLE SPEED WATER

PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6502.29
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.40"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 50.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M129 -98 E/D=.000015
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

NO	VELOCITY Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME CONC. Cv %	WEIGHT CONC. Cw %	MASS Ms TON/HR	REYNOLDS NUMBER Re	PIPELINE LOSSES Im FT/FT	PIPELINE LOSSES Iw FT/FT	FRICTION FACTRS Fm	FRICTION FACTRS Fw	HAZEN WLLMS SAME Re: C	Im-Iw ----- Sm-Sw	TIME t HH.MM
1	23.63	21700.6	77.3	0.998	1.006	0.5	1.3	69.5	0.400E+07	0.0512	0.0540	0.0095	0.0101	159.	-.3472	15.02
2	22.15	20342.8	77.5	0.998	1.011	0.8	2.0	105.4	0.376E+07	0.0447	0.0477	0.0094	0.0101	161.	-.2341	15.04
3	21.09	19366.7	77.7	0.998	0.999	0.1	0.2	10.3	0.358E+07	0.0411	0.0435	0.0096	0.0102	159.	******	15.07
4	19.72	18109.4	77.7	0.998	0.997	0.0	-0.1	-5.6	0.336E+07	0.0358	0.0383	0.0096	0.0102	160.	0.0000	15.09
5	17.80	16349.9	77.8	0.998	1.001	0.2	0.4	17.2	0.303E+07	0.0306	0.0316	0.0100	0.0104	158.	-.3631	15.10
6	16.68	15321.6	77.9	0.998	1.006	0.5	1.3	49.0	0.284E+07	0.0277	0.0279	0.0103	0.0104	156.	-.0241	15.13
7	14.40	13224.7	77.9	0.998	1.001	0.2	0.6	18.3	0.246E+07	0.0206	0.0212	0.0103	0.0106	158.	-.1730	15.15
8	12.93	11879.0	77.9	0.998	1.003	0.3	0.9	26.2	0.221E+07	0.0167	0.0173	0.0103	0.0107	159.	-.1085	15.18
9	11.34	10412.8	77.9	0.998	1.005	0.4	1.1	27.8	0.193E+07	0.0131	0.0135	0.0105	0.0109	159.	-.0629	15.20
10	10.04	9219.8	77.9	0.998	1.002	0.3	0.7	16.4	0.171E+07	0.0106	0.0108	0.0109	0.0111	158.	-.0323	15.22
11	8.59	7886.1	77.9	0.998	1.006	0.5	1.3	26.5	0.146E+07	0.0081	0.0080	0.0113	0.0113	157.	0.0063	15.23
12	7.34	6737.3	77.9	0.998	1.004	0.4	1.0	17.5	0.125E+07	0.0061	0.0060	0.0117	0.0116	156.	0.0131	15.25
13	6.59	6054.4	77.8	0.998	1.004	0.4	0.9	14.1	0.112E+07	0.0050	0.0049	0.0119	0.0118	156.	0.0142	15.26

TESTED BY LEE WHITLOCK DATE 12/11/04

COMMENTS: INITIAL VARIABLE SPEED WATER TEST OF NEWLY CONSTRUCTED 20" SLURRY PIPELINE W/ 18" SG LOOP. NEW SLURRY TANK INSTALLED AND WATER LEVEL 5 FT DOWN FROM TOP. ORIFICE HAS BEEN REMOVED AND HAGLER SG LOOP. VENT ADDED TO SUCTION.

WITNESSED BY L.ENCARNACIO FOR FIPR

Version: 20050627

M219 -04 12/11/04

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO T219 -04 DATE 12/11/04

PUMP TEST DATA FOR FIPR
------------------ VARIABLE SPEED WATER

PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE	RDG	SOURCE INSTRUMENT
1	NULL	SUCTION	#1 YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2 YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3 ROSEMOUNT 4 12'H2O 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4 ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5S		DISCHARGE	#5 ROSEMONT 6 239'H2O 1E1 07093B 1.000
6P		DIFHEAD	#6 ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7 ROSEMOUNT 5 60'H2O 1E2 07093B 0.000
8.		FLOWBEND	#8 ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
9.		LOSS 20	#9 ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
10S		FLOWBEND	#10ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
11.		FLOWBEND	#11ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
12S		LOSS 20"	#12ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
13P		LOSS 20"	#13ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15.	NULL	FLOWORIFICE	#15ROSEMOUNT 5 60'H2O 1E2 01164E 0.000
16S	NULL	DISCHARGE	#16ROSEMONT 7 692'H2O 1E1 07093B 0.000
17		SUCTION	#17ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P		TEMPTANK	#18 RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19 RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20 BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21 DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22 BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23 RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24 LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25 18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26 LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27 LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO# 6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29 6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30 LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31 LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32 LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6502.29
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.40"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 50.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M129 -98 E/D=.000015
SAMPLER AREA = 0.00 SQUARE FEET

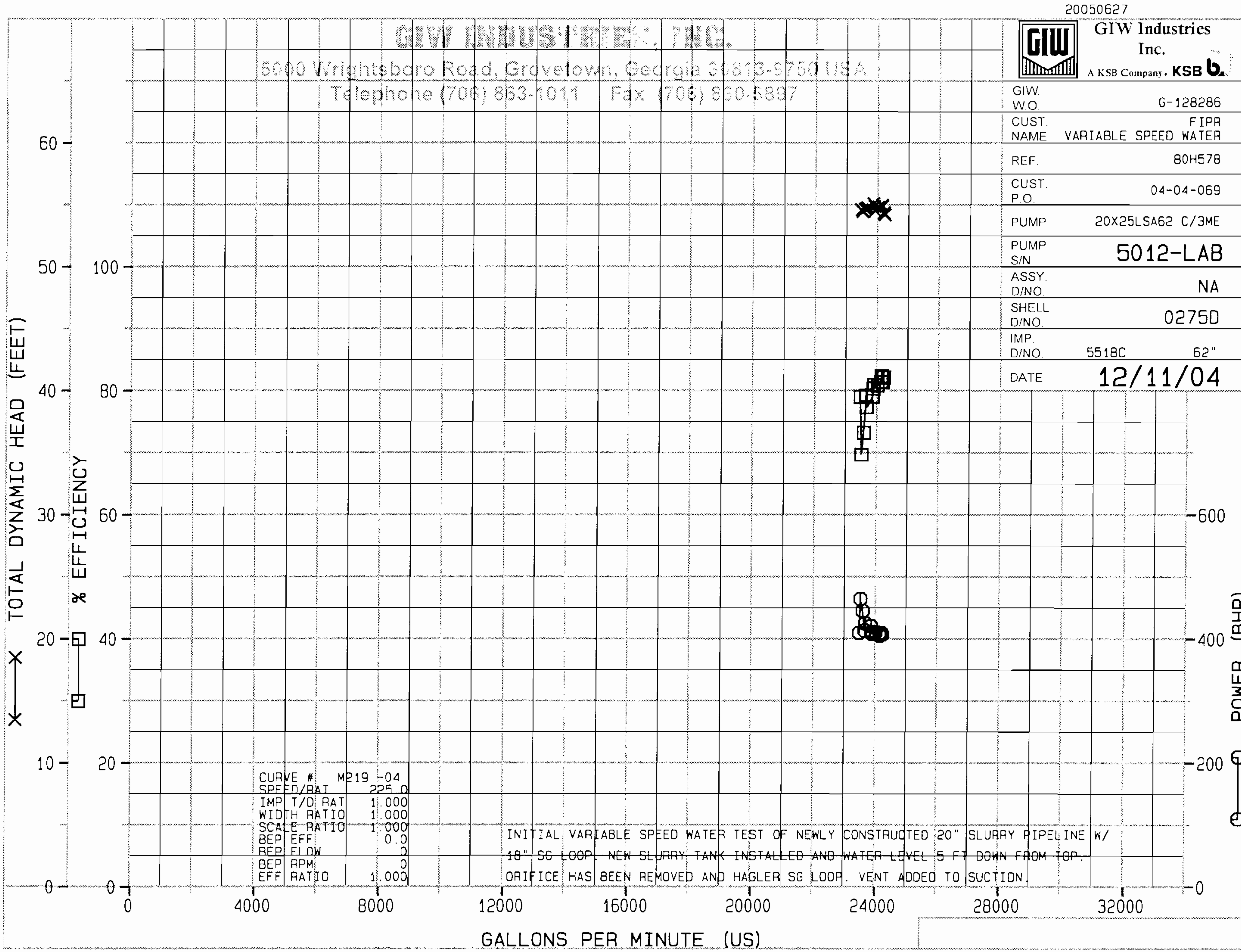
TEST RESULTS

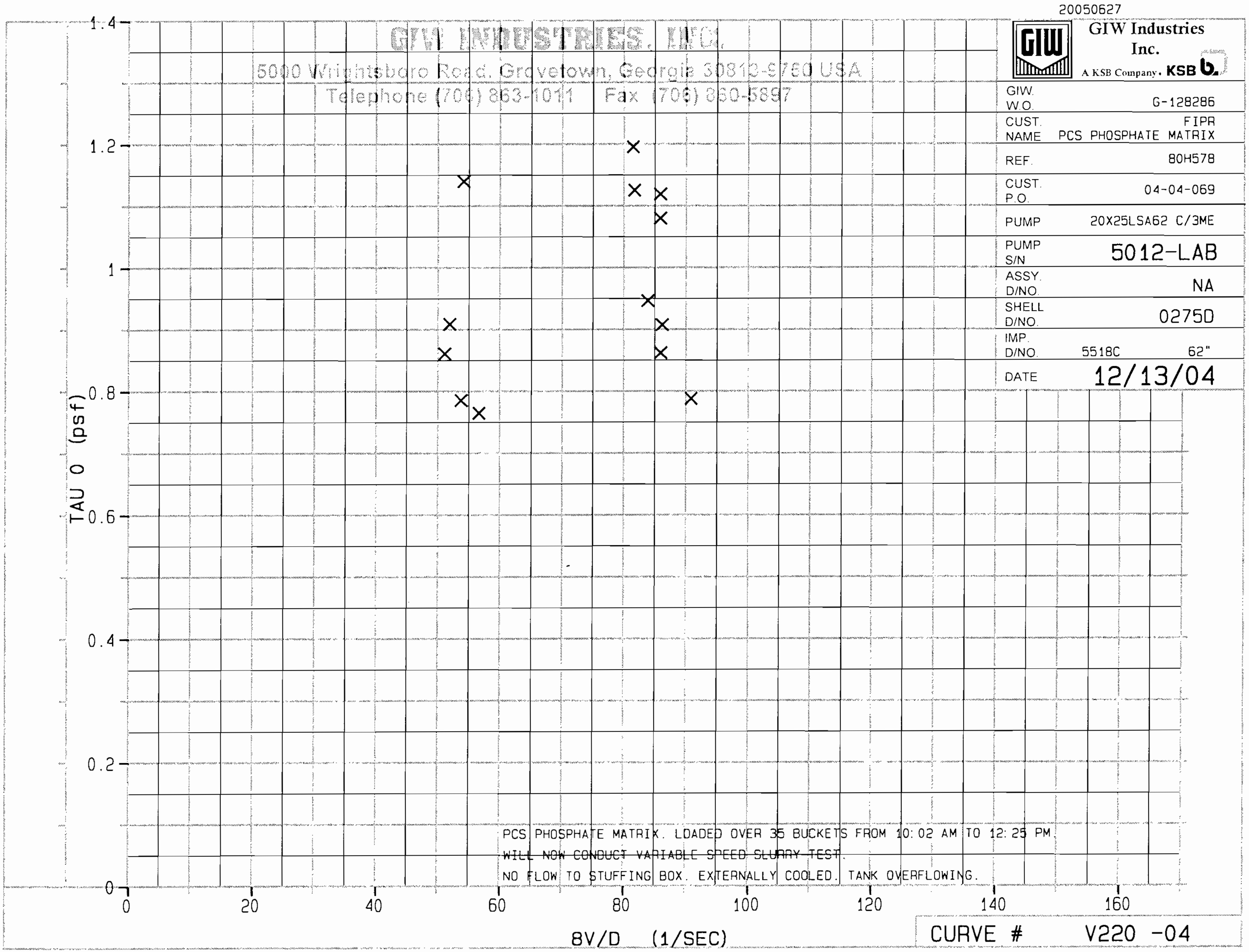
	FLOW MEASUREMENT		HEAD MEASUREMENT			S.G.	DRIVER POWER		SPEED	PUMP		TEMP	SCALED PERFORMANCE				TIME	MAG18"	BEND12
	FLOW Q	VELOCITY	DISCH	SUCTN	TOT HD		INPUT	OUTPUT	N	OUTPUT	EFF	Tm	FLOW	HEAD	POWER	EFF	t	C 25	S 10
NO	GPM	FT/S	PSI	" HG	H FT		KW	BHP	RPM	WHP	n %	F	GPM	FT	BHP	%	H.MM	*1.000	*1.000
1	21700.6	23.63	16.95	0.73	43.83	1.01	0.0	296.7	202.0	241.6	81.4	77.3	24173.	54.4	410.1	81.4	15.02	21701.	22633.
2	20342.8	22.15	15.00	0.86	38.32	1.01	0.0	242.2	189.1	199.0	82.2	77.5	24200.	54.2	407.7	82.2	15.04	20343.	21363.
3	19366.7	21.09	13.82	1.00	35.38	.999	0.0	209.9	180.6	172.9	82.4	77.7	24126.	54.9	405.7	82.4	15.07	19367.	20475.
4	18109.4	19.72	12.20	1.09	31.03	.997	0.0	173.6	169.0	141.5	81.5	77.7	24111.	55.0	409.7	81.5	15.09	18109.	19127.
5	16349.9	17.80	10.20	1.20	25.46	1.00	0.0	130.0	153.3	105.2	80.9	77.8	24004.	54.9	411.5	80.9	15.10	16350.	17208.
6	15321.6	16.68	9.19	1.35	22.43	1.01	0.0	107.7	144.3	87.3	81.0	77.9	23889.	54.5	408.4	81.0	15.13	15322.	16093.
7	13224.7	14.40	7.13	1.53	16.85	1.00	0.0	70.1	124.7	56.4	80.4	77.9	23867.	54.9	412.1	80.4	15.15	13225.	13926.
8	11879.0	12.93	6.01	1.65	13.69	1.00	0.0	52.1	112.1	41.2	79.1	77.9	23840.	55.1	421.1	79.1	15.18	11879.	12467.
9	10412.8	11.34	4.93	1.80	10.63	1.00	0.0	35.4	99.1	28.1	79.3	77.9	23637.	54.8	414.4	79.3	15.20	10413.	10918.
10	9219.8	10.04	4.16	1.92	8.44	1.00	0.0	24.9	88.4	19.7	79.0	77.9	23457.	54.6	410.3	79.0	15.22	9219.8	9663.2
11	7886.1	8.59	3.32	2.02	6.09	1.01	0.0	15.8	75.0	12.2	77.4	77.9	23655.	54.8	425.5	77.4	15.23	7886.1	8187.9
12	6737.3	7.34	2.75	2.12	4.47	1.00	0.0	10.4	64.3	7.6	73.3	77.9	23564.	54.7	446.0	73.3	15.25	6737.3	6989.0
13	6054.4	6.59	2.46	2.20	3.62	1.00	0.0	8.0	58.0	5.6	69.7	77.8	23496.	54.5	465.2	69.7	15.26	6054.4	6300.1

TESTED BY LEE WHITLOCK DATE 12/11/04 COMMENTS: INITIAL VARIABLE SPEED WATER TEST OF NEWLY CONSTRUCTED 20" SLURRY PIPELINE W/ 18" SG LOOP. NEW SLURRY TANK INSTALLED AND WATER LEVEL 5 FT DOWN FROM TOP.

WITNESSED BY L.ENCARNACIO FOR FIPR ORIFICE HAS BEEN REMOVED AND HAGLER SG LOOP. VENT ADDED TO SUCTION.

Version: 20050627 T219 -04 12/11/04


20050627
GIW Industries Inc.
A KSB Company. KSB
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW. W.O. G-128286
CUST. NAME FIPR VARIABLE SPEED WATER
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/11/04
TOTAL DYNAMIC HEAD (FEET)
% EFFICIENCY
POWER (BHP)
GALLONS PER MINUTE (US)
CURVE # M219 -04
SPEED/RAT 225.0
IMP T/D RAT 1.000
WIDTH RATIO 1.000
SCALE RATIO 1.000
BEP EFF 0.0
BEP FLOW 0
BEP RPM 0
EFF RATIO 1.000
INITIAL VARIABLE SPEED WATER TEST OF NEWLY CONSTRUCTED 20" SLURRY PIPELINE W/
18" SG LOOP. NEW SLURRY TANK INSTALLED AND WATER LEVEL 5 FT DOWN FROM TOP.
ORIFICE HAS BEEN REMOVED AND HAGLER SG LOOP. VENT ADDED TO SUCTION.
0
4000
8000
12000
16000
20000
24000
28000
32000
0
10
20
30
40
50
60
0
20
40
60
80
100
0
200
400
600


20050627
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW Industries Inc.
A KSB Company. KSB
GIW W.O. G-128286
CUST. NAME FIPR PCS PHOSPHATE MATRIX
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/13/04
TAU 0 (psf)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
20
40
60
80
100
120
140
160
8V/D (1/SEC)
PCS PHOSPHATE MATRIX. LOADED OVER 35 BUCKETS FROM 10:02 AM TO 12:25 PM.
WILL NOW CONDUCT VARIABLE SPEED SLURRY TEST.
NO FLOW TO STUFFING BOX. EXTERNALLY COOLED. TANK OVERFLOWING.
CURVE # V220 -04

PUMP DETAIL

PUMP 20X25LSA62 C/3ME

SERIAL NUMBER 5012-LAB
ASSEMBLY DRAWING NO NA
SHELL DRAWING NO 0275D
IMPELLER DRAWING NO 5518C
IMPELLER DIAMETER 62"
OUTLET ANGLE
OUTLET WIDTH
ROTATION CLOCKWISE
HYDROSTATIC PRESS. STD

DRIVER DETAIL

TYPE VARIABLE SPEED DRIVE
MAKE GENERAL ELECTRIC
SERIAL NO 5511957
FRAME SIZE 5368480
RPM = 450 BHP = 2450.
4160 VOLTS 3 PHASE 60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO 225.000

IMP TURN DOWN RATIO 1.000
MERIDINAL WIDTH RATIO 1.000
SCALE RATIO 1.000
BEP REF 0.GPM, 0.RPM
EFFICIENCY 0.0% BY 1.000

CH	USE	RDG	SOURCE	INSTRUMENT
1	NULL	SUCTION	#1	YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2	YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3	ROSEMOUNT 4 12'H2O 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4	ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5S		DISCHARGE	#5	ROSEMONT 6 239'H2O 1E1 07093B 1.000
6P		DIFHEAD	#6	ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7	ROSEMOUNT 5 60'H2O 1E2 07093B 0.000
8.		FLOWBEND	#8	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
9.		LOSS 20	#9	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
10S		FLOWBEND	#10	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
11.		FLOWBEND	#11	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
12S		LOSS 20"	#12	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
13P		LOSS 20"	#13	ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14	ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15.	NULL	FLOWORIFICE	#15	ROSEMOUNT 5 60'H2O 1E2 01164E 0.000
16S	NULL	DISCHARGE	#16	ROSEMONT 7 692'H2O 1E1 07093B 0.000
17		SUCTION	#17	ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P		TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23	RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO V220 -04 DATE 12/13/04

PUMP TEST DATA FOR FIPR
------------------ PCS PHOSPHATE MATRIX
PROJECT 80H578
GIW WORK ORDER NO G-128286
CUSTOMER ORDER NO 04-04-069

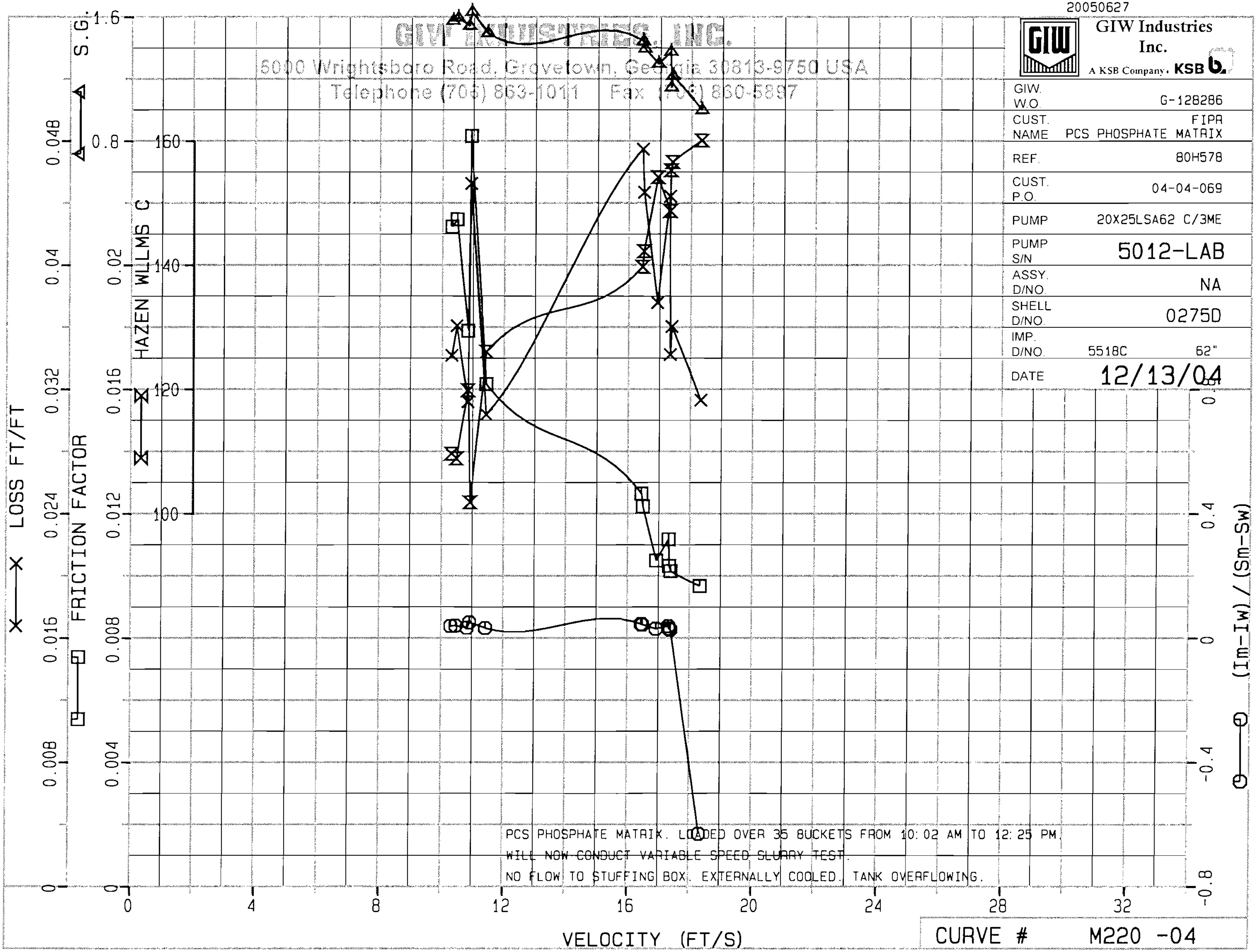
TEST CONSTANTS
1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.50"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 275.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

NO	VELOCITY Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME CONC. Cv %	WEIGHT CONC. Cw %	MASS Ms TON/HR	PIPELINE LOSSES: Im FT/FT	Iw FT/FT	dp/dx psf	Tau 0 psf	8V/D 1/SEC	Tau 0 ln psf	8V/D ln 1/SEC	TIME t HH.MM
1	18.31	16815.9	73.1	0.999	1.001	0.2	0.4	16.9	0.0313	0.0329	1.9546	0.7888	90.739	-.2373	4.5080	9.58
2	17.32	15904.1	74.1	0.998	1.148	9.0	20.9	952.4	0.0343	0.0296	2.1379	0.8627	85.819	-.1477	4.4522	10.13
3	17.36	15948.2	74.4	0.998	1.221	13.5	29.3	1425.7	0.0361	0.0297	2.2504	0.9081	86.057	-.0964	4.4550	10.19
4	16.90	15522.4	75.3	0.998	1.300	18.3	37.3	1882.2	0.0376	0.0282	2.3469	0.9471	83.760	-.0544	4.4279	10.32
5	17.30	15888.0	75.9	0.998	1.354	21.6	42.2	2272.6	0.0429	0.0294	2.6780	1.0807	85.732	0.0776	4.4512	10.45
6	17.30	15888.0	76.3	0.998	1.377	23.0	44.2	2419.4	0.0445	0.0294	2.7745	1.1196	85.732	0.1130	4.4512	10.53
7	16.46	15120.7	77.4	0.998	1.398	24.2	45.9	2427.8	0.0447	0.0267	2.7906	1.1261	81.592	0.1188	4.4017	11.14
8	16.41	15076.6	77.9	0.998	1.445	27.1	49.6	2706.8	0.0475	0.0266	2.9642	1.1962	81.354	0.1791	4.3988	11.24
9	11.41	10477.1	77.9	0.998	1.498	30.3	53.6	2103.4	0.0304	0.0135	1.8968	0.7654	56.535	-.2673	4.0349	11.38
10	10.82	9938.8	77.7	0.998	1.546	33.1	56.8	2184.7	0.0312	0.0122	1.9482	0.7862	53.630	-.2406	3.9821	11.53
11	10.29	9448.7	77.4	0.998	1.578	35.1	59.0	2199.7	0.0342	0.0111	2.1347	0.8614	50.986	-.1492	3.9315	12.03
12	10.45	9597.4	77.2	0.998	1.597	36.3	60.2	2307.7	0.0361	0.0115	2.2536	0.9094	51.788	-.0949	3.9472	12.09
13	10.90	10011.1	77.6	0.998	1.636	38.6	62.6	2565.7	0.0453	0.0124	2.8259	1.1404	54.020	0.1314	3.9894	12.21

TESTED BY LEE WHITLOCK DATE 12/13/04 COMMENTS: PCS PHOSPHATE MATRIX. LOADED OVER 35 BUCKETS FROM 10:02 AM TO 12:25 PM.
WILL NOW CONDUCT VARIABLE SPEED SLURRY TEST.
WITNESSED BY GRAEME ADDIE FOR FIPR NO FLOW TO STUFFING BOX. EXTERNALLY COOLED. TANK OVERFLOWING.
Version: 20050627

V220 -04 12/13/04


20050627
GIW Industries Inc.
A KSB Company. KSB
GIW. W.O. G-128286
CUST. NAME FIPR PCS PHOSPHATE MATRIX
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/13/04
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
S.G.
LOSS FT/FT
FRICTION FACTOR
HAZEN WLLMS C
(Im-Iw) / (Sm-Sw)
PCS PHOSPHATE MATRIX. LOADED OVER 35 BUCKETS FROM 10:02 AM TO 12:25 PM.
WILL NOW CONDUCT VARIABLE SPEED SLURRY TEST.
NO FLOW TO STUFFING BOX. EXTERNALLY COOLED. TANK OVERFLOWING.
VELOCITY (FT/S)
CURVE # M220 -04

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS	3 PHASE 60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF	0.GPM, 0.RPM
EFFICIENCY	0.0% BY 1.000

CH	USE RDG	SOURCE INSTRUMENT
1	NULLSUCTION	#1 YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULLLOSS 20"	#2 YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE S.G.U-SECUP	#3 ROSEMOUNT 4 12'H2O 1E2 07093B 0.500
4	AVE S.G.U-SECDN	#4 ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5S	DISCHARGE	#5 ROSEMONT 6 239'H2O 1E1 07093B 1.000
6P	DIFHEAD	#6 ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.	NULLFLOWORIFICE	#7 ROSEMOUNT 5 60'H2O 1E2 07093B 0.000
8.	FLOWBEND	#8 ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
9.	LOSS 20	#9 ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
10S	FLOWBEND	#10ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
11.	FLOWBEND	#11ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
12S	LOSS 20"	#12ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
13P	LOSS 20"	#13ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULLDISCHARGE	#14ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15.	NULLFLOWORIFICE	#15ROSEMOUNT 5 60'H2O 1E2 01164E 0.000
16S	NULLDISCHARGE	#16ROSEMONT 7 692'H2O 1E1 07093B 0.000
17	SUCTION	#17ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P	TEMPTANK	#18 RTD TANK F 1E1 10204D 1.000
19S	TEMPAMBIENT	#19 RTD AMBIENT F 1E1 10204B 1.000
20P	BHP TRQ*RPM	#20 BENSFELD 30K FTLB1E-102122B 1.000
21	RPM TRQ BAR	#21 DAYTRONIC 300 RPM 1E1 02122D 1.000
22S	BHP TRQ BAR	#22 BENSFELD 3000HP 1E1 02122F 1.000
23S	NULLTEMPAMBIENT	#23 RTD7 100OHM F 1E1 04088B 0.000
24P	NULLBHP TRQ*RPM	#24 LEBOW DAY 166 FTLB1E1 12211B 0.000
25P	FLOW18" MAG	#25 18" F&P 32000 GPM 1E-111164B 1.000
26S	NULLBHP TRQ BAR	#26 LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULLFLOW3"MAG	#27 LOAD CELL 100LB 1E2 01101B 0.000
28S	NULLFLOWORIFICE	TECO# 6158 21.80 FPS 1E2 09256C 0.000
29.	NULLFLOW6"MAG	#29 6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULLBHP TRQ*RPM	#30 LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULLRPM TRQ BAR	#31 LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULLBHP TRQ BAR	#32 LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO M220 -04 DATE 12/13/04

PUMP TEST DATA FOR FIPR
------------------ PCS PHOSPHATE MATRIX

PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.50"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 275.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

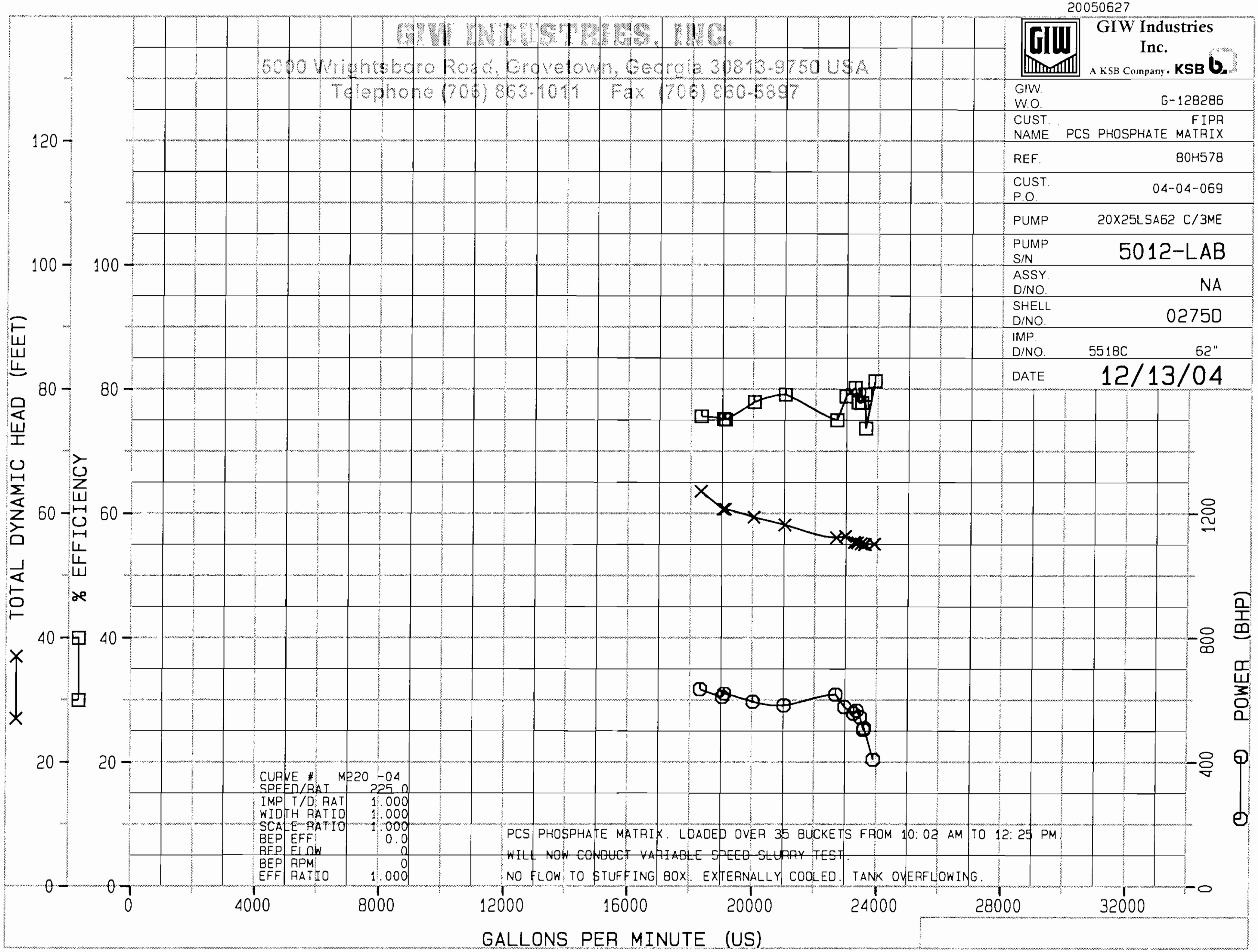
NO	VELOCITY Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME CONC. Cv %	WEIGHT CONC. Cw %	MASS Ms TON/HR	REYNOLDS NUMBER Re	PIPELINE LOSSES Im FT/FT	PIPELINE LOSSES Iw FT/FT	FRICTION FACTRS Fm	FRICTION FACTRS Fw SAME Re	HAZEN WLLMS C	Im-Iw ----- Sm-Sw	TIME t HH.MM
1	18.31	16815.9	73.1	0.999	1.001	0.2	0.4	16.9	0.293E+07	0.0313	0.0329	0.0097	0.0102	160.	-.6289	9.58
2	17.32	15904.1	74.1	0.998	1.148	9.0	20.9	952.4	0.281E+07	0.0343	0.0296	0.0103	0.0103	155.	0.0314	10.13
3	17.36	15948.2	74.4	0.998	1.221	13.5	29.3	1425.7	0.282E+07	0.0361	0.0297	0.0102	0.0102	157.	0.0285	10.19
4	16.90	15522.4	75.3	0.998	1.300	18.3	37.3	1882.2	0.278E+07	0.0376	0.0282	0.0105	0.0103	154.	0.0311	10.32
5	17.30	15888.0	75.9	0.998	1.354	21.6	42.2	2272.6	0.287E+07	0.0429	0.0294	0.0110	0.0102	150.	0.0379	10.45
6	17.30	15888.0	76.3	0.998	1.377	23.0	44.2	2419.4	0.289E+07	0.0445	0.0294	0.0112	0.0102	149.	0.0397	10.53
7	16.46	15120.7	77.4	0.998	1.398	24.2	45.9	2427.8	0.279E+07	0.0447	0.0267	0.0122	0.0103	142.	0.0449	11.14
8	16.41	15076.6	77.9	0.998	1.445	27.1	49.6	2706.8	0.280E+07	0.0475	0.0266	0.0127	0.0103	140.	0.0468	11.24
9	11.41	10477.1	77.9	0.998	1.498	30.3	53.6	2103.4	0.195E+07	0.0304	0.0135	0.0162	0.0108	126.	0.0338	11.38
10	10.82	9938.8	77.7	0.998	1.546	33.1	56.8	2184.7	0.184E+07	0.0312	0.0122	0.0179	0.0108	120.	0.0347	11.53
11	10.29	9448.7	77.4	0.998	1.578	35.1	59.0	2199.7	0.174E+07	0.0342	0.0111	0.0213	0.0109	110.	0.0398	12.03
12	10.45	9597.4	77.2	0.998	1.597	36.3	60.2	2307.7	0.177E+07	0.0361	0.0115	0.0215	0.0109	109.	0.0412	12.09
13	10.90	10011.1	77.6	0.998	1.636	38.6	62.6	2565.7	0.185E+07	0.0453	0.0124	0.0242	0.0108	102.	0.0515	12.21

TESTED BY LEE WHITLOCK DATE 12/13/04 COMMENTS: PCS PHOSPHATE MATRIX. LOADED OVER 35 BUCKETS FROM 10:02 AM TO 12:25 PM. WILL NOW CONDUCT VARIABLE SPEED SLURRY TEST.

WITNESSED BY GRAEME ADDIE FOR FIPR NO FLOW TO STUFFING BOX. EXTERNALLY COOLED. TANK OVERFLOWING.

Version: 20050627 M220 -04 12/13/04

20050627


GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW Industries Inc.
A KSB Company. KSB
GIW. W.O. G-128286
CUST. NAME FIPR PCS PHOSPHATE MATRIX
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/13/04
TOTAL DYNAMIC HEAD (FEET)
% EFFICIENCY
POWER (BHP)
GALLONS PER MINUTE (US)
CURVE # M220 -04
SPEED/RAT 225.0
IMP T/D RAT 1.000
WIDTH RATIO 1.000
SCALE RATIO 1.000
BEP EFF 0.0
BEP FLOW 0
BEP RPM 0
EFF RATIO 1.000
PCS PHOSPHATE MATRIX. LOADED OVER 35 BUCKETS FROM 10:02 AM TO 12:25 PM.
WILL NOW CONDUCT VARIABLE SPEED SLURRY TEST.
NO FLOW TO STUFFING BOX. EXTERNALLY COOLED. TANK OVERFLOWING.
0
20
40
60
80
100
120
400
800
1200
4000
8000
12000
16000
20000
24000
28000
32000

PUMP DETAIL

PUMP 20X25LSA62 C/3ME

SERIAL NUMBER 5012-LAB
ASSEMBLY DRAWING NO NA
SHELL DRAWING NO 0275D
IMPELLER DRAWING NO 5518C
IMPELLER DIAMETER 62"
OUTLET ANGLE
OUTLET WIDTH
ROTATION CLOCKWISE
HYDROSTATIC PRESS. STD

DRIVER DETAIL

TYPE VARIABLE SPEED DRIVE
MAKE GENERAL ELECTRIC
SERIAL NO 5511957
FRAME SIZE 5368480
RPM = 450 BHP = 2450.
4160 VOLTS 3 PHASE 60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO 225.000

IMP TURN DOWN RATIO 1.000
MERIDINAL WIDTH RATIO 1.000
SCALE RATIO 1.000
BEP REF 0.GPM, 0.RPM
EFFICIENCY 0.0% BY 1.000

CH	USE	RDG SOURCE	INSTRUMENT
1	NULL	SUCTION	#1 YOKOGAWA-30-30 H20-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2 YOKOGAWA -4-8' H20-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3 ROSEMOUNT 4 12'H20 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4 ROSEMONT4 -4-8'H20-1E2 07134B 0.500
5S		DISCHARGE	#5 ROSEMONT 6 239'H20 1E1 07093B 1.000
6P		DIFHEAD	#6 ROSEMONT 6 236'H20 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7 ROSEMOUNT 5 60'H20 1E2 07093B 0.000
8.		FLOWBEND	#8 ROSEMOUNT 5 24'H20 1E2 07093B 1.000
9.		LOSS 20	#9 ROSEMOUNT 5 24'H20 1E2 07093B 1.000
10S		FLOWBEND	#10ROSEMOUNT 4 12'H20 1E2 07134B 1.000
11.		FLOWBEND	#11ROSEMOUNT 4 12'H20 1E2 07134B 1.000
12S		LOSS 20"	#12ROSEMOUNT 4 12'H20 1E2 07134B 1.000
13P		LOSS 20"	#13ROSEMONT4 -4-8'H20-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14ROSEMOUNT 5 24'H20 1E2 07134B 0.000
15.	NULL	FLOWORIFICE	#15ROSEMOUNT 5 60'H20 1E2 01164E 0.000
16S	NULL	DISCHARGE	#16ROSEMONT 7 692'H20 1E1 07093B 0.000
17		SUCTION	#17ROSE. 5 -30-30'H20-1E2 07093B 1.000
18P		TEMPTANK	#18 RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19 RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20 BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21 DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22 BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23 RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24 LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25 18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26 LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27 LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO# 6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29 6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30 LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31 LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32 LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO T220 -04 DATE 12/13/04

PUMP TEST DATA FOR FIPR
------------------- PCS PHOSPHATE MATRIX
PROJECT 80H578
GIW WORK ORDER NO G-128286
CUSTOMER ORDER NO 04-04-069

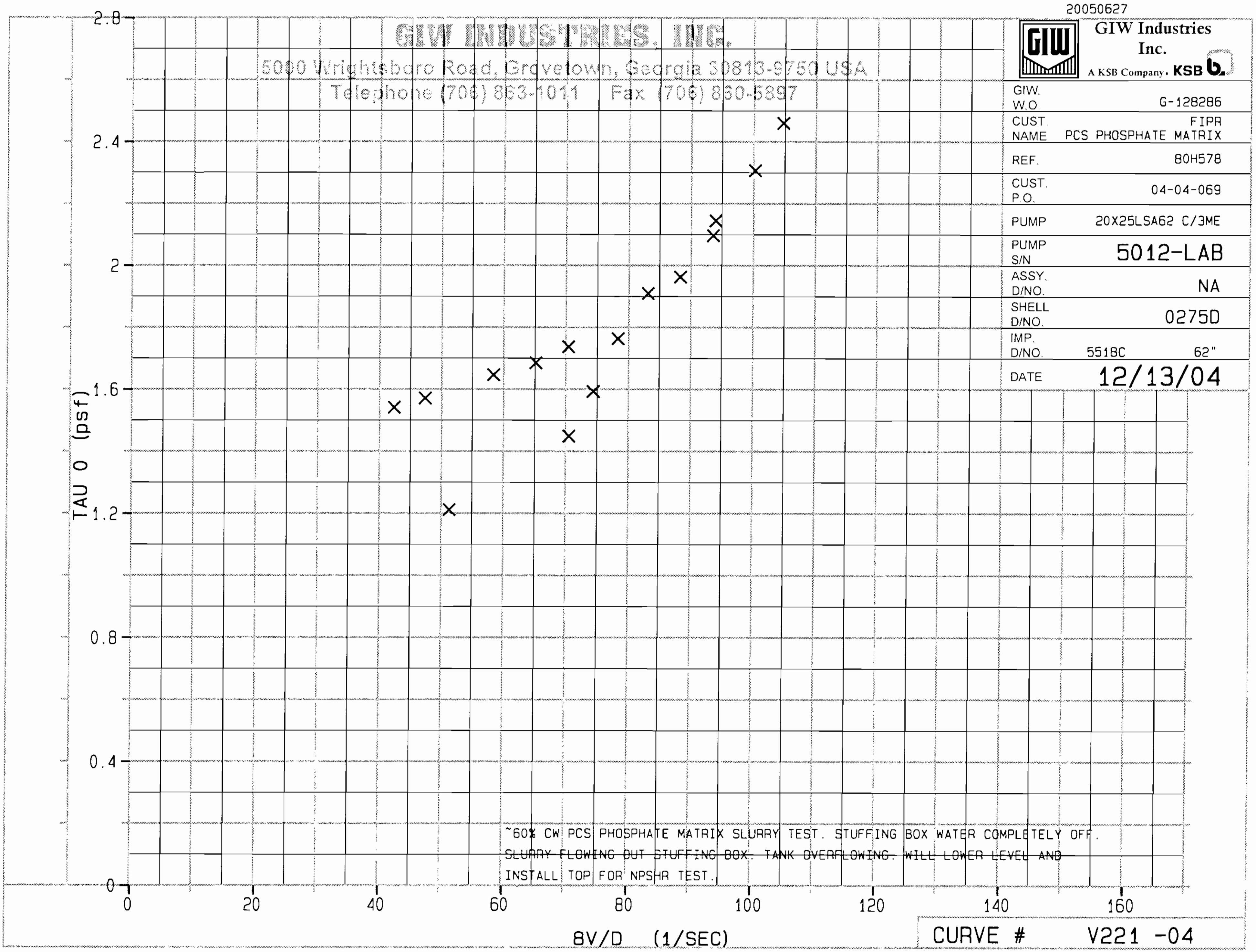
TEST CONSTANTS
1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.50"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 275.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

NO	FLOW MEASUREMENT: FLOW GPM	Q:VELOCITY FT/S	HEAD MEASUREMENT: DISCH: PSI	SUCTN: " HG	TOT HD: H FT	S.G.	DRIVER POWER: INPUT: KW	OUTPUT: BHP	SPEED: N RPM	PUMP OUTPUT: WHP	EFF: n %	TEMP: Tm F	SCALED PERFORMANCE FLOW GPM	HEAD: FT	POWER: BHP	EFF: %	TIME: t H.MM	MAG18": C 25 *1.000	BEND12: S 10 *1.000
1	16815.9	18.31	7.41	-6.03	27.35	1.00	0.0	142.9	158.5	116.3	81.3	73.1	23878.	55.2	409.3	81.3	9.58	16816.	16759.
2	15904.1	17.32	8.95	-4.31	25.03	1.15	0.0	156.4	151.7	115.3	73.7	74.1	23594.	55.1	510.7	73.7	10.13	15904.	15806.
3	15948.2	17.36	10.23	-3.47	25.22	1.22	0.0	156.6	152.2	124.0	79.2	74.4	23570.	55.1	505.5	79.2	10.19	15948.	15780.
4	15522.4	16.90	11.25	-2.09	24.16	1.30	0.0	158.2	148.9	123.2	77.8	75.3	23463.	55.2	546.5	77.8	10.32	15522.	15409.
5	15888.0	17.30	13.64	0.07	25.64	1.35	0.0	178.8	153.1	139.3	77.9	75.9	23348.	55.4	567.3	77.9	10.45	15888.	15738.
6	15888.0	17.30	14.99	1.99	25.89	1.38	0.0	178.3	153.8	143.1	80.3	76.3	23249.	55.4	558.5	80.3	10.53	15888.	15746.
7	15120.7	16.46	12.48	-2.18	24.46	1.40	0.0	165.5	148.2	130.6	78.9	77.4	22956.	56.4	579.1	78.9	11.14	15121.	14957.
8	15076.6	16.41	14.24	-0.12	24.85	1.45	0.0	182.1	149.6	136.7	75.1	77.9	22668.	56.2	619.0	75.1	11.24	15077.	14983.
9	10477.1	11.41	10.73	3.38	14.50	1.50	0.0	72.5	112.3	57.5	79.2	77.9	21000.	58.2	584.2	79.2	11.38	10477.	10269.
10	9938.8	10.82	11.08	3.01	14.67	1.55	0.0	73.0	111.8	56.9	78.0	77.7	20011.	59.5	595.7	78.0	11.53	9938.8	9652.7
11	9448.7	10.29	11.64	3.09	15.00	1.58	0.0	75.0	111.8	56.5	75.3	77.4	19012.	60.7	611.3	75.3	12.03	9448.7	9127.2
12	9597.4	10.45	11.89	2.83	15.38	1.60	0.0	79.2	113.2	59.5	75.1	77.2	19077.	60.8	622.2	75.1	12.09	9597.4	9260.6
13	10011.1	10.90	13.66	0.70	19.04	1.64	0.0	104.1	123.1	78.8	75.7	77.6	18301.	63.6	635.9	75.7	12.21	10011.	9576.8

TESTED BY LEE WHITLOCK DATE 12/13/04 COMMENTS: PCS PHOSPHATE MATRIX. LOADED OVER 35 BUCKETS FROM 10:02 AM TO 12:25 PM.
WILL NOW CONDUCT VARIABLE SPEED SLURRY TEST.
WITNESSED BY GRAEME ADDIE FOR FIPR NO FLOW TO STUFFING BOX. EXTERNALLY COOLED. TANK OVERFLOWING.
Version: 20050627

T220 -04 12/13/04


20050627
GIW Industries Inc.
A KSB Company. KSB
GIW. W.O. G-128286
CUST. NAME FIPR PCS PHOSPHATE MATRIX
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/13/04
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
TAU 0 (psf)
2.8
2.4
2
1.6
1.2
0.8
0.4
0
0
20
40
60
80
100
120
140
160
8V/D (1/SEC)
~60% CW PCS PHOSPHATE MATRIX SLURRY TEST. STUFFING BOX WATER COMPLETELY OFF.
SLURRY FLOWING OUT STUFFING BOX. TANK OVERFLOWING. WILL LOWER LEVEL AND
INSTALL TOP FOR NPSHR TEST.
CURVE # V221 -04

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE RDG	SOURCE INSTRUMENT
1	NULLSUCTION	#1 YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULLLOSS 20"	#2 YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE S.G.U-SECUP	#3 ROSEMOUNT 4 12'H2O 1E2 07093B 0.500
4	AVE S.G.U-SECDN	#4 ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5S	DISCHARGE	#5 ROSEMONT 6 239'H2O 1E1 07093B 1.000
6P	DIFHEAD	#6 ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.	NULLFLOWORIFICE	#7 ROSEMOUNT 5 60'H2O 1E2 07093B 0.000
8.	FLOWBEND	#8 ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
9.	LOSS 20	#9 ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
10S	FLOWBEND	#10ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
11.	FLOWBEND	#11ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
12S	LOSS 20"	#12ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
13P	LOSS 20"	#13ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULLDISCHARGE	#14ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15.	NULLFLOWORIFICE	#15ROSEMOUNT 5 60'H2O 1E2 01164E 0.000
16S	NULLDISCHARGE	#16ROSEMONT 7 692'H2O 1E1 07093B 0.000
17	SUCTION	#17ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P	TEMPTANK	#18 RTD TANK F 1E1 10204D 1.000
19S	TEMPAMBIENT	#19 RTD AMBIENT F 1E1 10204B 1.000
20P	BHP TRQ*RPM	#20 BENSFELD 30K FTLB1E-102122B 1.000
21	RPM TRQ BAR	#21 DAYTRONIC 300 RPM 1E1 02122D 1.000
22S	BHP TRQ BAR	#22 BENSFELD 3000HP 1E1 02122F 1.000
23S	NULLTEMPAMBIENT	#23 RTD7 100OHM F 1E1 04088B 0.000
24P	NULLBHP TRQ*RPM	#24 LEBOW DAY 166 FTLB1E1 12211B 0.000
25P	FLOW18" MAG	#25 18" F&P 32000 GPM 1E-111164B 1.000
26S	NULLBHP TRQ BAR	#26 LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULLFLOW3"MAG	#27 LOAD CELL 100LB 1E2 01101B 0.000
28S	NULLFLOWORIFICE	TECO# 6158 21.80 FPS 1E2 09256C 0.000
29.	NULLFLOW6"MAG	#29 6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULLBHP TRQ*RPM	#30 LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULLRPM TRQ BAR	#31 LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULLBHP TRQ BAR	#32 LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO V221 -04 DATE 12/13/04

PUMP TEST DATA FOR	FIPR
------------------	PCS PHOSPHATE MATRIX
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.50"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 275.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

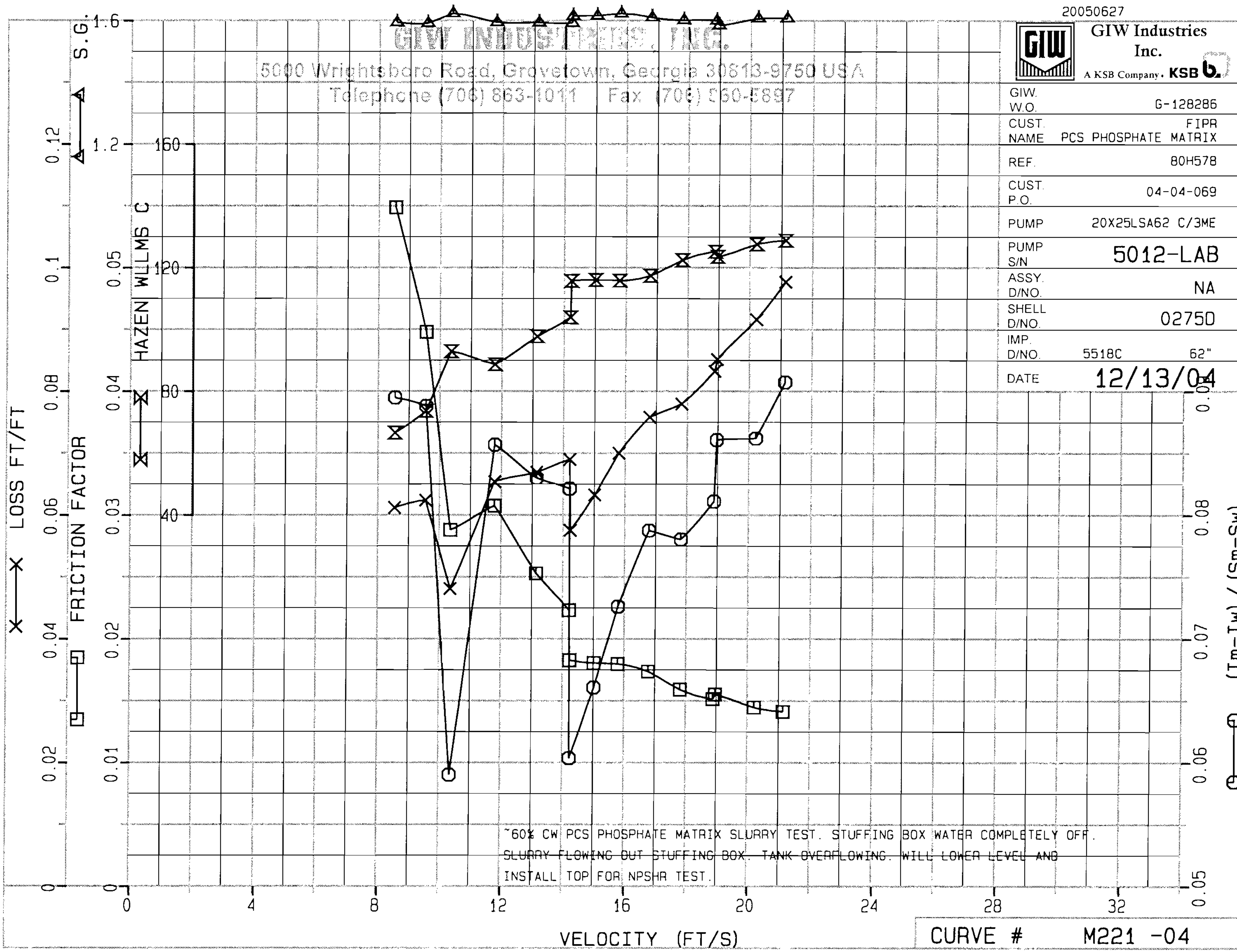
NO	VELOCITY Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME CONC. Cv %	WEIGHT CONC. Cw %	MASS Ms TON/HR	PIPELINE LOSSES Im FT/FT	Iw FT/FT	dp/dx psf	Tau 0 psf	8V/D 1/SEC	Tau 0 ln psf	8V/D ln 1/SEC	TIME t HH.MM
1	10.33	9488.9	78.1	0.998	1.624	37.9	61.8	2385.1	0.0482	0.0112	3.0060	1.2130	51.202	0.1931	3.9358	12.27
2	14.21	13052.0	78.5	0.998	1.616	37.4	61.4	3239.1	0.0576	0.0203	3.5945	1.4505	70.429	0.3719	4.2546	12.30
3	14.99	13767.0	78.9	0.998	1.617	37.5	61.4	3422.5	0.0633	0.0224	3.9515	1.5946	74.287	0.4666	4.3079	12.33
4	15.77	14482.0	79.5	0.998	1.624	37.9	61.9	3640.6	0.0701	0.0246	4.3728	1.7646	78.146	0.5679	4.3586	12.36
5	16.76	15389.9	79.9	0.998	1.612	37.2	61.1	3792.4	0.0759	0.0275	4.7363	1.9113	83.044	0.6478	4.4194	12.38
6	17.79	16341.9	80.5	0.998	1.603	36.6	60.6	3968.9	0.0780	0.0308	4.8682	1.9645	88.181	0.6753	4.4794	12.44
7	18.86	17322.1	80.7	0.998	1.602	36.5	60.5	4198.6	0.0833	0.0343	5.1996	2.0982	93.470	0.7411	4.5376	12.46
8	20.20	18551.2	81.3	0.997	1.608	37.0	60.9	4546.7	0.0917	0.0390	5.7208	2.3086	100.10	0.8366	4.6062	12.49
9	21.11	19390.8	82.0	0.997	1.608	36.9	60.9	4750.5	0.0978	0.0424	6.1005	2.4618	104.63	0.9009	4.6505	12.51
10	18.94	17394.4	82.2	0.997	1.586	35.6	59.5	4112.1	0.0852	0.0345	5.3186	2.1463	93.860	0.7637	4.5418	12.56
11	14.18	13027.9	82.0	0.997	1.593	36.1	60.0	3115.6	0.0690	0.0201	4.3085	1.7387	70.299	0.5531	4.2528	13.09
12	13.12	12047.7	81.6	0.997	1.595	36.2	60.1	2889.7	0.0670	0.0174	4.1799	1.6867	65.010	0.5228	4.1745	13.10
13	11.76	10798.5	81.6	0.997	1.596	36.2	60.1	2593.0	0.0654	0.0141	4.0834	1.6478	58.269	0.4994	4.0651	13.13
14	9.53	8749.8	81.4	0.997	1.593	36.0	59.9	2090.2	0.0624	0.0096	3.8968	1.5725	47.214	0.4527	3.8547	13.14
15	8.52	7825.9	81.0	0.998	1.595	36.2	60.1	1876.5	0.0613	0.0078	3.8228	1.5427	42.229	0.4335	3.7431	13.16

TESTED BY LEE WHITLOCK DATE 12/13/04 COMMENTS: ~60% CW PCS PHOSPHATE MATRIX SLURRY TEST. STUFFING BOX WATER COMPLETELY OFF. SLURRY FLOWING OUT STUFFING BOX. TANK OVERFLOWING. WILL LOWER LEVEL AND INSTALL TOP FOR NPSHR TEST.

WITNESSED BY GRAEME ADDIE FOR FIPR

Version: 20050627

V221 -04 12/13/04



20050627
GIW Industries Inc.
A KSB Company. KSB
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5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW. W.O. G-128286
CUST. NAME FIPR PCS PHOSPHATE MATRIX
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/13/04
S.G.
FRICTION FACTOR
LOSS FT/FT
HAZEN WLLMS C
(Im-Iw)/(Sm-Sw)
~60% CW PCS PHOSPHATE MATRIX SLURRY TEST. STUFFING BOX WATER COMPLETELY OFF.
SLURRY FLOWING OUT STUFFING BOX. TANK OVERFLOWING. WILL LOWER LEVEL AND
INSTALL TOP FOR NPSHR TEST.
VELOCITY (FT/S)
CURVE # M221 -04

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO M221 -04   DATE 12/13/04

PUMP TEST DATA FOR   FIPR
------------------ PCS PHOSPHATE MATRIX
PROJECT   80H578
GIW WORK ORDER NO   G-128286
CUSTOMER ORDER NO   04-04-069

PUMP DETAIL

PUMP   20X25LSA62 C/3ME

SERIAL NUMBER   5012-LAB
ASSEMBLY DRAWING NO   NA
SHELL DRAWING NO   0275D
IMPELLER DRAWING NO   5518C
IMPELLER DIAMETER   62"
OUTLET ANGLE
OUTLET WIDTH
ROTATION   CLOCKWISE
HYDROSTATIC PRESS.   STD

DRIVER DETAIL

TYPE   VARIABLE SPEED DRIVE
MAKE   GENERAL ELECTRIC
SERIAL NO   5511957
FRAME SIZE   5368480
RPM = 450   BHP = 2450.
4160 VOLTS 3 PHASE 60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO   225.000

IMP TURN DOWN RATIO   1.000
MERIDINAL WIDTH RATIO 1.000
SCALE RATIO   1.000
BEP REF   0.GPM,   0.RPM
EFFICIENCY   0.0%   BY 1.000

CH	USE	RDG	SOURCE	INSTRUMENT
1	NULL	SUCTION	#1	YOKOGAWA-30-30 H20-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2	YOKOGAWA -4-8' H20-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3	ROSEMOUNT 4 12'H20 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4	ROSEMONT4 -4-8'H20-1E2 07134B 0.500
5S		DISCHARGE	#5	ROSEMONT 6 239'H20 1E1 07093B 1.000
6P		DIFHEAD	#6	ROSEMONT 6 236'H20 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7	ROSEMOUNT 5 60'H20 1E2 07093B 0.000
8.		FLOWBEND	#8	ROSEMOUNT 5 24'H20 1E2 07093B 1.000
9.		LOSS 20	#9	ROSEMOUNT 5 24'H20 1E2 07093B 1.000
10S		FLOWBEND	#10	ROSEMOUNT 4 12'H20 1E2 07134B 1.000
11.		FLOWBEND	#11	ROSEMOUNT 4 12'H20 1E2 07134B 1.000
12S		LOSS 20"	#12	ROSEMOUNT 4 12'H20 1E2 07134B 1.000
13P		LOSS 20"	#13	ROSEMONT4 -4-8'H20-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14	ROSEMOUNT 5 24'H20 1E2 07134B 0.000
15.	NULL	FLOWORIFICE	#15	ROSEMOUNT 5 60'H20 1E2 01164E 0.000
16S	NULL	DISCHARGE	#16	ROSEMONT 7 692'H20 1E1 07093B 0.000
17		SUCTION	#17	ROSE. 5 -30-30'H20-1E2 07093B 1.000
18P		TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23	RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

TEST CONSTANTS
1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.50"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 275.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

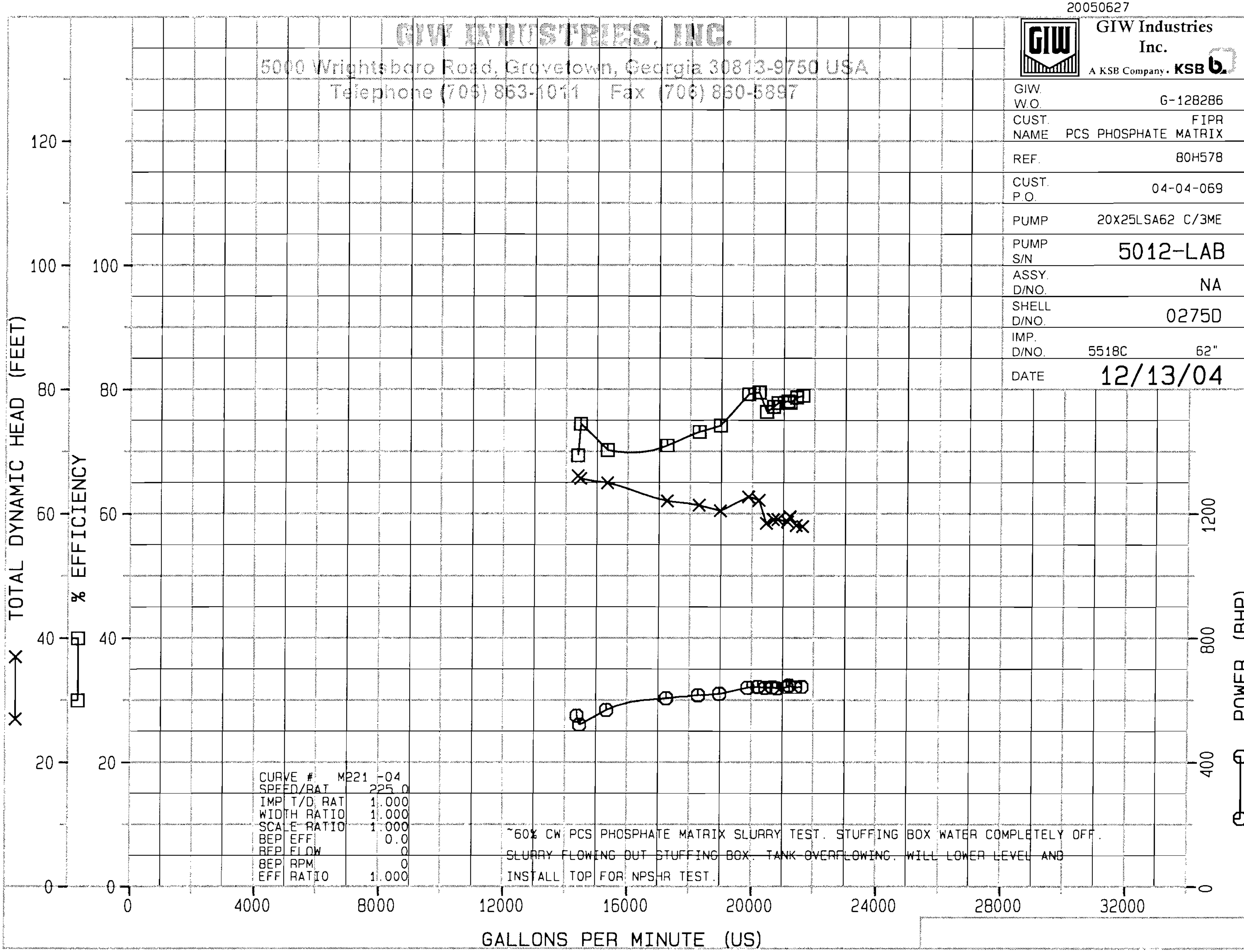
TEST RESULTS

NO	VELOCITY Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME CONC. Cv %	WEIGHT CONC. Cw %	MASS Ms TON/HR	REYNOLDS NUMBER Re	PIPELINE LOSSES Im FT/FT	PIPELINE LOSSES Iw FT/FT	FRICTION FACTRS Fm	FRICTION FACTRS Fw SAME Re	HAZEN WLLMS C	Im-Iw ----- Sm-Sw	TIME t HH.MM
1	10.33	9488.9	78.1	0.998	1.624	37.9	61.8	2385.1	0.177E+07	0.0482	0.0112	0.0288	0.0109	93.	0.0591	12.27
2	14.21	13052.0	78.5	0.998	1.616	37.4	61.4	3239.1	0.244E+07	0.0576	0.0203	0.0183	0.0104	116.	0.0604	12.30
3	14.99	13767.0	78.9	0.998	1.617	37.5	61.4	3422.5	0.259E+07	0.0633	0.0224	0.0181	0.0104	116.	0.0661	12.33
4	15.77	14482.0	79.5	0.998	1.624	37.9	61.9	3640.6	0.275E+07	0.0701	0.0246	0.0180	0.0103	116.	0.0726	12.36
5	16.76	15389.9	79.9	0.998	1.612	37.2	61.1	3792.4	0.293E+07	0.0759	0.0275	0.0174	0.0102	117.	0.0788	12.38
6	17.79	16341.9	80.5	0.998	1.603	36.6	60.6	3968.9	0.314E+07	0.0780	0.0308	0.0160	0.0101	123.	0.0781	12.44
7	18.86	17322.1	80.7	0.998	1.602	36.5	60.5	4198.6	0.333E+07	0.0833	0.0343	0.0152	0.0100	125.	0.0811	12.46
8	20.20	18551.2	81.3	0.997	1.608	37.0	60.9	4546.7	0.360E+07	0.0917	0.0390	0.0145	0.0099	128.	0.0862	12.49
9	21.11	19390.8	82.0	0.997	1.608	36.9	60.9	4750.5	0.380E+07	0.0978	0.0424	0.0142	0.0099	129.	0.0908	12.51
10	18.94	17394.4	82.2	0.997	1.586	35.6	59.5	4112.1	0.341E+07	0.0852	0.0345	0.0155	0.0100	124.	0.0861	12.56
11	14.18	13027.9	82.0	0.997	1.593	36.1	60.0	3115.6	0.255E+07	0.0690	0.0201	0.0223	0.0104	104.	0.0822	13.09
12	13.12	12047.7	81.6	0.997	1.595	36.2	60.1	2889.7	0.235E+07	0.0670	0.0174	0.0253	0.0105	98.	0.0830	13.10
13	11.76	10798.5	81.6	0.997	1.596	36.2	60.1	2593.0	0.210E+07	0.0654	0.0141	0.0308	0.0106	89.	0.0857	13.13
14	9.53	8749.8	81.4	0.997	1.593	36.0	59.9	2090.2	0.170E+07	0.0624	0.0096	0.0448	0.0110	74.	0.0888	13.14
15	8.52	7825.9	81.0	0.998	1.595	36.2	60.1	1876.5	0.151E+07	0.0613	0.0078	0.0549	0.0112	67.	0.0895	13.16

TESTED BY LEE WHITLOCK DATE 12/13/04 COMMENTS: ~60% CW PCS PHOSPHATE MATRIX SLURRY TEST. STUFFING BOX WATER COMPLETELY OFF. SLURRY FLOWING OUT STUFFING BOX. TANK OVERFLOWING. WILL LOWER LEVEL AND INSTALL TOP FOR NPSHR TEST.

WITNESSED BY GRAEME ADDIE FOR FIPR

Version: 20050627   M221 -04 12/13/04


20050627
GIW Industries Inc.
A KSB Company. KSB
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW W.O. G-128286
CUST. NAME FIPR PCS PHOSPHATE MATRIX
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/13/04
CURVE # M221 -04
SPEED/RAT 225.0
IMP T/D RAT 1.000
WIDTH RATIO 1.000
SCALE RATIO 1.000
BEP EFF 0.0
BEP FLOW 0
BEP RPM 0
EFF RATIO 1.000
~60% CW PCS PHOSPHATE MATRIX SLURRY TEST. STUFFING BOX WATER COMPLETELY OFF.
SLURRY FLOWING OUT STUFFING BOX. TANK OVERFLOWING. WILL LOWER LEVEL AND
INSTALL TOP FOR NPSHR TEST.
TOTAL DYNAMIC HEAD (FEET)
% EFFICIENCY
POWER (BHP)
GALLONS PER MINUTE (US)
0
20
40
60
80
100
120
400
800
1200
4000
8000
12000
16000
20000
24000
28000
32000

PUMP DETAIL	
PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL	
TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS	
SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF	0.GPM, 0.RPM
EFFICIENCY	0.0% BY 1.000

CH	USE RDG	SOURCE	INSTRUMENT
1	NULLSUCTION	#1	YOKOGAWA-30-30 H20-1E2 06011B 0.000
2S	NULLLOSS 20"	#2	YOKOGAWA -4-8' H20-1E2 12040B 0.000
3	AVE S.G.U-SECUP	#3	ROSEMOUNT 4 12'H20 1E2 07093B 0.500
4	AVE S.G.U-SECDN	#4	ROSEMONT4 -4-8'H20-1E2 07134B 0.500
5S	DISCHARGE	#5	ROSEMONT 6 239'H20 1E1 07093B 1.000
6P	DIFHEAD	#6	ROSEMONT 6 236'H20 1E1 07093B 1.000
7.	NULLFLOWORIFICE	#7	ROSEMOUNT 5 60'H20 1E2 07093B 0.000
8.	FLOWBEND	#8	ROSEMOUNT 5 24'H20 1E2 07093B 1.000
9.	LOSS 20	#9	ROSEMOUNT 5 24'H20 1E2 07093B 1.000
10S	FLOWBEND	#10	ROSEMOUNT 4 12'H20 1E2 07134B 1.000
11.	FLOWBEND	#11	ROSEMOUNT 4 12'H20 1E2 07134B 1.000
12S	LOSS 20"	#12	ROSEMOUNT 4 12'H20 1E2 07134B 1.000
13P	LOSS 20"	#13	ROSEMONT4 -4-8'H20-1E2 01164E 1.000
14.	NULLDISCHARGE	#14	ROSEMOUNT 5 24'H20 1E2 07134B 0.000
15.	NULLFLOWORIFICE	#15	ROSEMOUNT 5 60'H20 1E2 01164E 0.000
16S	NULLDISCHARGE	#16	ROSEMONT 7 692'H20 1E1 07093B 0.000
17	SUCTION	#17	ROSE. 5 -30-30'H20-1E2 07093B 1.000
18P	TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S	TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P	BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21	RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S	BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULLTEMPAMBIENT	#23	RTD7 100OHM F 1E1 04088B 0.000
24P	NULLBHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25P	FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULLBHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULLFLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULLFLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULLFLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULLBHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULLRPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULLBHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO T221 -04 DATE 12/13/04

PUMP TEST DATA FOR	FIPR
	PCS PHOSPHATE MATRIX
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.50"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 275.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

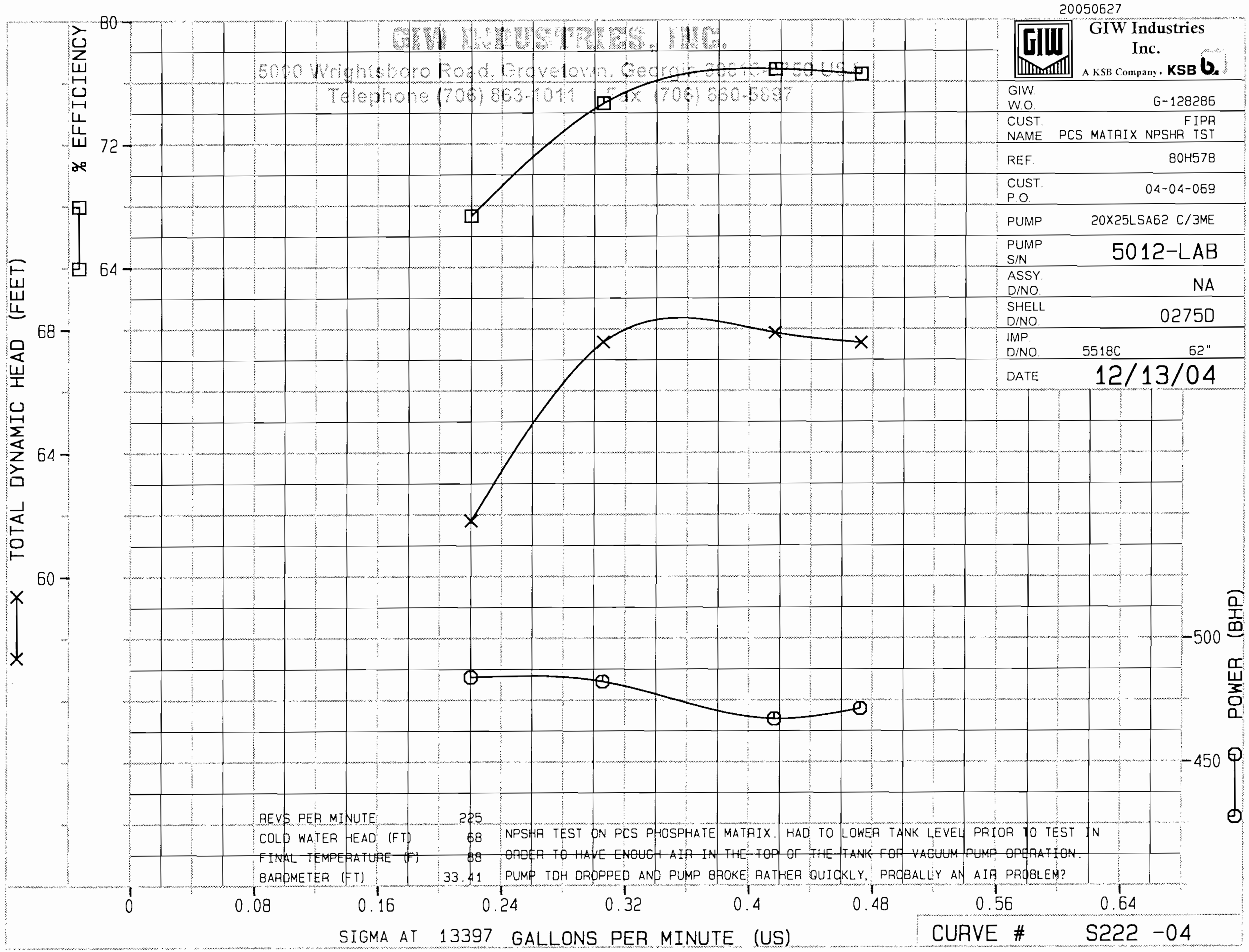
NO	FLOW MEASUREMENT: FLOW GPM	Q VELOCITY FT/S	HEAD MEASUREMENT: DISCH PSI	SUCTN " HG	TOT HD H FT	S.G.	DRIVER POWER: INPUT KW	OUTPUT BHP	SPEED: N RPM	PUMP: OUTPUT WHP	EFF n %	TEMP: Tm F	SCALED PERFORMANCE: FLOW GPM	HEAD FT	POWER BHP	EFF %	TIME: t H.MM	MAG18": C 25 *1.000	BEND12: S 10 *1.000
1	9488.9	10.33	21.12	2.57	28.37	1.62	0.0	148.2	147.8	110.4	74.5	78.1	14441.	65.7	522.4	74.5	12.27	9488.9	9072.6
2	13052.0	14.21	17.88	-0.65	27.13	1.62	0.0	182.3	147.9	144.5	79.3	78.5	19854.	62.8	641.5	79.3	12.30	13052.	12466.
3	13767.0	14.99	19.07	-0.50	28.94	1.62	0.0	204.5	153.5	162.7	79.6	78.9	20183.	62.2	644.4	79.6	12.33	13767.	13024.
4	14482.0	15.77	20.66	2.23	29.42	1.62	0.0	228.6	159.5	174.7	76.4	79.5	20425.	58.5	641.3	76.4	12.36	14482.	13613.
5	15389.9	16.76	22.29	1.50	32.83	1.61	0.0	266.1	167.7	205.6	77.3	79.9	20649.	59.1	642.8	77.3	12.38	15390.	14028.
6	16341.9	17.79	24.58	1.71	36.53	1.60	0.0	310.3	176.9	241.6	77.9	80.5	20790.	59.1	639.0	77.9	12.44	16342.	15628.
7	17322.1	18.86	26.40	1.70	39.59	1.60	0.0	355.0	184.7	277.3	78.1	80.7	21106.	58.8	642.2	78.1	12.46	17322.	16700.
8	18551.2	20.20	28.81	1.26	43.74	1.61	0.0	418.6	195.1	329.5	78.7	81.3	21391.	58.2	641.8	78.7	12.49	18551.	17072.
9	19390.8	21.11	30.54	1.08	46.75	1.61	0.0	465.8	202.0	368.1	79.0	82.0	21600.	58.0	643.9	79.0	12.51	19391.	17073.
10	17394.4	18.94	26.45	1.58	40.14	1.59	0.0	359.0	184.7	279.7	77.9	82.2	21186.	59.5	648.6	77.9	12.56	17394.	16656.
11	13027.9	14.18	20.09	2.32	28.62	1.59	0.0	202.1	154.7	150.0	74.2	82.0	18948.	60.5	621.8	74.2	13.09	13028.	12518.
12	12047.7	13.12	19.09	2.46	26.73	1.60	0.0	177.2	148.4	129.7	73.2	81.6	18264.	61.4	617.2	73.2	13.10	12048.	11696.
13	10798.5	11.76	17.82	2.66	24.39	1.60	0.0	149.5	141.0	106.1	71.0	81.6	17234.	62.1	607.6	71.0	13.13	10798.	10558.
14	8749.8	9.53	16.08	2.94	21.22	1.59	0.0	106.3	128.6	74.7	70.3	81.4	15312.	65.0	569.5	70.3	13.14	8749.8	8487.8
15	7825.9	8.52	15.28	3.21	19.65	1.60	0.0	89.2	122.6	62.0	69.4	81.0	14357.	66.1	550.8	69.4	13.16	7825.9	7670.9

TESTED BY LEE WHITLOCK DATE 12/13/04 COMMENTS: ~60% CW PCS PHOSPHATE MATRIX SLURRY TEST. STUFFING BOX WATER COMPLETELY OFF. SLURRY FLOWING OUT STUFFING BOX. TANK OVERFLOWING. WILL LOWER LEVEL AND INSTALL TOP FOR NPSHR TEST.

WITNESSED BY GRAEME ADDIE FOR FIPR

Version: 20050627

T221 -04 12/13/04


20050627
GIW Industries Inc.
A KSB Company · KSB
GIW. W.O. G-128286
CUST. NAME FIPR PCS MATRIX NPSHR TST
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/13/04
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia
Telephone (706) 863-1011 Fax (706) 860-5897
% EFFICIENCY
80
72
64
TOTAL DYNAMIC HEAD (FEET)
68
64
60
POWER (BHP)
500
450
REVS PER MINUTE 225
COLD WATER HEAD (FT) 68
FINAL TEMPERATURE (F) 88
BAROMETER (FT) 33.41
NPSHR TEST ON PCS PHOSPHATE MATRIX. HAD TO LOWER TANK LEVEL PRIOR TO TEST IN
ORDER TO HAVE ENOUGH AIR IN THE TOP OF THE TANK FOR VACUUM PUMP OPERATION.
PUMP TDH DROPPED AND PUMP BROKE RATHER QUICKLY, PROBALLY AN AIR PROBLEM?
0
0.08
0.16
0.24
0.32
0.4
0.48
0.56
0.64
SIGMA AT 13397 GALLONS PER MINUTE (US)
CURVE # S222 -04

PUMP DETAIL

PUMP 20X25LSA62 C/3ME

SERIAL NUMBER 5012-LAB
ASSEMBLY DRAWING NO NA
SHELL DRAWING NO 0275D
IMPELLER DRAWING NO 5518C
IMPELLER DIAMETER 62"
OUTLET ANGLE
OUTLET WIDTH
ROTATION CLOCKWISE
HYDROSTATIC PRESS. STD

DRIVER DETAIL

TYPE VARIABLE SPEED DRIVE
MAKE GENERAL ELECTRIC
SERIAL NO 5511957
FRAME SIZE 5368480
RPM = 450 BHP = 2450.
4160 VOLTS 3 PHASE 60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO 225.000

IMP TURN DOWN RATIO 1.000
MERIDINAL WIDTH RATIO 1.000
SCALE RATIO 1.000
BEP REF 0.GPM, 0.RPM
EFFICIENCY 0.0% BY 1.000

CH	USE RDG SOURCE	INSTRUMENT
1	NULLSUCTION	#1 YOKOGAWA-30-30 H20-1E2 06011B 0.000
2S	NULLLOSS 20"	#2 YOKOGAWA -4-8' H20-1E2 12040B 0.000
3	AVE S.G.U-SECUP	#3 ROSEMOUNT 4 12'H20 1E2 07093B 0.500
4	AVE S.G.U-SECDN	#4 ROSEMONT4 -4-8'H20-1E2 07134B 0.500
5S	DISCHARGE	#5 ROSEMONT 6 239'H20 1E1 07093B 1.000
6P	DIFHEAD	#6 ROSEMONT 6 236'H20 1E1 07093B 1.000
7.	NULLFLOWORIFICE	#7 ROSEMOUNT 5 60'H20 1E2 07093B 0.000
8.	FLOWBEND	#8 ROSEMOUNT 5 24'H20 1E2 07093B 1.000
9.	LOSS 20	#9 ROSEMOUNT 5 24'H20 1E2 07093B 1.000
10S	FLOWBEND	#10ROSEMOUNT 4 12'H20 1E2 07134B 1.000
11.	FLOWBEND	#11ROSEMOUNT 4 12'H20 1E2 07134B 1.000
12S	LOSS 20"	#12ROSEMOUNT 4 12'H20 1E2 07134B 1.000
13P	LOSS 20"	#13ROSEMONT4 -4-8'H20-1E2 01164E 1.000
14.	NULLDISCHARGE	#14ROSEMOUNT 5 24'H20 1E2 07134B 0.000
15.	NULLFLOWORIFICE	#15ROSEMOUNT 5 60'H20 1E2 01164E 0.000
16S	NULLDISCHARGE	#16ROSEMONT 7 692'H20 1E1 07093B 0.000
17	SUCTION	#17ROSE. 5 -30-30'H20-1E2 07093B 1.000
18P	TEMPTANK	#18 RTD TANK F 1E1 10204D 1.000
19S	TEMPAMBIENT	#19 RTD AMBIENT F 1E1 10204B 1.000
20P	BHP TRQ*RPM	#20 BENSFELD 30K FTLB1E-102122B 1.000
21	RPM TRQ BAR	#21 DAYTRONIC 300 RPM 1E1 02122D 1.000
22S	BHP TRQ BAR	#22 BENSFELD 3000HP 1E1 02122F 1.000
23S	NULLTEMPAMBIENT	#23 RTD7 100OHM F 1E1 04088B 0.000
24P	NULLBHP TRQ*RPM	#24 LEBOW DAY 166 FTLB1E1 12211B 0.000
25P	FLOW18" MAG	#25 18" F&P 32000 GPM 1E-111164B 1.000
26S	NULLBHP TRQ BAR	#26 LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULLFLOW3"MAG	#27 LOAD CELL 100LB 1E2 01101B 0.000
28S	NULLFLOWORIFICE	TECO# 6158 21.80 FPS 1E2 09256C 0.000
29.	NULLFLOW6"MAG	#29 6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULLBHP TRQ*RPM	#30 LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULLRPM TRQ BAR	#31 LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULLBHP TRQ BAR	#32 LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO S222 -04 DATE 12/13/04

PUMP TEST DATA FOR FIPR
------------------ PCS MATRIX NPSHR TST
PROJECT 80H578
GIW WORK ORDER NO G-128286
CUSTOMER ORDER NO 04-04-069

TEST CONSTANTS
1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.50"
G = 32.14 FT/S/S

TEST RESULTS

NO	FLOW MEASUREMENT: FLOW Q GPM	VELOCITY FT/S	HEAD MEASUREMENT: DISCH. PSI	SUCTN " HG	TOT HD H FT	S.G.	DRIVER POWER: INPUT KW	OUTPUT BHP	SPEED: N RPM	PUMP: OUTPUT WHP	EFF n %	TEMP: Tm F	CAVITATION: NPSH FT	SIGMA	SCALED PERFORMANCE: FLOW GPM	HEAD FT	POWER BHP	EFF %	TIME: t H.MM	MAG18": C 25 *1.000
1	13397.5	14.59	44.45	-1.84	67.56	1.58	0.0	471.7	225.1	361.0	76.5	84.9	31.9	0.472	13392.	67.5	471.2	76.5	14.53	13397.
2	13413.5	14.60	41.71	-6.90	67.89	1.56	0.0	467.6	224.0	359.4	76.9	86.8	28.1	0.416	13473.	68.5	473.9	76.9	14.58	13414.
3	13453.7	14.65	36.60	-17.25	67.59	1.57	0.0	482.7	223.6	360.3	74.6	87.9	20.6	0.305	13540.	68.5	492.0	74.6	15.00	13454.
4	13361.3	14.55	28.70	-25.16	61.81	1.56	0.0	484.4	224.5	326.3	67.4	88.4	14.8	0.220	13390.	62.1	487.6	67.4	15.05	13361.

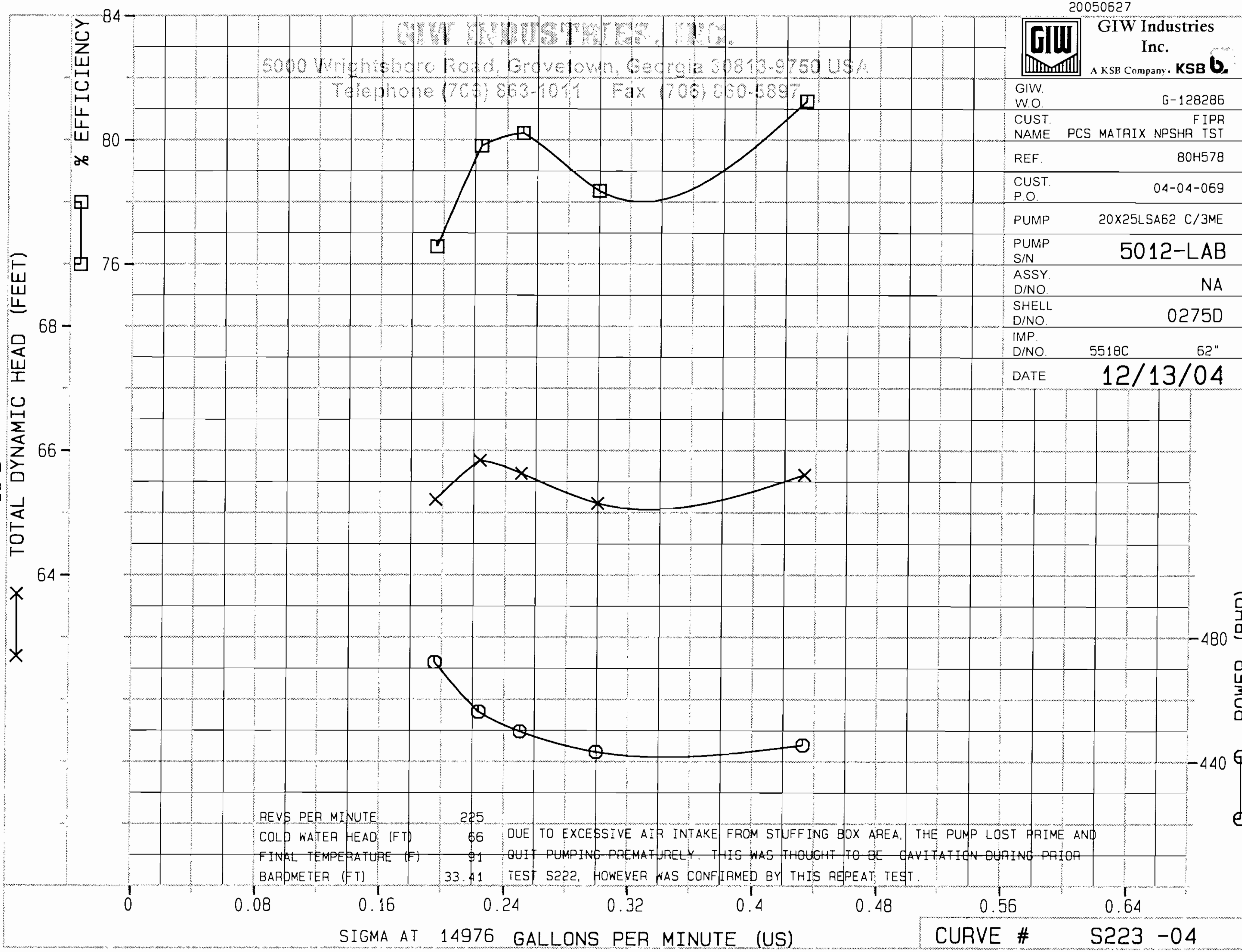
TESTED BY LEE WHITLOCK DATE 12/13/04

WITNESSED BY GRAEME ADDIE FOR FIPR

COMMENTS: NPSHR TEST ON PCS PHOSPHATE MATRIX. HAD TO LOWER TANK LEVEL PRIOR TO TEST IN ORDER TO HAVE ENOUGH AIR IN THE TOP OF THE TANK FOR VACUUM PUMP OPERATION. PUMP TDH DROPPED AND PUMP BROKE RATHER QUICKLY, PROBALLY AN AIR PROBLEM?

Version: 20050627

S222 -04 12/13/04


20050627
GIW Industries Inc.
A KSB Company. KSB
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW W.O. G-128286
CUST. NAME FIPR PCS MATRIX NPSHR TST
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/13/04
% EFFICIENCY
84
80
76
TOTAL DYNAMIC HEAD (FEET)
68
66
64
POWER (BHP)
480
440
REVS PER MINUTE 225
COLD WATER HEAD (FT) 66
FINAL TEMPERATURE (F) 91
BAROMETER (FT) 33.41
DUE TO EXCESSIVE AIR INTAKE FROM STUFFING BOX AREA, THE PUMP LOST PRIME AND QUIT PUMPING PREMATURELY. THIS WAS THOUGHT TO BE CAVITATION DURING PRIOR TEST S222, HOWEVER WAS CONFIRMED BY THIS REPEAT TEST.
0
0.08
0.16
0.24
0.32
0.4
0.48
0.56
0.64
SIGMA AT 14976 GALLONS PER MINUTE (US)
CURVE # S223 -04

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE	RDG	SOURCE	INSTRUMENT
1	NULL	SUCTION	#1	YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2	YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3	ROSEMOUNT 4 12'H2O 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4	ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5S		DISCHARGE	#5	ROSEMONT 6 239'H2O 1E1 07093B 1.000
6P		DIFHEAD	#6	ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7	ROSEMOUNT 5 60'H2O 1E2 07093B 0.000
8.		FLOWBEND	#8	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
9.		LOSS 20	#9	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
10S		FLOWBEND	#10	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
11.		FLOWBEND	#11	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
12S		LOSS 20"	#12	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
13P		LOSS 20"	#13	ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14	ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15.	NULL	FLOWORIFICE	#15	ROSEMOUNT 5 60'H2O 1E2 01164E 0.000
16S	NULL	DISCHARGE	#16	ROSEMONT 7 692'H2O 1E1 07093B 0.000
17		SUCTION	#17	ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P		TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23	RTD7 1000HM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO S223 -04   DATE 12/13/04

PUMP TEST DATA FOR	FIPR
------------------	PCS MATRIX NPSHR TST
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.50"
G = 32.14 FT/S/S

TEST RESULTS

	FLOW MEASUREMENT		HEAD MEASUREMENT			S.G.	DRIVER POWER		SPEED	PUMP		TEMP	CAVITATION		SCALED PERFORMANCE				TIME	MAG18"
	FLOW Q	VELOCITY	DISCH.	SUCTN	TOT HD		INPUT	OUTPUT	N	OUTPUT	EFF	Tm	NPSH	SIGMA	FLOW	HEAD	POWER	EFF	t	C 25
NO	GPM	FT/S	PSI	" HG	H FT		KW	BHP	RPM	WHP	n %	F	FT		GPM	FT	BHP	%	H.MM	*1.000
1	14976.1	16.31	37.10	-6.39	65.62	1.46	0.0	445.5	224.8	362.0	81.3	88.5	28.4	0.432	14990.	65.7	446.7	81.3	17.33	14976.
2	14369.6	15.65	31.76	-17.57	65.16	1.47	0.0	443.3	225.1	347.4	78.4	89.2	19.6	0.299	14364.	65.1	442.7	78.4	17.37	14370.
3	14891.8	16.21	29.69	-21.76	65.64	1.46	0.0	449.8	224.7	360.9	80.2	89.8	16.4	0.250	14915.	65.8	451.9	80.2	17.40	14892.
4	15004.2	16.34	28.63	-23.99	65.85	1.46	0.0	456.1	224.7	364.1	79.8	90.1	14.7	0.223	15023.	66.0	457.8	79.8	17.42	15004.
5	15128.8	16.47	26.87	-26.22	65.22	1.45	0.0	472.1	224.1	361.5	76.6	90.5	12.8	0.195	15191.	65.8	477.9	76.6	17.44	15129.

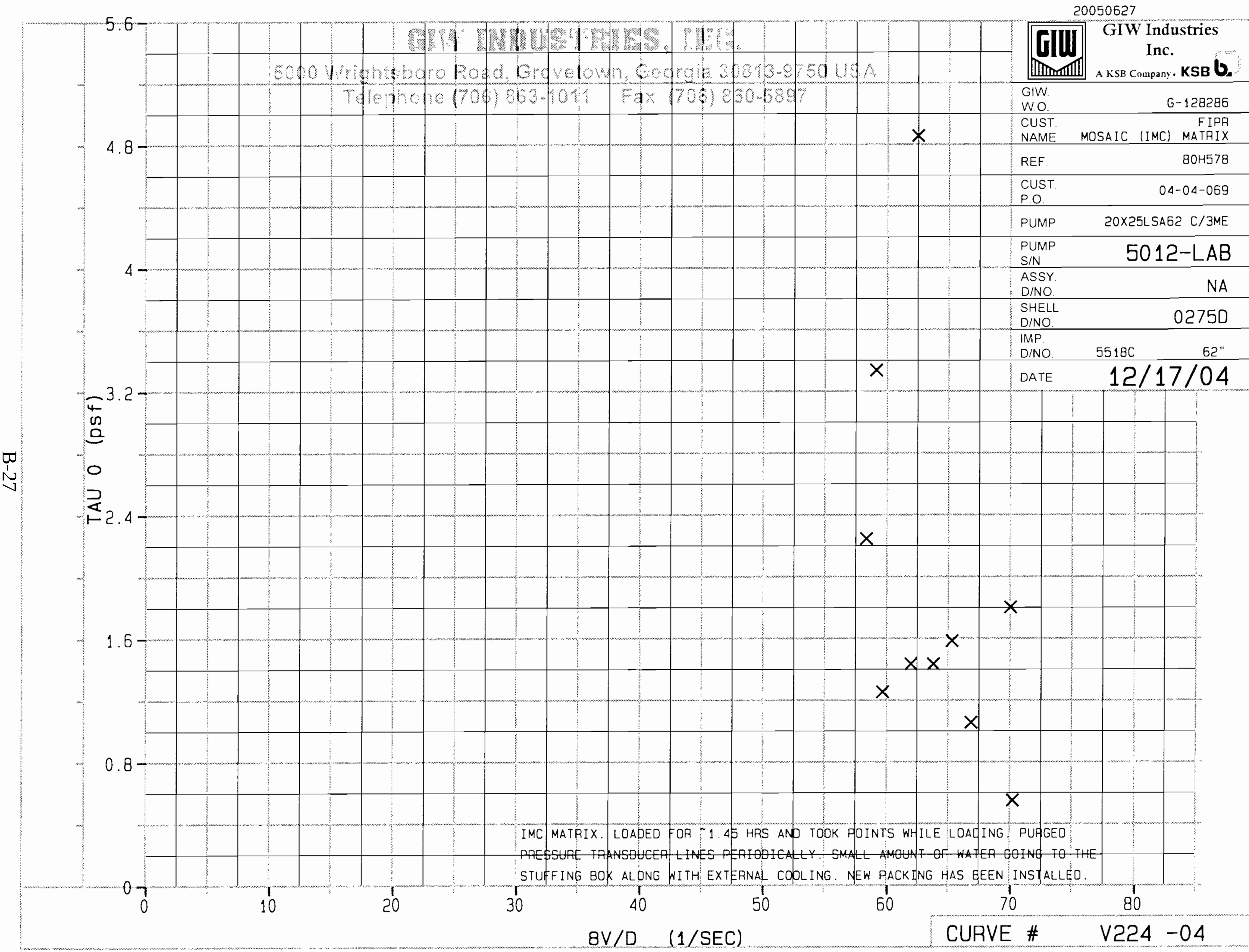
TESTED BY LEE WHITLOCK DATE 12/13/04

COMMENTS: DUE TO EXCESSIVE AIR INTAKE FROM STUFFING BOX AREA, THE PUMP LOST PRIME AND QUIT PUMPING PREMATURELY. THIS WAS THOUGHT TO BE CAVITATION DURING PRIOR TEST S222, HOWEVER WAS CONFIRMED BY THIS REPEAT TEST.

WITNESSED BY GRAEME ADDIE FOR FIPR

Version: 20050627

S223 -04 12/13/04


20050627
GIW Industries Inc.
A KSB Company · KSB
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW W.O. G-128286
CUST. NAME MOSAIC (IMC) FIPR MATRIX
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/17/04
TAU 0 (psf)
5.6
4.8
4
3.2
2.4
1.6
0.8
0
0
10
20
30
40
50
60
70
80
8V/D (1/SEC)
IMC MATRIX. LOADED FOR ~1.45 HRS AND TOOK POINTS WHILE LOADING. PURGED PRESSURE TRANSDUCER LINES PERIODICALLY. SMALL AMOUNT OF WATER GOING TO THE STUFFING BOX ALONG WITH EXTERNAL COOLING. NEW PACKING HAS BEEN INSTALLED.
CURVE # V224 -04

PUMP DETAIL	
PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL	
TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS	
SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE RDG	SOURCE INSTRUMENT	
1	NULLSUCTION	#1 YOKOGAWA-30-30 H2O-1E2 06011B	0.000
2S	NULLLOSS 20"	#2 YOKOGAWA -4-8' H2O-1E2 12040B	0.000
3	AVE S.G.U-SECUP	#3 ROSEMOUNT 4 12'H2O 1E2 07093B	0.500
4	AVE S.G.U-SECDN	#4 ROSEMONT4 -4-8'H2O-1E2 07134B	0.500
5.	DISCHARGE	#5 ROSEMONT 6 239'H2O 1E1 07093B	1.000
6P	DIFHEAD	#6 ROSEMONT 6 236'H2O 1E1 07093B	1.000
7.	NULLFLOWORIFICE	#7 ROSEMOUNT 5 60'H2O 1E2 07093B	0.000
8.	FLOWBEND	#8 ROSEMOUNT 5 24'H2O 1E2 07093B	1.000
9S	LOSS 20	#9 ROSEMOUNT 5 24'H2O 1E2 07093B	1.000
10S	FLOWBEND	#10ROSEMOUNT 4 12'H2O 1E2 07134B	1.000
11.	FLOWBEND	#11ROSEMOUNT 4 12'H2O 1E2 07134B	1.000
12S	NULLLOSS 20"	#12ROSEMOUNT 4 12'H2O 1E2 07134B	0.000
13P	LOSS 20"	#13ROSEMONT4 -4-8'H2O-1E2 01164E	1.000
14.	NULLDISCHARGE	#14ROSEMOUNT 5 24'H2O 1E2 07134B	0.000
15S	DIFHEAD	#15ROSEMOUNT 5 60'H2O 1E2 01164E	1.000
16S	NULLDISCHARGE	#16ROSEMONT 7 692'H2O 1E1 07093B	0.000
17	SUCTION	#17ROSE. 5 -30-30'H2O-1E2 07093B	1.000
18P	TEMPTANK	#18 RTD TANK F 1E1 10204D	1.000
19S	TEMPAMBIENT	#19 RTD AMBIENT F 1E1 10204B	1.000
20P	BHP TRQ*RPM	#20 BENSFELD 30K FTLB1E-102122B	1.000
21	RPM TRQ BAR	#21 DAYTRONIC 300 RPM 1E1 02122D	1.000
22S	BHP TRQ BAR	#22 BENSFELD 3000HP 1E1 02122F	1.000
23S	NULLTEMPAMBIENT	#23 RTD7 100OHM F 1E1 04088B	0.000
24P	NULLBHP TRQ*RPM	#24 LEBOW DAY 166 FTLB1E1 12211B	0.000
25P	FLOW18" MAG	#25 18" F&P 32000 GPM 1E-111164B	1.000
26S	NULLBHP TRQ BAR	#26 LEBOW, DAY 75HP 1E2 12211D	0.000
27P	NULLFLOW3"MAG	#27 LOAD CELL 100LB 1E2 01101B	0.000
28S	NULLFLOWORIFICE	TECO# 6158 21.80 FPS 1E2 09256C	0.000
29.	NULLFLOW6"MAG	#29 6" YOKO 2800 GPM 1E1 12281A	0.000
30P	NULLBHP TRQ*RPM	#30 LEBOW,DAY 833 FTLB1E1 05098C	0.000
31	NULLRPM TRQ BAR	#31 LEBOW,DAY1500 RPM 1E0 05024C	0.000
32S	NULLBHP TRQ BAR	#32 LEBOW,DAY 300 HP 1E1 07287C	0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO V224 -04 DATE 12/17/04

PUMP TEST DATA FOR	FIPR
	MOSAIC (IMC) MATRIX
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS
1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.95"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 245.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

NO	VELOCITY Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME CONC. Cv %	WEIGHT CONC. Cw %	MASS Ms TON/HR	PIPELINE LOSSES Im FT/FT	Iw FT/FT	dp/dx psf	Tau 0 psf	8V/D 1/SEC	Tau 0 ln psf	8V/D ln 1/SEC	TIME t HH.MM
1	14.16	13003.8	64.6	0.999	0.999	0.0	-0.1	-2.5	0.0220	0.0207	1.3728	0.5540	70.169	-.5906	4.2509	9.13
2	13.48	12381.2	64.7	0.999	1.137	8.3	19.4	683.2	0.0420	0.0189	2.6234	1.0586	66.809	0.0570	4.2018	9.27
3	12.86	11814.8	64.9	0.999	1.230	14.0	30.1	1095.3	0.0571	0.0173	3.5623	1.4376	63.753	0.3629	4.1550	9.38
4	12.49	11473.3	65.2	0.999	1.322	19.5	39.2	1486.7	0.0571	0.0164	3.5623	1.4376	61.910	0.3629	4.1257	9.51
5	12.03	11047.5	65.9	0.999	1.399	24.2	45.9	1775.8	0.0499	0.0152	3.1153	1.2572	59.613	0.2289	4.0879	10.07
6	13.17	12091.9	66.4	0.999	1.451	27.4	50.0	2193.5	0.0630	0.0180	3.9322	1.5868	65.248	0.4617	4.1782	10.18
7	14.12	12967.6	66.6	0.999	1.468	28.4	51.3	2442.3	0.0717	0.0205	4.4726	1.8049	69.974	0.5905	4.2481	10.22
8	11.76	10802.5	67.0	0.999	1.503	30.5	53.8	2186.4	0.0893	0.0146	5.5728	2.2488	58.290	0.8104	4.0654	10.33
9	11.91	10943.1	67.9	0.999	1.552	33.5	57.2	2431.7	0.1326	0.0149	8.2762	3.3398	59.049	1.2059	4.0784	10.46
10	12.60	11569.7	68.8	0.999	1.889	53.9	75.6	4134.8	0.1930	0.0165	12.041	4.8591	62.431	1.5809	4.1341	11.05

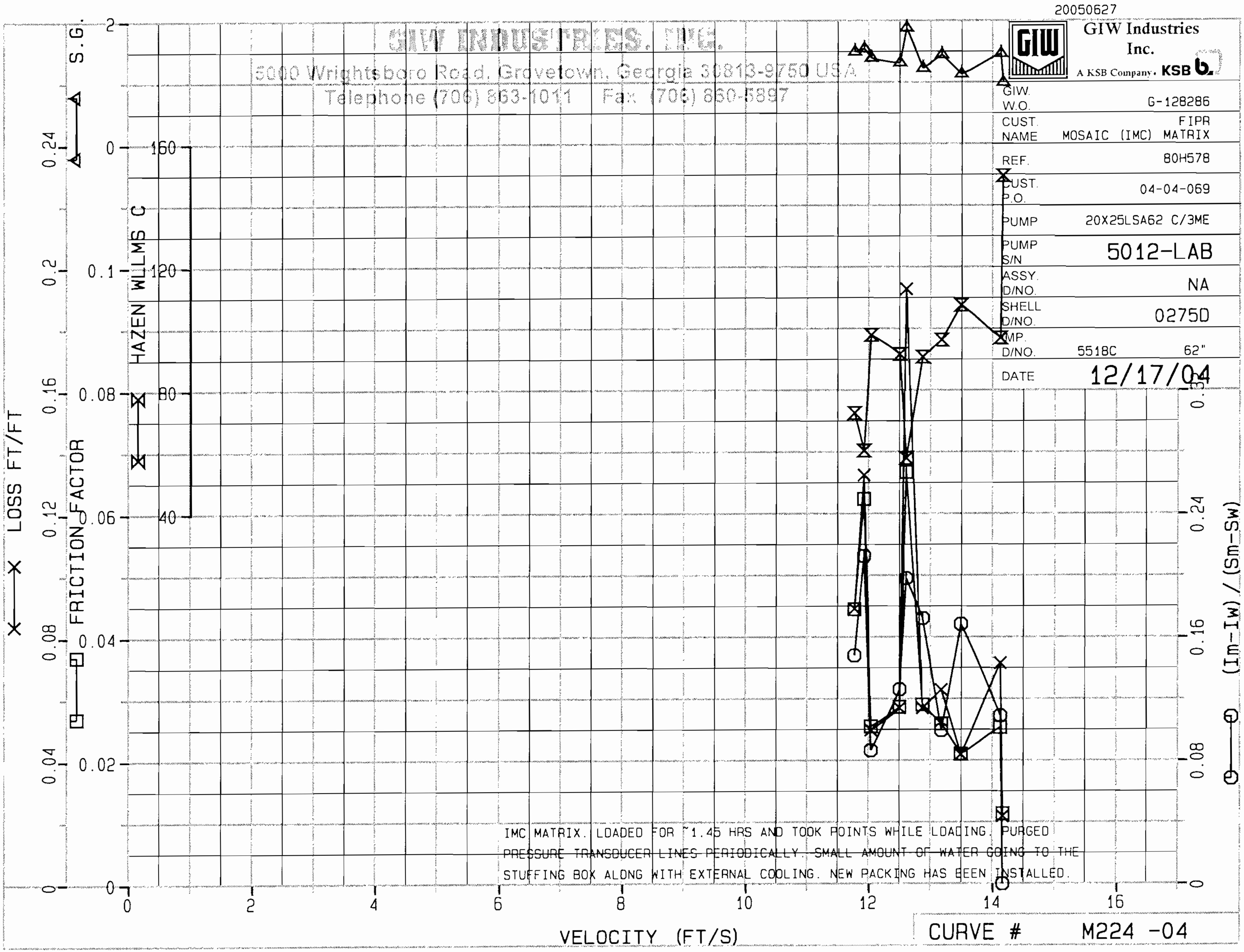
TESTED BY LEE WHITLOCK DATE 12/17/04

WITNESSED BY GRAEME ADDIE FOR FIPR

COMMENTS: IMC MATRIX. LOADED FOR ~1.45 HRS AND TOOK POINTS WHILE LOADING. PURGED PRESSURE TRANSDUCER LINES PERIODICALLY. SMALL AMOUNT OF WATER GOING TO THE STUFFING BOX ALONG WITH EXTERNAL COOLING. NEW PACKING HAS BEEN INSTALLED.

Version: 20050627

V224 -04 12/17/04


20050627
GIW Industries Inc.
A KSB Company. KSB
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW W.O. G-128286
CUST. NAME FIPR MOSAIC (IMC) MATRIX
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/17/04
S.G.
LOSS FT/FT
FRICTION FACTOR
HAZEN WLLMS C
(Im-Iw) / (Sm-Sw)
IMC MATRIX. LOADED FOR ~1.45 HRS AND TOOK POINTS WHILE LOADING. PURGED
PRESSURE TRANSDUCER LINES PERIODICALLY. SMALL AMOUNT OF WATER GOING TO THE
STUFFING BOX ALONG WITH EXTERNAL COOLING. NEW PACKING HAS BEEN INSTALLED.
VELOCITY (FT/S)
CURVE # M224 -04

UMP DETAIL

UMP	20X25LSA62 C/3ME
ERIAL NUMBER	5012-LAB
SSEMBLY DRAWING NO	NA
HELL DRAWING NO	0275D
MPELLER DRAWING NO	5518C
MPELLER DIAMETER	62"
UTLET ANGLE	
UTLET WIDTH	
OTATION	CLOCKWISE
YDROSTATIC PRESS.	STD

RIVER DETAIL

YPE	VARIABLE SPEED DRIVE
AKE	GENERAL ELECTRIC
ERIAL NO	5511957
RAME SIZE	5368480
PM = 450	BHP = 2450.
160 VOLTS 3 PHASE	60 CPS

CALED PERFORMANCE FACTORS

PEED OR RATIO	225.000
MP TURN DOWN RATIO	1.000
ERIDINAL WIDTH RATIO	1.000
CALE RATIO	1.000
EP REF 0.GPM,	0.RPM
FFICIENCY 0.0%	BY 1.000

CH	USE RDG	SOURCE INSTRUMENT
1	NULLSUCTION	#1 YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULLLOSS 20"	#2 YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE S.G.U-SECUP	#3 ROSEMOUNT 4 12'H2O 1E2 07093B 0.500
4	AVE S.G.U-SECDN	#4 ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5.	DISCHARGE	#5 ROSEMONT 6 239'H2O 1E1 07093B 1.000
6P	DIFHEAD	#6 ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.	NULLFLOWORIFICE	#7 ROSEMOUNT 5 60'H2O 1E2 07093B 0.000
8.	FLOWBEND	#8 ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
9S	LOSS 20	#9 ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
10S	FLOWBEND	#10ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
11.	FLOWBEND	#11ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
12S	NULLLOSS 20"	#12ROSEMOUNT 4 12'H2O 1E2 07134B 0.000
13P	LOSS 20"	#13ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULLDISCHARGE	#14ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15S	DIFHEAD	#15ROSEMOUNT 5 60'H2O 1E2 01164E 1.000
16S	NULLDISCHARGE	#16ROSEMONT 7 692'H2O 1E1 07093B 0.000
17	SUCTION	#17ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P	TEMPTANK	#18 RTD TANK F 1E1 10204D 1.000
19S	TEMPAMBIENT	#19 RTD AMBIENT F 1E1 10204B 1.000
20P	BHP TRQ*RPM	#20 BENSFELD 30K FTLB1E-102122B 1.000
21	RPM TRQ BAR	#21 DAYTRONIC 300 RPM 1E1 02122D 1.000
22S	BHP TRQ BAR	#22 BENSFELD 3000HP 1E1 02122F 1.000
23S	NULLTEMPAMBIENT	#23 RTD7 100OHM F 1E1 04088B 0.000
24P	NULLBHP TRQ*RPM	#24 LEBOW DAY 166 FTLB1E1 12211B 0.000
25P	FLOW18" MAG	#25 18" F&P 32000 GPM 1E-111164B 1.000
26S	NULLBHP TRQ BAR	#26 LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULLFLOW3"MAG	#27 LOAD CELL 100LB 1E2 01101B 0.000
28S	NULLFLOWORIFICE	TECO# 6158 21.80 FPS 1E2 09256C 0.000
29.	NULLFLOW6"MAG	#29 6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULLBHP TRQ*RPM	#30 LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULLRPM TRQ BAR	#31 LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULLBHP TRQ BAR	#32 LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO M224 -04 DATE 12/17/04

PUMP TEST DATA FOR	FIPR
	MOSAIC (IMC) MATRIX
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.95"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 245.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

EST RESULTS

O	VELOCITY Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME CONC. Cv %	WEIGHT CONC. Cw %	MASS Ms TON/HR	REYNOLDS NUMBER Re	PIPELINE LOSSES Im FT/FT	Iw FT/FT	FRICTION FACTRS Fm	Fw SAME Re	HAZEN WLLMS C	Im-Iw ----- Sm-Sw	TIME t HH.MM
1	14.16	13003.8	64.6	0.999	0.999	0.0	-0.1	-2.5	0.201E+07	0.0220	0.0207	0.0114	0.0107	150.	0.0000	9.13
2	13.48	12381.2	64.7	0.999	1.137	8.3	19.4	683.2	0.191E+07	0.0420	0.0189	0.0211	0.0108	108.	0.1686	9.27
3	12.86	11814.8	64.9	0.999	1.230	14.0	30.1	1095.3	0.183E+07	0.0571	0.0173	0.0291	0.0109	91.	0.1724	9.38
4	12.49	11473.3	65.2	0.999	1.322	19.5	39.2	1486.7	0.178E+07	0.0571	0.0164	0.0287	0.0109	92.	0.1263	9.51
5	12.03	11047.5	65.9	0.999	1.399	24.2	45.9	1775.8	0.174E+07	0.0499	0.0152	0.0256	0.0109	98.	0.0867	10.07
6	13.17	12091.9	66.4	0.999	1.451	27.4	50.0	2193.5	0.191E+07	0.0630	0.0180	0.0260	0.0108	96.	0.0997	10.18
7	14.12	12967.6	66.6	0.999	1.468	28.4	51.3	2442.3	0.206E+07	0.0717	0.0205	0.0254	0.0107	97.	0.1092	10.22
8	11.76	10802.5	67.0	0.999	1.503	30.5	53.8	2186.4	0.173E+07	0.0893	0.0146	0.0446	0.0109	73.	0.1483	10.33
9	11.91	10943.1	67.9	0.999	1.552	33.5	57.2	2431.7	0.177E+07	0.1326	0.0149	0.0625	0.0109	61.	0.2128	10.46
10	12.60	11569.7	68.8	0.999	1.889	53.9	75.6	4134.8	0.190E+07	0.1930	0.0165	0.0668	0.0108	58.	0.1983	11.05

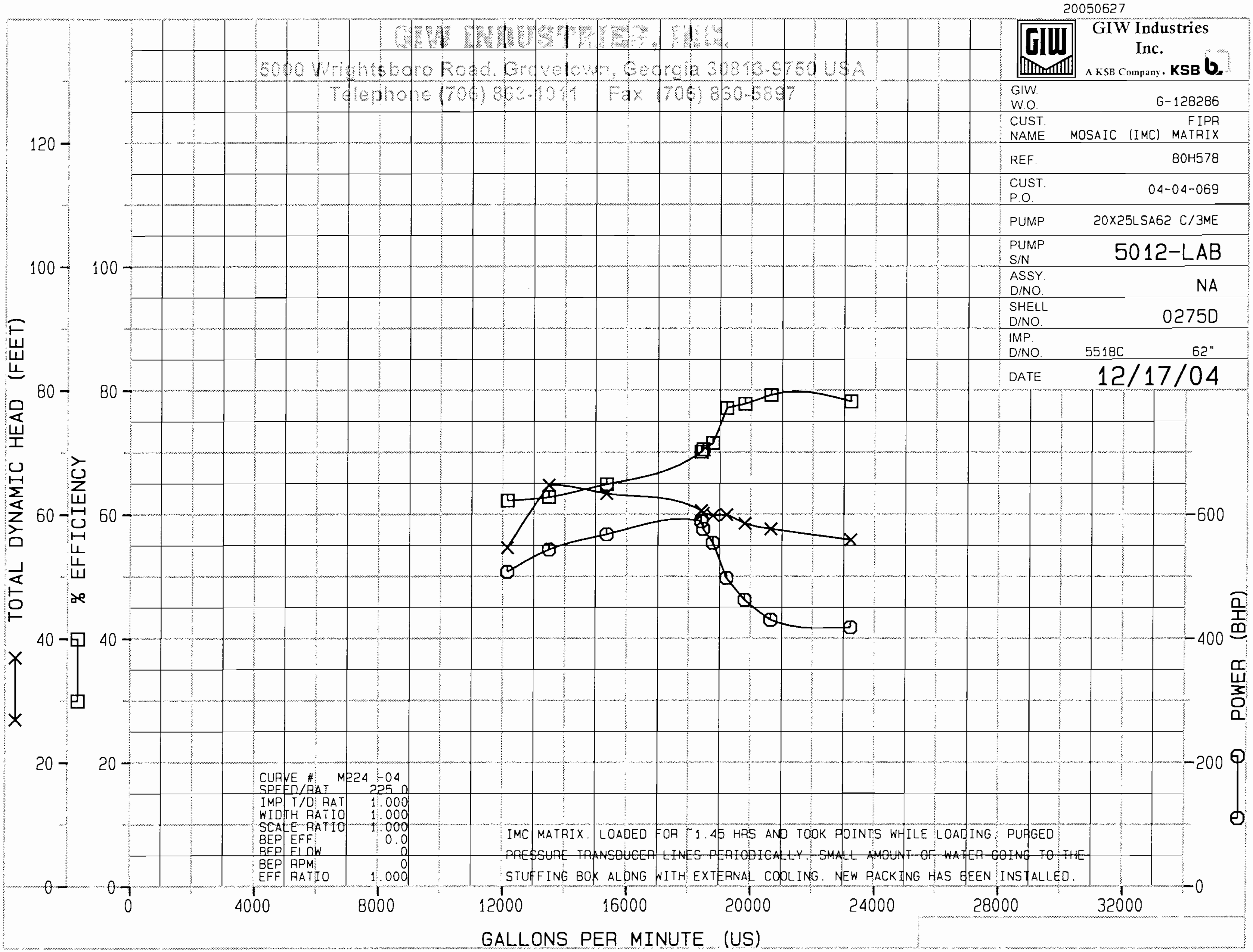
TESTED BY LEE WHITLOCK DATE 12/17/04

ITNESSED BY GRAEME ADDIE FOR FIPR

COMMENTS: IMC MATRIX. LOADED FOR ~1.45 HRS AND TOOK POINTS WHILE LOADING. PURGED PRESSURE TRANSDUCER LINES PERIODICALLY. SMALL AMOUNT OF WATER GOING TO THE STUFFING BOX ALONG WITH EXTERNAL COOLING. NEW PACKING HAS BEEN INSTALLED.

ersion: 20050627

M224 -04 12/17/04


20050627
GIW Industries Inc.
A KSB Company. KSB
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW W.O. G-128286
CUST. NAME FIPR MOSAIC (IMC) MATRIX
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/17/04
TOTAL DYNAMIC HEAD (FEET)
% EFFICIENCY
POWER (BHP)
GALLONS PER MINUTE (US)
CURVE # M224 -04
SPEED/RAT 225.0
IMP T/D RAT 1.000
WIDTH RATIO 1.000
SCALE RATIO 1.000
BEP EFF 0.0
BEP FLOW 0
BEP RPM 0
EFF RATIO 1.000
IMC MATRIX. LOADED FOR ~1.45 HRS AND TOOK POINTS WHILE LOADING. PURGED PRESSURE TRANSDUCER LINES PERIODICALLY. SMALL AMOUNT OF WATER GOING TO THE STUFFING BOX ALONG WITH EXTERNAL COOLING. NEW PACKING HAS BEEN INSTALLED.

PUMP DETAIL	
PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL	
TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS	
SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE	RDG	SOURCE INSTRUMENT
1	NULL	SUCTION	#1 YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2 YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3 ROSEMOUNT 4 12'H2O 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4 ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5.		DISCHARGE	#5 ROSEMONT 6 239'H2O 1E1 07093B 1.000
6P		DIFHEAD	#6 ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7 ROSEMOUNT 5 60'H2O 1E2 07093B 0.000
8.		FLOWBEND	#8 ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
9S		LOSS 20	#9 ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
10S		FLOWBEND	#10ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
11.		FLOWBEND	#11ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
12S	NULL	LOSS 20"	#12ROSEMOUNT 4 12'H2O 1E2 07134B 0.000
13P		LOSS 20"	#13ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15S		DIFHEAD	#15ROSEMOUNT 5 60'H2O 1E2 01164E 1.000
16S	NULL	DISCHARGE	#16ROSEMONT 7 692'H2O 1E1 07093B 0.000
17		SUCTION	#17ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P		TEMPTANK	#18 RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19 RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20 BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21 DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22 BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23 RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24 LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25 18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26 LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27 LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO# 6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29 6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30 LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31 LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32 LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO T224 -04 DATE 12/17/04

PUMP TEST DATA FOR	FIPR
	MOSAIC (IMC) MATRIX
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.95"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 245.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

	FLOW MEASUREMENT		HEAD MEASUREMENT			S.G.	DRIVER POWER		SPEED	PUMP		TEMP	SCALED PERFORMANCE				TIME	MAG18"	BEND12
	FLOW Q	VELOCITY	DISCH	SUCTN	TOT HD		INPUT	OUTPUT	N	OUTPUT	EFF	Tm	FLOW	HEAD	POWER	EFF	t	C 25	S 10
NO	GPM	FT/S	PSI	" HG	H FT		KW	BHP	RPM	WHP	n %	F	GPM	FT	BHP	%	H.MM	*1.000	*1.000
1	13003.8	14.16	2.62	-8.36	17.58	.999	0.0	73.7	126.1	57.7	78.2	64.6	23200.	55.9	418.5	78.2	9.13	13004.	12714.
2	12381.2	13.48	6.46	-6.16	20.82	1.14	0.0	93.3	135.1	74.0	79.3	64.7	20614.	57.7	430.5	79.3	9.27	12381.	11490.
3	11814.8	12.86	7.99	-5.06	20.89	1.23	0.0	98.5	134.3	76.7	77.9	64.9	19788.	58.6	462.6	77.9	9.38	11815.	10921.
4	11473.3	12.49	10.30	-2.85	21.43	1.32	0.0	106.3	134.5	82.1	77.2	65.2	19195.	60.0	497.9	77.2	9.51	11473.	10769.
5	11047.5	12.03	11.21	-1.86	20.77	1.40	0.0	113.4	132.5	81.1	71.5	65.9	18754.	59.9	554.6	71.5	10.07	11048.	8699.9
6	12091.9	13.17	15.32	-0.68	25.91	1.45	0.0	162.7	147.6	114.8	70.5	66.4	18439.	60.2	577.0	70.5	10.18	12092.	10912.
7	12967.6	14.12	18.38	-0.03	30.19	1.47	0.0	207.0	158.7	145.2	70.1	66.6	18380.	60.7	589.3	70.1	10.22	12968.	11463.
8	10802.5	11.76	18.07	-4.17	31.48	1.50	0.0	198.8	158.5	129.1	64.9	67.0	15332.	63.4	568.5	64.9	10.33	10802.	9692.9
9	10943.1	11.91	26.54	-3.82	42.83	1.55	0.0	292.3	182.9	183.7	62.8	67.9	13460.	64.8	544.0	62.8	10.46	10943.	10217.
10	11569.7	12.60	38.69	-3.37	49.77	1.89	0.0	440.9	214.6	274.6	62.3	68.8	12129.	54.7	508.1	62.3	11.05	11570.	15753.

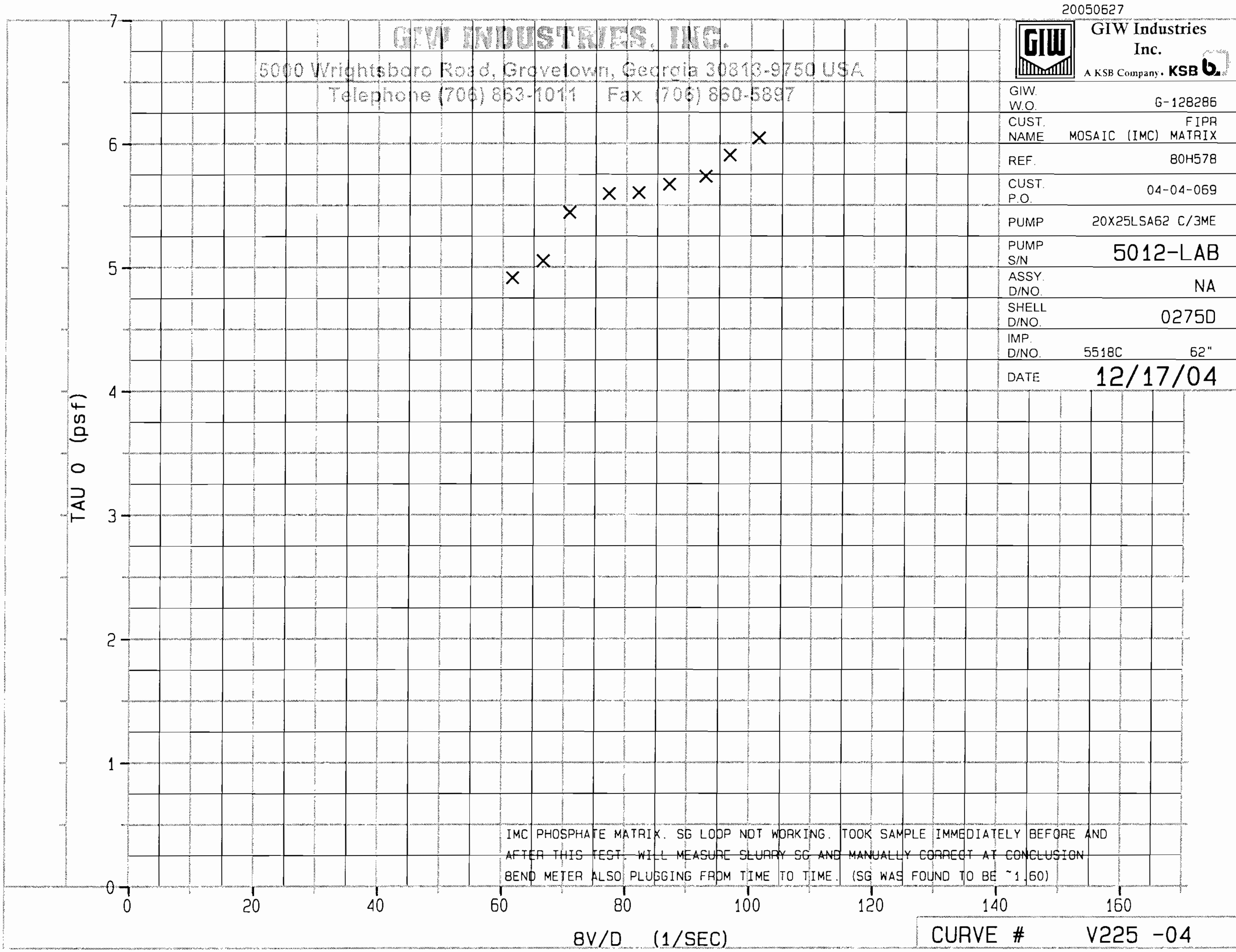
TESTED BY LEE WHITLOCK DATE 12/17/04

COMMENTS: IMC MATRIX. LOADED FOR ~1.45 HRS AND TOOK POINTS WHILE LOADING. PURGED PRESSURE TRANSDUCER LINES PERIODICALLY. SMALL AMOUNT OF WATER GOING TO THE STUFFING BOX ALONG WITH EXTERNAL COOLING. NEW PACKING HAS BEEN INSTALLED.

WITNESSED BY GRAEME ADDIE FOR FIPR

Version: 20050627

T224 -04 12/17/04


20050627
GIW Industries Inc.
A KSB Company. KSB
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW. W.O. G-128286
CUST. NAME FIPR MOSAIC (IMC) MATRIX
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/17/04
TAU 0 (psf)
8V/D (1/SEC)
0
1
2
3
4
5
6
7
0
20
40
60
80
100
120
140
160
IMC PHOSPHATE MATRIX. SG LOOP NOT WORKING. TOOK SAMPLE IMMEDIATELY BEFORE AND
AFTER THIS TEST. WILL MEASURE SLURRY SG AND MANUALLY CORRECT AT CONCLUSION
BEND METER ALSO PLUGGING FROM TIME TO TIME. (SG WAS FOUND TO BE ~1.60)
CURVE # V225 -04

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480

RPM = 450 BHP = 2450.
4160 VOLTS 3 PHASE 60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF	0.GPM, 0.RPM
EFFICIENCY	0.0% BY 1.000

CH	USE	RDG	SOURCE	INSTRUMENT
1	NULL	SUCTION	#1	YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2	YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3	ROSEMOUNT 4 12'H2O 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4	ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5.		DISCHARGE	#5	ROSEMONT 6 239'H2O 1E1 07093B 1.000
6P		DIFHEAD	#6	ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7	ROSEMOUNT 5 60'H2O 1E2 07093B 0.000
8.		FLOWBEND	#8	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
9P		LOSS 20	#9	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
10S		FLOWBEND	#10	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
11.		FLOWBEND	#11	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
12S	NULL	LOSS 20"	#12	ROSEMOUNT 4 12'H2O 1E2 07134B 0.000
13S		LOSS 20"	#13	ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14	ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15S		DIFHEAD	#15	ROSEMOUNT 5 60'H2O 1E2 01164E 1.000
16S	NULL	DISCHARGE	#16	ROSEMONT 7 692'H2O 1E1 07093B 0.000
17		SUCTION	#17	ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P		TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23	RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO V225 -04 DATE 12/17/04

PUMP TEST DATA FOR	FIPR
	MOSAIC (IMC) MATRIX
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

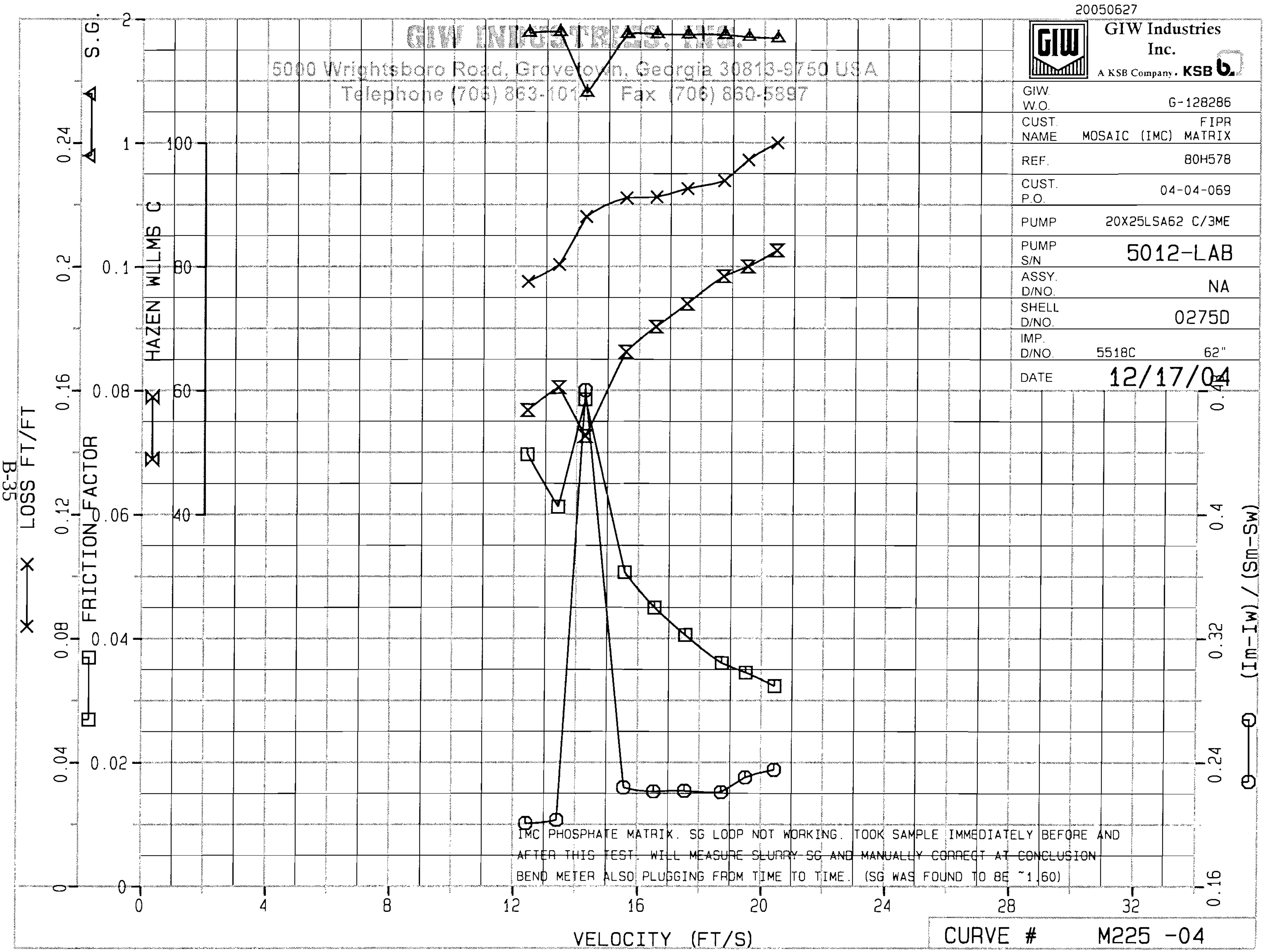
1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.95"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 245.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

NO	VELOCITY Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME CONC. Cv %	WEIGHT CONC. Cw %	MASS Ms TON/HR	PIPELINE LOSSES Im FT/FT	PIPELINE LOSSES Iw FT/FT	dp/dx psf	Tau 0 psf	8V/D 1/SEC	Tau 0 ln psf	8V/D ln 1/SEC	TIME t HH.MM
1	12.40	11384.9	69.4	0.999	1.891	54.0	75.7	4078.2	0.1953	0.0160	12.186	4.9176	61.433	1.5928	4.1180	11.09
2	13.38	12292.8	69.8	0.999	1.897	54.4	76.0	4432.6	0.2008	0.0184	12.528	5.0555	66.332	1.6205	4.1947	11.11
3	14.25	13088.1	72.6	0.999	1.406	24.7	46.5	2140.8	0.2163	0.0206	13.497	5.4464	70.624	1.6950	4.2574	11.47
4	15.54	14273.2	72.7	0.999	1.882	53.5	75.3	5066.1	0.2223	0.0242	13.873	5.5984	77.018	1.7225	4.3440	11.50
5	16.51	15164.9	73.0	0.999	1.881	53.4	75.3	5373.1	0.2226	0.0271	13.893	5.6062	81.830	1.7239	4.4046	11.52
6	17.51	16080.8	73.3	0.999	1.877	53.2	75.1	5674.4	0.2253	0.0302	14.061	5.6744	86.772	1.7360	4.4633	11.54
7	18.69	17165.4	74.5	0.998	1.875	53.0	75.0	6038.9	0.2278	0.0341	14.217	5.7372	92.625	1.7470	4.5286	11.57
8	19.47	17884.4	79.1	0.998	1.857	52.0	74.2	6164.3	0.2346	0.0365	14.639	5.9075	96.505	1.7762	4.5696	11.59
9	20.40	18740.0	80.0	0.998	1.848	51.5	73.8	6395.1	0.2401	0.0398	14.983	6.0464	101.12	1.7995	4.6163	12.01

TESTED BY LEE WHITLOCK DATE 12/17/04 COMMENTS: IMC PHOSPHATE MATRIX. SG LOOP NOT WORKING. TOOK SAMPLE IMMEDIATELY BEFORE AND AFTER THIS TEST. WILL MEASURE SLURRY SG AND MANUALLY CORRECT AT CONCLUSION.
WITNESSED BY GRAEME ADDIE FOR FIPR BEND METER ALSO PLUGGING FROM TIME TO TIME. (SG WAS FOUND TO BE ~1.60)

Version: 20050627 V225 -04 12/17/04


20050627
GIW Industries Inc.
A KSB Company. KSB
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW W.O. G-128286
CUST. NAME MOSAIC (IMC) FIPR MATRIX
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/17/04
S.G.
HAZEN WLLMS C
FRICTION FACTOR
LOSS FT/FT
(Im-Iw)/(Sm-Sw)
VELOCITY (FT/S)
IMC PHOSPHATE MATRIX. SG LOOP NOT WORKING. TOOK SAMPLE IMMEDIATELY BEFORE AND
AFTER THIS TEST. WILL MEASURE SLURRY SG AND MANUALLY CORRECT AT CONCLUSION
BEND METER ALSO PLUGGING FROM TIME TO TIME. (SG WAS FOUND TO BE ~1.60)
CURVE # M225 -04

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE	RDG	SOURCE	INSTRUMENT
1	NULL	SUCTION	#1	YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2	YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3	ROSEMOUNT 4 12'H2O 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4	ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5.		DISCHARGE	#5	ROSEMONT 6 239'H2O 1E1 07093B 1.000
6P		DIFHEAD	#6	ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7	ROSEMOUNT 5 60'H2O 1E2 07093B 0.000
8.		FLOWBEND	#8	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
9P		LOSS 20	#9	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
10S		FLOWBEND	#10	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
11.		FLOWBEND	#11	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
12S	NULL	LOSS 20"	#12	ROSEMOUNT 4 12'H2O 1E2 07134B 0.000
13S		LOSS 20"	#13	ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14	ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15S		DIFHEAD	#15	ROSEMOUNT 5 60'H2O 1E2 01164E 1.000
16S	NULL	DISCHARGE	#16	ROSEMONT 7 692'H2O 1E1 07093B 0.000
17		SUCTION	#17	ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P		TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23	RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO M225 -04 DATE 12/17/04

PUMP TEST DATA FOR	FIPR
	MOSAIC (IMC) MATRIX
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.95"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 245.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

NO	VELOCITY Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME CONC. Cv %	WEIGHT CONC. Cw %	MASS Ms TON/HR	REYNOLDS NUMBER Re	PIPELINE LOSSES Im FT/FT	PIPELINE LOSSES Iw FT/FT	FRICTION FACTRS Fm	FRICTION FACTRS Fw SAME Re	HAZEN WLLMS C	Im-Iw ----- Sm-Sw	TIME t HH.MM
1	12.40	11384.9	69.4	0.999	1.891	54.0	75.7	4078.2	0.188E+07	0.1953	0.0160	0.0697	0.0108	57.	0.2011	11.09
2	13.38	12292.8	69.8	0.999	1.897	54.4	76.0	4432.6	0.204E+07	0.2008	0.0184	0.0613	0.0107	61.	0.2031	11.11
3	14.25	13088.1	72.6	0.999	1.406	24.7	46.5	2140.8	0.226E+07	0.2163	0.0206	0.0786	0.0105	53.	0.4804	11.47
4	15.54	14273.2	72.7	0.999	1.882	53.5	75.3	5066.1	0.247E+07	0.2223	0.0242	0.0507	0.0104	66.	0.2241	11.50
5	16.51	15164.9	73.0	0.999	1.881	53.4	75.3	5373.1	0.264E+07	0.2226	0.0271	0.0451	0.0103	70.	0.2216	11.52
6	17.51	16080.8	73.3	0.999	1.877	53.2	75.1	5674.4	0.281E+07	0.2253	0.0302	0.0406	0.0103	74.	0.2220	11.54
7	18.69	17165.4	74.5	0.998	1.875	53.0	75.0	6038.9	0.305E+07	0.2278	0.0341	0.0361	0.0101	79.	0.2211	11.57
8	19.47	17884.4	79.1	0.998	1.857	52.0	74.2	6164.3	0.337E+07	0.2346	0.0365	0.0346	0.0100	80.	0.2306	11.59
9	20.40	18740.0	80.0	0.998	1.848	51.5	73.8	6395.1	0.358E+07	0.2401	0.0398	0.0324	0.0100	83.	0.2355	12.01

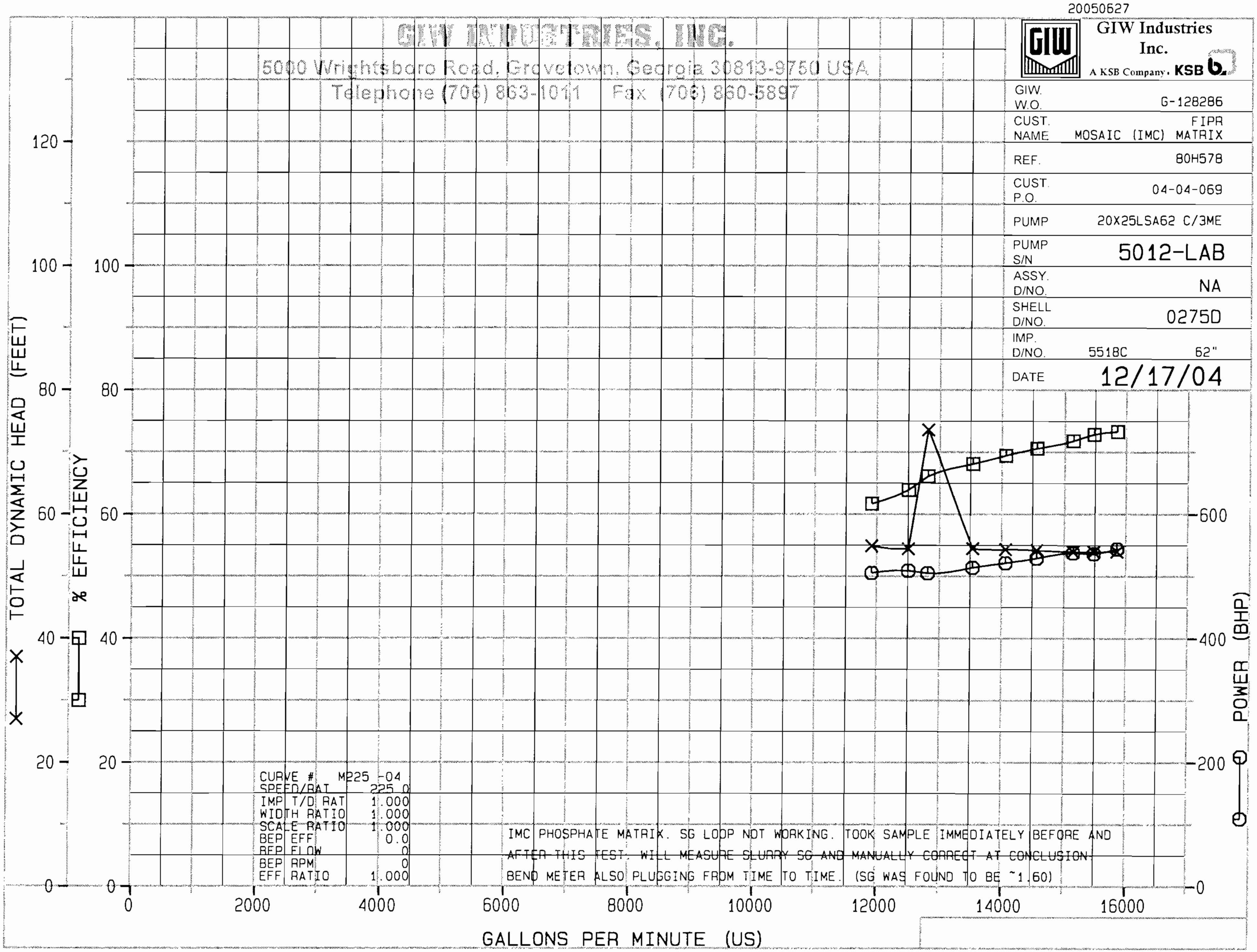
TESTED BY LEE WHITLOCK DATE 12/17/04

WITNESSED BY GRAEME ADDIE FOR FIPR

COMMENTS: IMC PHOSPHATE MATRIX. SG LOOP NOT WORKING. TOOK SAMPLE IMMEDIATELY BEFORE AND AFTER THIS TEST. WILL MEASURE SLURRY SG AND MANUALLY CORRECT AT CONCLUSION. BEND METER ALSO PLUGGING FROM TIME TO TIME. (SG WAS FOUND TO BE ~1.60)

Version: 20050627

M225 -04 12/17/04


20050627
GIW Industries Inc.
A KSB Company. KSB
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW. W.O. G-128286
CUST. NAME MOSAIC (IMC) FIPR MATRIX
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/17/04
TOTAL DYNAMIC HEAD (FEET)
% EFFICIENCY
POWER (BHP)
GALLONS PER MINUTE (US)
CURVE # M225 -04
SPEED/RAT 225.0
IMP T/D RAT 1.000
WIDTH RATIO 1.000
SCALE RATIO 1.000
BEP EFF 0.0
BEP FLOW 0
BEP RPM 0
EFF RATIO 1.000
IMC PHOSPHATE MATRIX. SG LOOP NOT WORKING. TOOK SAMPLE IMMEDIATELY BEFORE AND
AFTER THIS TEST. WILL MEASURE SLURRY SG AND MANUALLY CORRECT AT CONCLUSION.
BEND METER ALSO PLUGGING FROM TIME TO TIME. (SG WAS FOUND TO BE ~1.60)

PUMP DETAIL	
PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL	
TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS	
SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF	0.GPM, 0.RPM
EFFICIENCY	0.0% BY 1.000

CH	USE RDG	SOURCE INSTRUMENT	
1	NULLSUCTION	#1 YOKOGAWA-30-30 H2O-1E2 06011B	0.000
2S	NULLLOSS 20"	#2 YOKOGAWA -4-8' H2O-1E2 12040B	0.000
3	AVE S.G.U-SECUP	#3 ROSEMOUNT 4 12'H2O 1E2 07093B	0.500
4	AVE S.G.U-SECDN	#4 ROSEMONT4 -4-8'H2O-1E2 07134B	0.500
5.	DISCHARGE	#5 ROSEMONT 6 239'H2O 1E1 07093B	1.000
6P	DIFHEAD	#6 ROSEMONT 6 236'H2O 1E1 07093B	1.000
7.	NULLFLOWORIFICE	#7 ROSEMONT 5 60'H2O 1E2 07093B	0.000
8.	FLOWBEND	#8 ROSEMOUNT 5 24'H2O 1E2 07093B	1.000
9P	LOSS 20	#9 ROSEMOUNT 5 24'H2O 1E2 07093B	1.000
10S	FLOWBEND	#10ROSEMOUNT 4 12'H2O 1E2 07134B	1.000
11.	FLOWBEND	#11ROSEMOUNT 4 12'H2O 1E2 07134B	1.000
12S	NULLLOSS 20"	#12ROSEMOUNT 4 12'H2O 1E2 07134B	0.000
13S	LOSS 20"	#13ROSEMONT4 -4-8'H2O-1E2 01164E	1.000
14.	NULLDISCHARGE	#14ROSEMOUNT 5 24'H2O 1E2 07134B	0.000
15S	DIFHEAD	#15ROSEMOUNT 5 60'H2O 1E2 01164E	1.000
16S	NULLDISCHARGE	#16ROSEMONT 7 692'H2O 1E1 07093B	0.000
17	SUCTION	#17ROSE. 5 -30-30'H2O-1E2 07093B	1.000
18P	TEMPTANK	#18 RTD TANK F 1E1 10204D	1.000
19S	TEMPAMBIENT	#19 RTD AMBIENT F 1E1 10204B	1.000
20P	BHP TRQ*RPM	#20 BENSFELD 30K FTLB1E-102122B	1.000
21	RPM TRQ BAR	#21 DAYTRONIC 300 RPM 1E1 02122D	1.000
22S	BHP TRQ BAR	#22 BENSFELD 3000HP 1E1 02122F	1.000
23S	NULLTEMPAMBIENT	#23 RTD7 100OHM F 1E1 04088B	0.000
24P	NULLBHP TRQ*RPM	#24 LEBOW DAY 166 FTLB1E1 12211B	0.000
25P	FLOW18" MAG	#25 18" F&P 32000 GPM 1E-111164B	1.000
26S	NULLBHP TRQ BAR	#26 LEBOW, DAY 75HP 1E2 12211D	0.000
27P	NULLFLOW3"MAG	#27 LOAD CELL 100LB 1E2 01101B	0.000
28S	NULLFLOWORIFICE	TECO# 6158 21.80 FPS 1E2 09256C	0.000
29.	NULLFLOW6"MAG	#29 6" YOKO 2800 GPM 1E1 12281A	0.000
30P	NULLBHP TRQ*RPM	#30 LEBOW,DAY 833 FTLB1E1 05098C	0.000
31	NULLRPM TRQ BAR	#31 LEBOW,DAY1500 RPM 1E0 05024C	0.000
32S	NULLBHP TRQ BAR	#32 LEBOW,DAY 300 HP 1E1 07287C	0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO T225 -04 DATE 12/17/04

PUMP TEST DATA FOR	FIPR
	MOSAIC (IMC) MATRIX
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.95"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 245.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

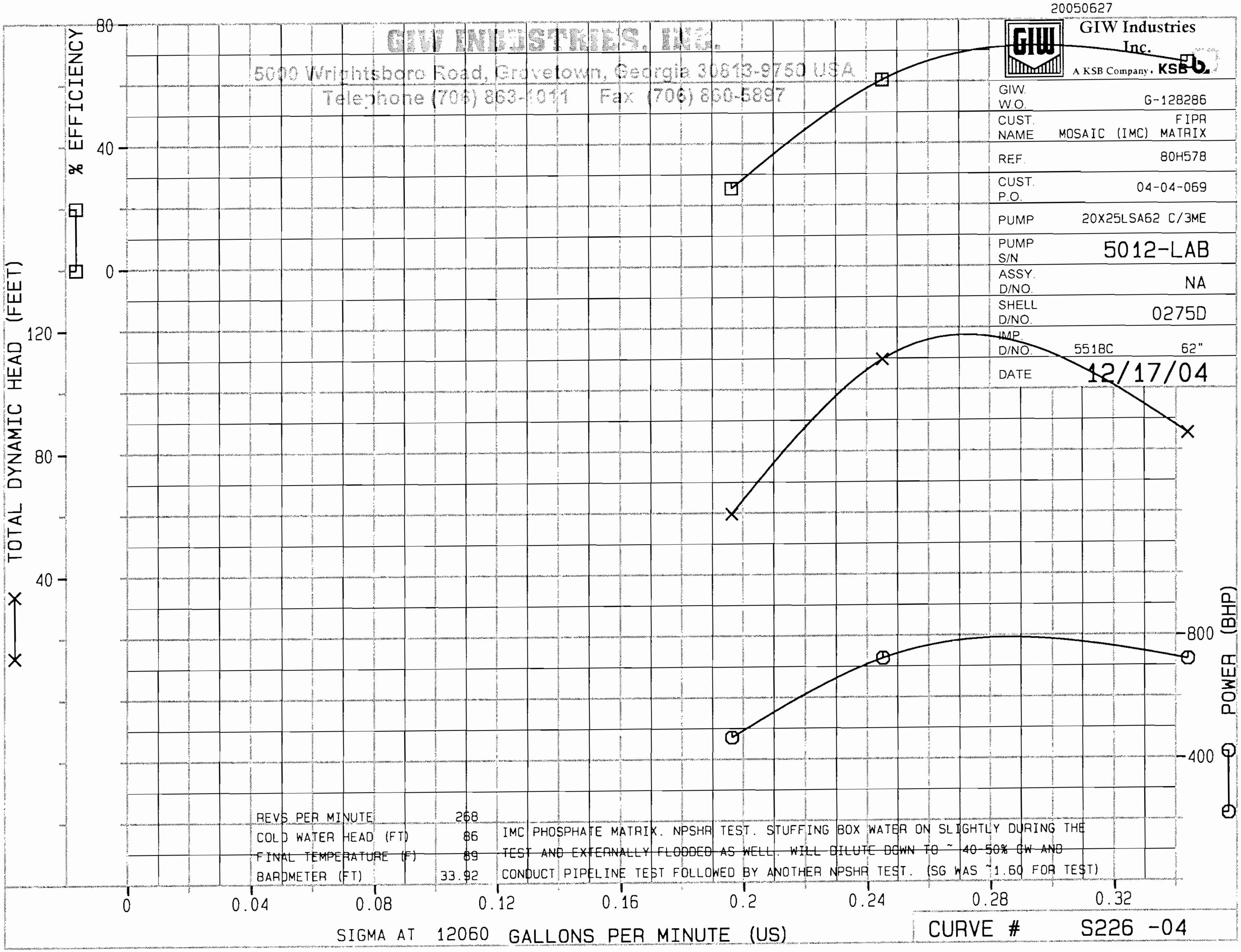
NO	FLOW MEASUREMENT: FLOW Q: GPM	VELOCITY: FT/S	HEAD MEASUREMENT: DISCH: PSI	SUCTN: " HG	TOT HD: H FT	S.G.	DRIVER POWER: INPUT: KW	OUTPUT: BHP	SPEED: N: RPM	PUMP: OUTPUT: WHP	EFF: n %	TEMP: Tm: F	SCALED PERFORMANCE: FLOW: GPM	HEAD: FT	POWER: BHP	EFF: %	TIME: t: H.MM	MAG18": C 25: *1.000	BEND12: S 10: *1.000
1	11384.9	12.40	39.17	-3.38	50.25	1.89	0.0	442.3	215.1	273.2	61.8	69.4	11908.	55.0	506.0	61.8	11.09	11385.	15744.
2	12292.8	13.38	40.90	-3.91	52.78	1.90	0.0	485.6	221.4	310.8	64.0	69.8	12492.	54.5	509.7	64.0	11.11	12293.	15720.
3	13088.1	14.25	43.96	-4.31	77.01	1.41	0.0	540.7	230.1	357.8	66.2	72.6	12800.	73.7	505.7	66.2	11.47	13088.	18258.
4	14273.2	15.54	46.02	-4.99	60.75	1.88	0.0	604.7	237.4	412.2	68.2	72.7	13526.	54.6	514.6	68.2	11.50	14273.	15779.
5	15164.9	16.51	47.64	-5.41	63.36	1.88	0.0	656.5	242.8	456.4	69.5	73.0	14050.	54.4	522.2	69.5	11.52	15165.	15786.
6	16080.8	17.51	49.45	-5.64	66.21	1.88	0.0	714.3	248.6	504.7	70.7	73.3	14557.	54.3	529.9	70.7	11.54	16081.	15801.
7	17165.4	18.69	51.38	-6.21	69.46	1.87	0.0	785.3	255.2	564.4	71.9	74.5	15134.	54.0	538.3	71.9	11.57	17165.	15812.
8	17884.4	19.47	52.75	-6.24	72.16	1.86	0.0	829.4	260.1	605.0	72.9	79.1	15471.	54.0	536.9	72.9	11.59	17884.	15113.
9	18740.0	20.40	54.69	-6.77	75.61	1.85	0.0	901.2	266.1	661.2	73.4	80.0	15846.	54.1	544.8	73.4	12.01	18740.	15926.

TESTED BY LEE WHITLOCK DATE 12/17/04 COMMENTS: IMC PHOSPHATE MATRIX. SG LOOP NOT WORKING. TOOK SAMPLE IMMEDIATELY BEFORE AND AFTER THIS TEST. WILL MEASURE SLURRY SG AND MANUALLY CORRECT AT CONCLUSION. BEND METER ALSO PLUGGING FROM TIME TO TIME. (SG WAS FOUND TO BE ~1.60)

WITNESSED BY GRAEME ADDIE FOR FIPR

Version: 20050627

T225 -04 12/17/04


20050627
GIW Industries Inc.
A KSB Company
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW W.O. G-128286
CUST. NAME MOSAIC (IMC) FIPR MATRIX
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 551BC 62"
DATE 12/17/04
% EFFICIENCY
TOTAL DYNAMIC HEAD (FEET)
POWER (BHP)
REVS PER MINUTE 268
COLD WATER HEAD (FT) 86
FINAL TEMPERATURE (F) 89
BAROMETER (FT) 33.92
IMC PHOSPHATE MATRIX. NPSHR TEST. STUFFING BOX WATER ON SLIGHTLY DURING THE TEST AND EXTERNALLY FLOODED AS WELL. WILL DILUTE DOWN TO ~ 40-50% CW AND CONDUCT PIPELINE TEST FOLLOWED BY ANOTHER NPSHR TEST. (SG WAS ~1.60 FOR TEST)
SIGMA AT 12060 GALLONS PER MINUTE (US)
CURVE # S226 -04

PUMP DETAIL	
PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL	
TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS	
SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE	RDG	SOURCE	INSTRUMENT
1	NULL	SUCTION	#1	YOKOGAWA-30-30 H20-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2	YOKOGAWA -4-8' H20-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3	ROSEMOUNT 4 12'H20 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4	ROSEMONT4 -4-8'H20-1E2 07134B 0.500
5.		DISCHARGE	#5	ROSEMONT 6 239'H20 1E1 07093B 1.000
6P		DIFHEAD	#6	ROSEMONT 6 236'H20 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7	ROSEMOUNT 5 60'H20 1E2 07093B 0.000
8.		FLOWBEND	#8	ROSEMOUNT 5 24'H20 1E2 07093B 1.000
9S		LOSS 20	#9	ROSEMOUNT 5 24'H20 1E2 07093B 1.000
10S		FLOWBEND	#10	ROSEMOUNT 4 12'H20 1E2 07134B 1.000
11.		FLOWBEND	#11	ROSEMOUNT 4 12'H20 1E2 07134B 1.000
12S	NULL	LOSS 20"	#12	ROSEMOUNT 4 12'H20 1E2 07134B 0.000
13P		LOSS 20"	#13	ROSEMONT4 -4-8'H20-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14	ROSEMOUNT 5 24'H20 1E2 07134B 0.000
15S		DIFHEAD	#15	ROSEMOUNT 5 60'H20 1E2 01164E 1.000
16S	NULL	DISCHARGE	#16	ROSEMONT 7 692'H20 1E1 07093B 0.000
17		SUCTION	#17	ROSE. 5 -30-30'H20-1E2 07093B 1.000
18P		TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23	RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO S226 -04 DATE 12/17/04

PUMP TEST DATA FOR	FIPR
	MOSAIC (IMC) MATRIX
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS
1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.95"
G = 32.14 FT/S/S

TEST RESULTS

NO	FLOW MEASUREMENT: FLOW GPM	FLOW MEASUREMENT: Q VELOCITY FT/S	HEAD MEASUREMENT: DISCH. PSI	HEAD MEASUREMENT: SUCTN " HG	HEAD MEASUREMENT: TOT HD H FT	S.G.	DRIVER POWER: INPUT KW	DRIVER POWER: OUTPUT BHP	SPEED: N RPM	PUMP: OUTPUT WHP	PUMP: EFF n %	TEMP: Tm F	CAVITATION: NPSH FT	CAVITATION: SIGMA	SCALED PERFORMANCE: FLOW GPM	SCALED PERFORMANCE: HEAD FT	SCALED PERFORMANCE: POWER BHP	SCALED PERFORMANCE: EFF %	TIME: t H.MM	MAG18": C 25 *1.000
1	12059.8	13.13	64.07	-6.42	85.57	1.83	0.0	721.8	267.7	476.1	66.0	86.6	29.4	0.344	10137.	60.5	428.7	66.0	12.27	12060.
2	11947.3	13.01	55.67	-14.60	109.84	1.33	0.0	728.3	267.6	442.0	60.7	87.5	21.0	0.245	10045.	77.6	432.8	60.7	12.31	11947.
3	5512.1	6.00	27.90	-20.16	59.83	1.45	0.0	472.3	269.8	120.6	25.5	88.6	16.8	0.196	4597.	41.6	274.0	25.5	12.34	5512.1

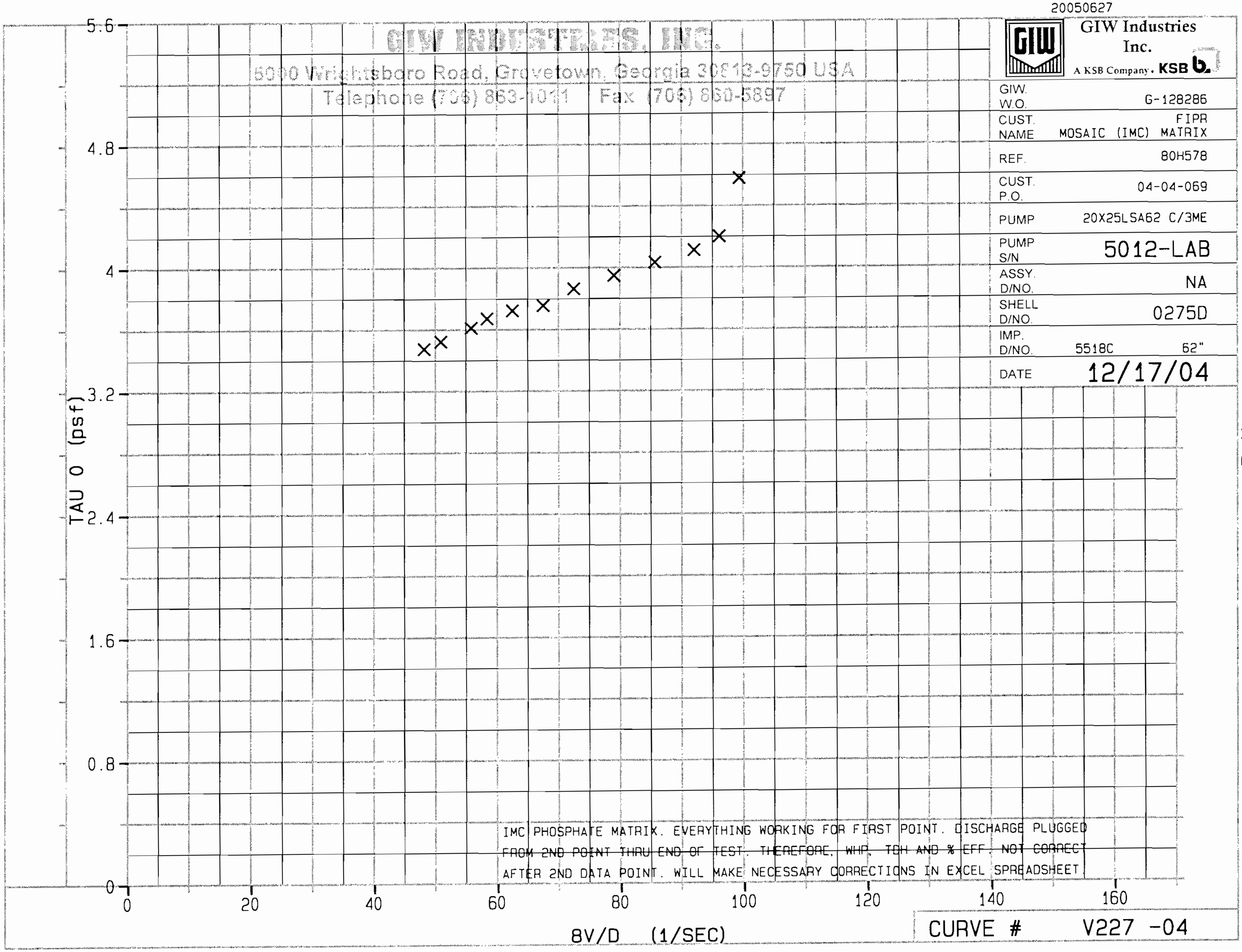
TESTED BY LEE WHITLOCK DATE 12/17/04

WITNESSED BY GRAEME ADDIE FOR FIPR

COMMENTS: IMC PHOSPHATE MATRIX. NPSHR TEST. STUFFING BOX WATER ON SLIGHTLY DURING THE TEST AND EXTERNALLY FLOODED AS WELL. WILL DILUTE DOWN TO ~ 40-50% CW AND CONDUCT PIPELINE TEST FOLLOWED BY ANOTHER NPSHR TEST. (SG WAS ~1.60 FOR TEST)

Version: 20050627

S226 -04 12/17/04


20050627
GIW Industries Inc.
A KSB Company. KSB
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW. W.O. G-128286
CUST. NAME FIPR MOSAIC (IMC) MATRIX
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/17/04
TAU 0 (psf)
5.6
4.8
4
3.2
2.4
1.6
0.8
0
0
20
40
60
80
100
120
140
160
8V/D (1/SEC)
IMC PHOSPHATE MATRIX. EVERYTHING WORKING FOR FIRST POINT. DISCHARGE PLUGGED
FROM 2ND POINT THRU END OF TEST. THEREFORE, WHP, TDH AND % EFF. NOT CORRECT
AFTER 2ND DATA POINT. WILL MAKE NECESSARY CORRECTIONS IN EXCEL SPREADSHEET
CURVE # V227 -04

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE	RDG	SOURCE	INSTRUMENT
1	NULL	SUCTION	#1	YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2	YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3	ROSEMONT 4 12'H2O 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4	ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5.		DISCHARGE	#5	ROSEMONT 6 239'H2O 1E1 07093B 1.000
6S		DIFHEAD	#6	ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7	ROSEMOUNT 5 60'H2O 1E2 07093B 0.000
8.		FLOWBEND	#8	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
9P		LOSS 20	#9	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
10S		FLOWBEND	#10	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
11.		FLOWBEND	#11	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
12S	NULL	LOSS 20"	#12	ROSEMOUNT 4 12'H2O 1E2 07134B 0.000
13S		LOSS 20"	#13	ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14	ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15P		DIFHEAD	#15	ROSEMOUNT 5 60'H2O 1E2 01164E 1.000
16S	NULL	DISCHARGE	#16	ROSEMONT 7 692'H2O 1E1 07093B 0.000
17		SUCTION	#17	ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P		TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23	RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO V227 -04 DATE 12/17/04

PUMP TEST DATA FOR	FIPR
	MOSAIC (IMC) MATRIX
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.95"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 245.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

NO	VELOCITY Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME CONC. Cv %	WEIGHT CONC. Cw %	MASS Ms TON/HR	PIPELINE LOSSES Im FT/FT	Iw FT/FT	dp/dx psf	Tau 0 psf	8V/D 1/SEC	Tau 0 ln psf	8V/D ln 1/SEC	TIME t HH.MM
1	20.03	18398.6	94.4	0.995	1.516	31.5	55.0	3841.4	0.1820	0.0377	11.354	4.5817	99.279	1.5221	4.5979	13.13
2	19.37	17792.0	101.9	0.994	1.508	31.0	54.5	3661.1	0.1670	0.0350	10.419	4.2043	96.006	1.4361	4.5644	13.44
3	18.54	17032.8	102.8	0.994	1.506	30.9	54.4	3495.6	0.1634	0.0322	10.198	4.1152	91.910	1.4147	4.5208	13.45
4	17.27	15859.9	102.9	0.994	1.506	30.9	54.4	3254.2	0.1603	0.0281	10.003	4.0366	85.580	1.3954	4.4495	13.46
5	15.92	14622.6	102.9	0.994	1.514	31.4	55.0	3048.5	0.1570	0.0241	9.7950	3.9527	78.904	1.3744	4.3682	13.47
6	14.61	13417.5	102.9	0.994	1.531	32.4	56.1	2885.8	0.1535	0.0205	9.5806	3.8662	72.401	1.3523	4.2822	13.49
7	13.60	12493.6	102.9	0.994	1.529	32.3	56.0	2679.7	0.1493	0.0180	9.3143	3.7587	67.416	1.3241	4.2109	13.50
8	12.58	11557.7	102.9	0.994	1.533	32.5	56.3	2494.5	0.1480	0.0155	9.2364	3.7273	62.366	1.3157	4.1330	13.51
9	11.77	10806.5	102.7	0.994	1.529	32.3	56.0	2315.6	0.1459	0.0137	9.1065	3.6748	58.312	1.3015	4.0658	13.54
10	11.25	10328.5	102.5	0.994	1.530	32.4	56.1	2218.7	0.1435	0.0126	8.9571	3.6146	55.733	1.2850	4.0206	13.56
11	10.25	9412.6	102.4	0.994	1.521	31.8	55.4	1986.1	0.1400	0.0106	8.7362	3.5254	50.791	1.2600	3.9277	13.57
12	9.70	8910.5	102.3	0.994	1.517	31.6	55.2	1866.0	0.1381	0.0096	8.6193	3.4782	48.081	1.2465	3.8729	13.58

TESTED BY LEE WHITLOCK DATE 12/17/04

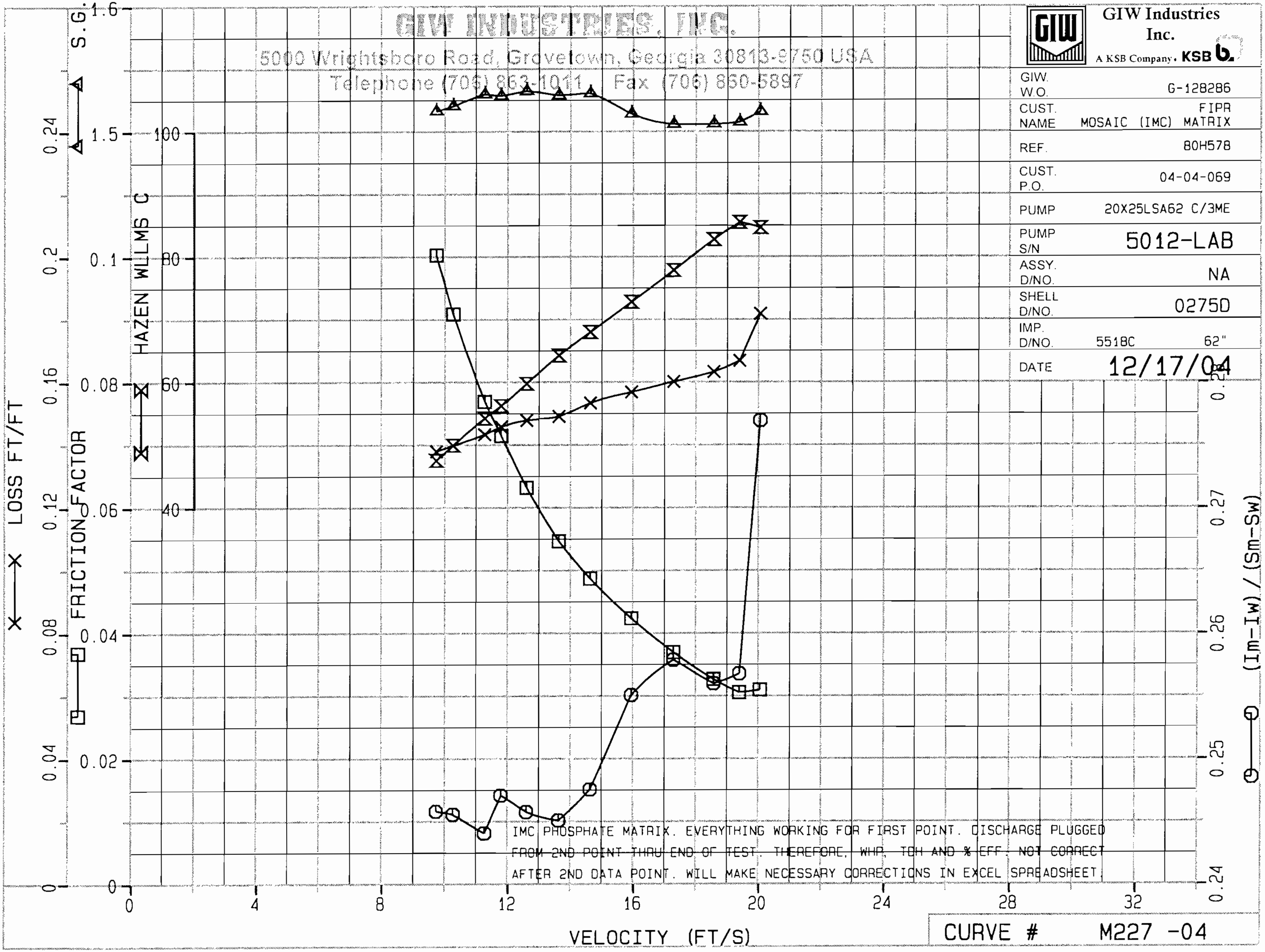
WITNESSED BY GRAEME ADDIE FOR FIPR

COMMENTS: IMC PHOSPHATE MATRIX. EVERYTHING WORKING FOR FIRST POINT. DISCHARGE PLUGGED FROM 2ND POINT THRU END OF TEST. THEREFORE, WHP, TDH AND % EFF. NOT CORRECT AFTER 2ND DATA POINT. WILL MAKE NECESSARY CORRECTIONS IN EXCEL SPREADSHEET.

Version: 20050627

V227 -04 12/17/04

20050627


GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW Industries Inc.
A KSB Company. KSB
GIW. W.O. G-128286
CUST. NAME MOSAIC (IMC) FIPR MATRIX
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/17/04
S.G.
HAZEN WLLMS C
FRICTION FACTOR
LOSS FT/FT
(Im-Iw) / (Sm-Sw)
VELOCITY (FT/S)
IMC PHOSPHATE MATRIX. EVERYTHING WORKING FOR FIRST POINT. DISCHARGE PLUGGED
FROM 2ND POINT THRU END OF TEST. THEREFORE, WHP, TDH AND % EFF. NOT CORRECT
AFTER 2ND DATA POINT. WILL MAKE NECESSARY CORRECTIONS IN EXCEL SPREADSHEET.
CURVE # M227 -04

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
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TEST CURVE NO M227 -04   DATE 12/17/04

PUMP TEST DATA FOR FIPR
------------------ MOSAIC (IMC) MATRIX

PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE	RDG	SOURCE	INSTRUMENT
1	NULL	SUCTION	#1	YOKOGAWA-30-30 H20-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2	YOKOGAWA -4-8' H20-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3	ROSEMOUNT 4 12'H20 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4	ROSEMONT4 -4-8'H20-1E2 07134B 0.500
5.		DISCHARGE	#5	ROSEMONT 6 239'H20 1E1 07093B 1.000
6S		DIFHEAD	#6	ROSEMONT 6 236'H20 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7	ROSEMOUNT 5 60'H20 1E2 07093B 0.000
8.		FLOWBEND	#8	ROSEMOUNT 5 24'H20 1E2 07093B 1.000
9P		LOSS 20	#9	ROSEMOUNT 5 24'H20 1E2 07093B 1.000
10S		FLOWBEND	#10	ROSEMOUNT 4 12'H20 1E2 07134B 1.000
11.		FLOWBEND	#11	ROSEMOUNT 4 12'H20 1E2 07134B 1.000
12S	NULL	LOSS 20"	#12	ROSEMOUNT 4 12'H20 1E2 07134B 0.000
13S		LOSS 20"	#13	ROSEMONT4 -4-8'H20-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14	ROSEMOUNT 5 24'H20 1E2 07134B 0.000
15P		DIFHEAD	#15	ROSEMOUNT 5 60'H20 1E2 01164E 1.000
16S	NULL	DISCHARGE	#16	ROSEMONT 7 692'H20 1E1 07093B 0.000
17		SUCTION	#17	ROSE. 5 -30-30'H20-1E2 07093B 1.000
18P		TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23	RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

TEST CONSTANTS

1 FT H20 = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.95"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 245.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

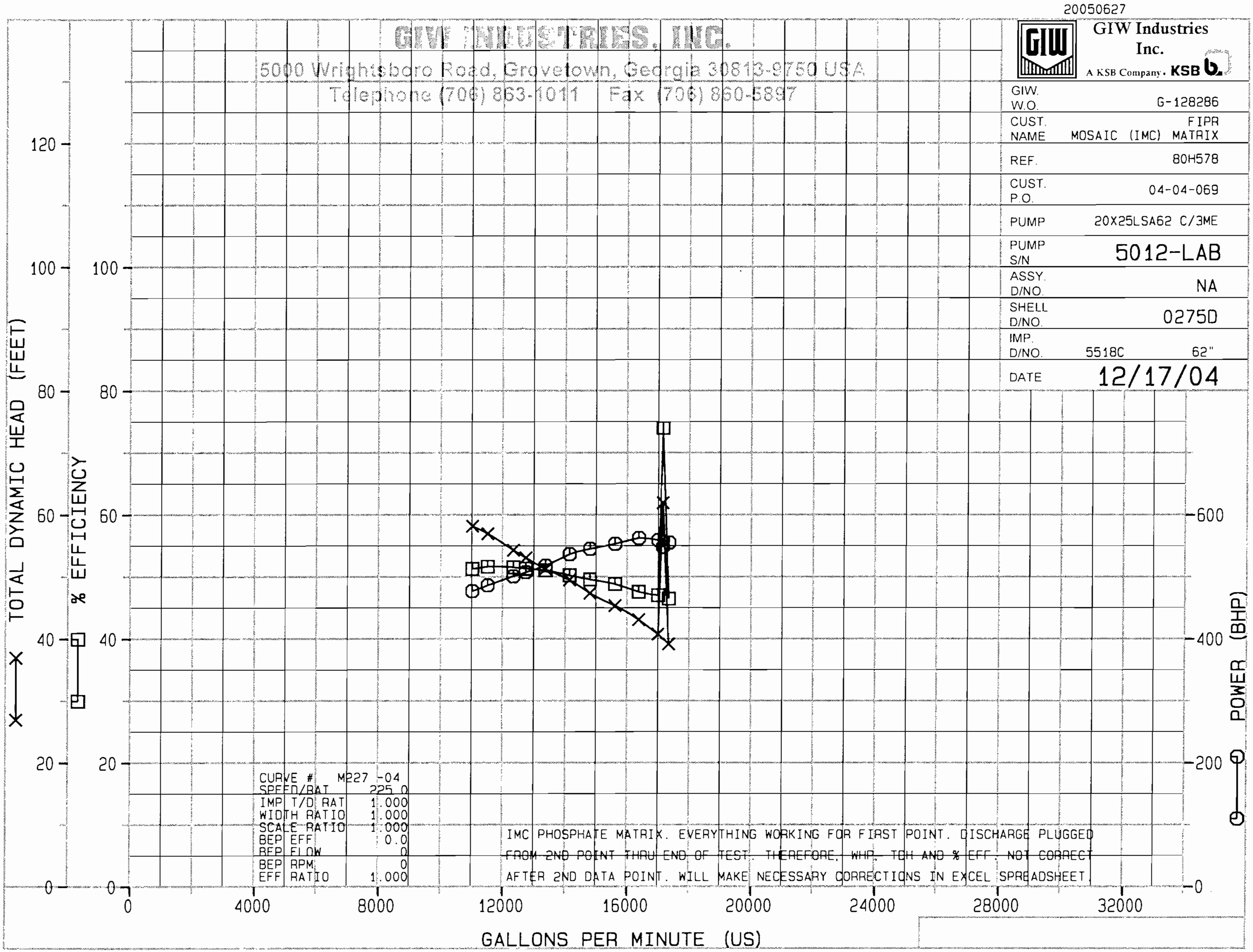
NO	VELOCITY Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME CONC. Cv %	WEIGHT CONC. Cw %	MASS Ms TON/HR	REYNOLDS NUMBER Re	PIPELINE LOSSES Im FT/FT	PIPELINE LOSSES Iw FT/FT	FRICTION FACTRS Fm	FRICTION FACTRS Fw SAME Re	HAZEN WLLMS C	Im-Iw ----- Sm-Sw	TIME t HH.MM
1	20.03	18398.6	94.4	0.995	1.516	31.5	55.0	3841.4	0.416E+07	0.1820	0.0377	0.0310	0.0098	85.	0.2770	13.13
2	19.37	17792.0	101.9	0.994	1.508	31.0	54.5	3661.1	0.434E+07	0.1670	0.0350	0.0306	0.0097	86.	0.2568	13.44
3	18.54	17032.8	102.8	0.994	1.506	30.9	54.4	3495.6	0.419E+07	0.1634	0.0322	0.0327	0.0098	83.	0.2560	13.45
4	17.27	15859.9	102.9	0.994	1.506	30.9	54.4	3254.2	0.391E+07	0.1603	0.0281	0.0370	0.0099	78.	0.2579	13.46
5	15.92	14622.6	102.9	0.994	1.514	31.4	55.0	3048.5	0.360E+07	0.1570	0.0241	0.0424	0.0099	73.	0.2551	13.47
6	14.61	13417.5	102.9	0.994	1.531	32.4	56.1	2885.8	0.331E+07	0.1535	0.0205	0.0488	0.0100	68.	0.2476	13.49
7	13.60	12493.6	102.9	0.994	1.529	32.3	56.0	2679.7	0.308E+07	0.1493	0.0180	0.0547	0.0101	64.	0.2451	13.50
8	12.58	11557.7	102.9	0.994	1.533	32.5	56.3	2494.5	0.284E+07	0.1480	0.0155	0.0633	0.0102	60.	0.2458	13.51
9	11.77	10806.5	102.7	0.994	1.529	32.3	56.0	2315.6	0.265E+07	0.1459	0.0137	0.0715	0.0103	56.	0.2471	13.54
10	11.25	10328.5	102.5	0.994	1.530	32.4	56.1	2218.7	0.253E+07	0.1435	0.0126	0.0770	0.0104	54.	0.2441	13.56
11	10.25	9412.6	102.4	0.994	1.521	31.8	55.4	1986.1	0.231E+07	0.1400	0.0106	0.0910	0.0105	50.	0.2456	13.57
12	9.70	8910.5	102.3	0.994	1.517	31.6	55.2	1866.0	0.218E+07	0.1381	0.0096	0.1004	0.0106	48.	0.2459	13.58

TESTED BY LEE WHITLOCK DATE 12/17/04

WITNESSED BY GRAEME ADDIE FOR FIPR

COMMENTS: IMC PHOSPHATE MATRIX. EVERYTHING WORKING FOR FIRST POINT. DISCHARGE PLUGGED FROM 2ND POINT THRU END OF TEST. THEREFORE, WHP, TDH AND % EFF. NOT CORRECT AFTER 2ND DATA POINT. WILL MAKE NECESSARY CORRECTIONS IN EXCEL SPREADSHEET.

Version: 20050627   M227 -04 12/17/04



20050627
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW Industries Inc.
A KSB Company. KSB
GIW. W.O. G-128286
CUST. NAME MOSAIC (IMC) FIPR MATRIX
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/17/04
CURVE # M227 -04
SPEED/RAT 225.0
IMP T/D RAT 1.000
WIDTH RATIO 1.000
SCALE RATIO 1.000
BEP EFF 0.0
BEP FLOW 0
BEP RPM 0
EFF RATIO 1.000
IMC PHOSPHATE MATRIX. EVERYTHING WORKING FOR FIRST POINT. DISCHARGE PLUGGED
FROM 2ND POINT THRU END OF TEST. THEREFORE, WHP, TDH AND % EFF. NOT CORRECT
AFTER 2ND DATA POINT. WILL MAKE NECESSARY CORRECTIONS IN EXCEL SPREADSHEET.
TOTAL DYNAMIC HEAD (FEET)
% EFFICIENCY
POWER (BHP)
GALLONS PER MINUTE (US)
0
20
40
60
80
100
120
0
4000
8000
12000
16000
20000
24000
28000
32000
200
400
600

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO T227 -04 DATE 12/17/04

PUMP TEST DATA FOR FIPR
MOSAIC (IMC) MATRIX

PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF	0.GPM, 0.RPM
EFFICIENCY	0.0% BY 1.000

CH	USE RDG	SOURCE	INSTRUMENT
1	NULLSUCTION	#1	YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULLLOSS 20"	#2	YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE S.G.U-SECUP	#3	ROSEMOUNT 4 12'H2O 1E2 07093B 0.500
4	AVE S.G.U-SECDN	#4	ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5.	DISCHARGE	#5	ROSEMONT 6 239'H2O 1E1 07093B 1.000
6S	DIFHEAD	#6	ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.	NULLFLOWORIFICE	#7	ROSEMOUNT 5 60'H2O 1E2 07093B 0.000
8.	FLOWBEND	#8	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
9P	LOSS 20	#9	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
10S	FLOWBEND	#10	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
11.	FLOWBEND	#11	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
12S	NULLLOSS 20"	#12	ROSEMOUNT 4 12'H2O 1E2 07134B 0.000
13S	LOSS 20"	#13	ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULLDISCHARGE	#14	ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15P	DIFHEAD	#15	ROSEMOUNT 5 60'H2O 1E2 01164E 1.000
16S	NULLDISCHARGE	#16	ROSEMONT 7 692'H2O 1E1 07093B 0.000
17	SUCTION	#17	ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P	TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S	TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P	BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21	RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S	BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULLTEMPAMBIENT	#23	RTD7 100OHM F 1E1 04088B 0.000
24P	NULLBHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25P	FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULLBHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULLFLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULLFLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULLFLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULLBHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULLRPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULLBHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.95"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 245.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

	FLOW MEASUREMENT		HEAD MEASUREMENT			S.G.	DRIVER POWER		SPEED	PUMP		TEMP	SCALED PERFORMANCE				TIME	MAG18"	BEND12
	FLOW Q	VELOCITY	DISCH	SUCTN	TOT HD		INPUT	OUTPUT	N	OUTPUT	EFF	Tm	FLOW	HEAD	POWER	EFF	t	C 25	S 10
NO	GPM	FT/S	PSI	" HG	H FT		KW	BHP	RPM	WHP	n %	F	GPM	FT	BHP	%	H.MM	*1.000	*1.000
1	18398.6	20.03	40.40	-9.10	71.58	1.52	0.0	680.9	241.8	504.3	74.1	94.4	17123.	62.0	548.8	74.1	13.13	18399.	17243.
2	17792.0	19.37	21.19	-7.85	41.36	1.51	0.0	602.2	231.1	280.2	46.5	101.9	17324.	39.2	555.9	46.5	13.44	17792.	16724.
3	17032.8	18.54	21.36	-7.49	41.08	1.51	0.0	565.3	225.7	266.1	47.1	102.8	16977.	40.8	559.8	47.1	13.45	17033.	16031.
4	15859.9	17.27	21.39	-7.44	40.61	1.51	0.0	514.2	218.3	245.0	47.6	102.9	16347.	43.1	563.0	47.6	13.46	15860.	14919.
5	14622.6	15.92	21.64	-6.92	39.93	1.51	0.0	456.7	211.0	223.3	48.9	102.9	15592.	45.4	553.7	48.9	13.47	14623.	13725.
6	13417.5	14.61	21.77	-6.65	39.09	1.53	0.0	408.5	204.3	202.7	49.6	102.9	14777.	47.4	545.7	49.6	13.49	13418.	12478.
7	12493.6	13.60	21.95	-6.29	38.83	1.53	0.0	372.5	199.2	187.4	50.3	102.9	14114.	49.6	537.0	50.3	13.50	12494.	11643.
8	11557.7	12.58	22.06	-6.07	38.47	1.53	0.0	336.8	194.8	172.1	51.1	102.9	13347.	51.3	518.7	51.1	13.51	11558.	10811.
9	10806.5	11.77	22.20	-5.77	38.36	1.53	0.0	311.5	191.2	160.1	51.4	102.7	12720.	53.1	508.0	51.4	13.54	10806.	10152.
10	10328.5	11.25	22.26	-5.67	38.20	1.53	0.0	295.5	188.6	152.5	51.6	102.5	12320.	54.4	501.4	51.6	13.56	10328.	9733.6
11	9412.6	10.25	22.45	-5.27	38.23	1.52	0.0	267.3	184.2	138.2	51.7	102.4	11496.	57.0	486.9	51.7	13.57	9412.6	8976.3
12	8910.5	9.70	22.55	-5.07	38.22	1.52	0.0	253.9	182.3	130.4	51.4	102.3	10999.	58.2	477.6	51.4	13.58	8910.5	8564.9

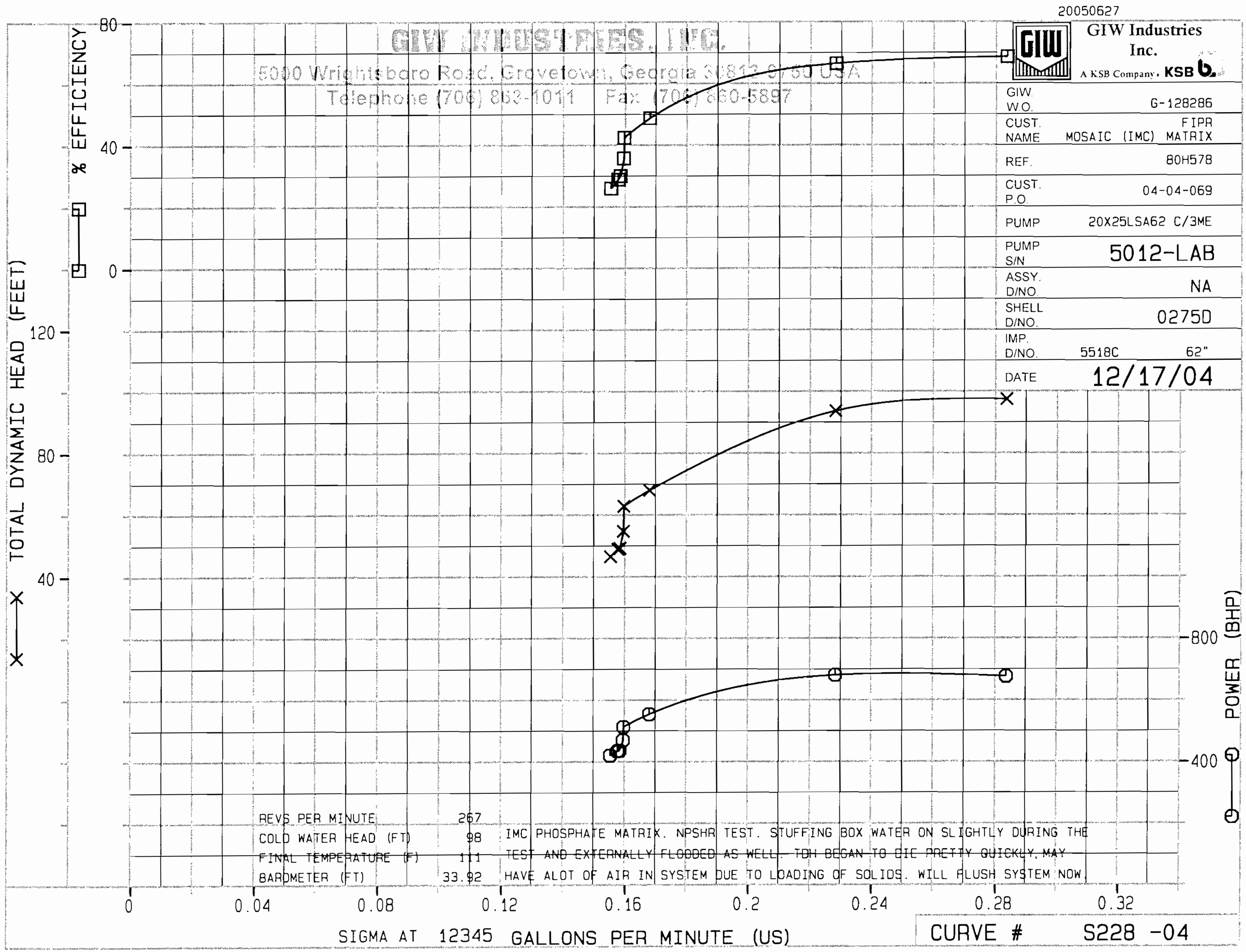
TESTED BY LEE WHITLOCK DATE 12/17/04

WITNESSED BY GRAEME ADDIE FOR FIPR

COMMENTS: IMC PHOSPHATE MATRIX. EVERYTHING WORKING FOR FIRST POINT. DISCHARGE PLUGGED FROM 2ND POINT THRU END OF TEST. THEREFORE, WHP, TDH AND % EFF. NOT CORRECT AFTER 2ND DATA POINT. WILL MAKE NECESSARY CORRECTIONS IN EXCEL SPREADSHEET.

Version: 20050627

T227 -04 12/17/04


20050627
GIW Industries Inc.
A KSB Company. KSB
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW W.O. G-128286
CUST. NAME MOSAIC (IMC) FIPR MATRIX
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/17/04
% EFFICIENCY
TOTAL DYNAMIC HEAD (FEET)
POWER (BHP)
80
40
0
120
80
40
800
400
REVS PER MINUTE 267
COLD WATER HEAD (FT) 98
FINAL TEMPERATURE (F) 111
BAROMETER (FT) 33.92
IMC PHOSPHATE MATRIX. NPSHR TEST. STUFFING BOX WATER ON SLIGHTLY DURING THE TEST AND EXTERNALLY FLOODED AS WELL. TDH BEGAN TO DIE PRETTY QUICKLY, MAY HAVE ALOT OF AIR IN SYSTEM DUE TO LOADING OF SOLIDS. WILL FLUSH SYSTEM NOW.
0
0.04
0.08
0.12
0.16
0.2
0.24
0.28
0.32
SIGMA AT 12345 GALLONS PER MINUTE (US)
CURVE # S228 -04

PUMP DETAIL

PUMP 20X25LSA62 C/3ME

SERIAL NUMBER 5012-LAB
ASSEMBLY DRAWING NO NA
SHELL DRAWING NO 0275D
IMPELLER DRAWING NO 5518C
IMPELLER DIAMETER 62"
OUTLET ANGLE
OUTLET WIDTH
ROTATION CLOCKWISE
HYDROSTATIC PRESS. STD

DRIVER DETAIL

TYPE VARIABLE SPEED DRIVE
MAKE GENERAL ELECTRIC
SERIAL NO 5511957
FRAME SIZE 5368480
RPM = 450 BHP = 2450.
4160 VOLTS 3 PHASE 60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO 225.000

IMP TURN DOWN RATIO 1.000
MERIDINAL WIDTH RATIO 1.000
SCALE RATIO 1.000
BEP REF 0.GPM, 0.RPM
EFFICIENCY 0.0% BY 1.000

CH	USE RDG	SOURCE INSTRUMENT
1	NULLSUCTION	#1 YOKOGAWA-30-30 H20-1E2 06011B 0.000
2S	NULLLOSS 20"	#2 YOKOGAWA -4-8' H20-1E2 12040B 0.000
3	AVE S.G.U-SECUP	#3 ROSEMOUNT 4 12'H20 1E2 07093B 0.500
4	AVE S.G.U-SECDN	#4 ROSEMONT4 -4-8'H20-1E2 07134B 0.500
5.	DISCHARGE	#5 ROSEMONT 6 239'H20 1E1 07093B 1.000
6P	DIFHEAD	#6 ROSEMONT 6 236'H20 1E1 07093B 1.000
7.	NULLFLOWORIFICE	#7 ROSEMONT 5 60'H20 1E2 07093B 0.000
8.	FLOWBEND	#8 ROSEMONT 5 24'H20 1E2 07093B 1.000
9S	LOSS 20	#9 ROSEMONT 5 24'H20 1E2 07093B 1.000
10S	FLOWBEND	#10ROSEMOUNT 4 12'H20 1E2 07134B 1.000
11.	FLOWBEND	#11ROSEMOUNT 4 12'H20 1E2 07134B 1.000
12S	NULLLOSS 20"	#12ROSEMOUNT 4 12'H20 1E2 07134B 0.000
13P	LOSS 20"	#13ROSEMONT4 -4-8'H20-1E2 01164E 1.000
14.	NULLDISCHARGE	#14ROSEMOUNT 5 24'H20 1E2 07134B 0.000
15S	DIFHEAD	#15ROSEMOUNT 5 60'H20 1E2 01164E 1.000
16S	NULLDISCHARGE	#16ROSEMONT 7 692'H20 1E1 07093B 0.000
17	SUCTION	#17ROSE. 5 -30-30'H20-1E2 07093B 1.000
18P	TEMPTANK	#18 RTD TANK F 1E1 10204D 1.000
19S	TEMPAMBIENT	#19 RTD AMBIENT F 1E1 10204B 1.000
20P	BHP TRQ*RPM	#20 BENSFELD 30K FTLB1E-102122B 1.000
21	RPM TRQ BAR	#21 DAYTRONIC 300 RPM 1E1 02122D 1.000
22S	BHP TRQ BAR	#22 BENSFELD 3000HP 1E1 02122F 1.000
23S	NULLTEMPAMBIENT	#23 RTD7 100OHM F 1E1 04088B 0.000
24P	NULLBHP TRQ*RPM	#24 LEBOW DAY 166 FTLB1E1 12211B 0.000
25P	FLOW18" MAG	#25 18" F&P 32000 GPM 1E-111164B 1.000
26S	NULLBHP TRQ BAR	#26 LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULLFLOW3"MAG	#27 LOAD CELL 100LB 1E2 01101B 0.000
28S	NULLFLOWORIFICE	TECO# 6158 21.80 FPS 1E2 09256C 0.000
29.	NULLFLOW6"MAG	#29 6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULLBHP TRQ*RPM	#30 LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULLRPM TRQ BAR	#31 LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULLBHP TRQ BAR	#32 LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO S228 -04 DATE 12/17/04

PUMP TEST DATA FOR FIPR
------------------ MOSAIC (IMC) MATRIX
PROJECT 80H578
GIW WORK ORDER NO G-128286
CUSTOMER ORDER NO 04-04-069

TEST CONSTANTS
1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.95"
G = 32.14 FT/S/S

TEST RESULTS

NO	FLOW MEASUREMENT: FLOW Q: GPM	FLOW MEASUREMENT: VELOCITY: FT/S	HEAD MEASUREMENT: DISCH: PSI	HEAD MEASUREMENT: SUCTN: " HG	HEAD MEASUREMENT: TOT HD: H FT	S.G.	DRIVER POWER: INPUT: KW	DRIVER POWER: OUTPUT: BHP	SPEED: N: RPM	PUMP: OUTPUT: WHP	PUMP: EFF: n %	TEMP: Tm: F	CAVITATION: NPSH: FT	CAVITATION: SIGMA	SCALED PERFORMANCE: FLOW: GPM	SCALED PERFORMANCE: HEAD: FT	SCALED PERFORMANCE: POWER: BHP	SCALED PERFORMANCE: EFF: %	TIME: t: H.MM	MAG18": C 25: *1.000
1	12345.0	13.44	61.21	-5.93	97.56	1.53	0.0	677.9	267.2	466.1	68.8	109.2	27.6	0.283	10396.	69.2	404.8	68.8	14.31	12345.
2	12557.9	13.67	54.95	-13.08	93.79	1.53	0.0	681.9	267.2	454.3	66.6	110.6	22.3	0.228	10575.	66.5	407.2	66.6	14.34	12558.
3	10292.3	11.21	34.92	-20.61	68.13	1.54	0.0	555.8	268.6	271.8	48.9	110.9	16.4	0.168	8623.	47.8	326.9	48.9	14.36	10292.
4	9348.3	10.18	29.90	-20.69	63.01	1.47	0.0	514.3	268.8	219.1	42.6	110.9	15.6	0.159	7824.	44.1	301.5	42.6	14.36	9348.3
5	8239.6	8.97	25.09	-20.67	54.89	1.48	0.0	471.7	269.4	169.2	35.9	110.8	15.5	0.159	6881.	38.3	274.7	35.9	14.36	8239.6
6	7159.1	7.79	21.60	-20.62	49.33	1.48	0.0	437.7	269.5	131.8	30.1	110.8	15.4	0.158	5977.	34.4	254.7	30.1	14.36	7159.1
7	6889.9	7.50	21.49	-20.73	49.09	1.48	0.0	436.1	269.6	126.5	29.0	110.7	15.4	0.157	5749.	34.2	253.4	29.0	14.36	6889.9
8	6379.8	6.95	19.65	-20.74	46.66	1.47	0.0	422.3	269.9	110.2	26.1	110.8	15.1	0.155	5319.	32.4	244.8	26.1	14.37	6379.8

TESTED BY LEE WHITLOCK DATE 12/17/04

WITNESSED BY GRAEME ADDIE FOR FIPR

COMMENTS: IMC PHOSPHATE MATRIX. NPSHR TEST. STUFFING BOX WATER ON SLIGHTLY DURING THE TEST AND EXTERNALLY FLOODED AS WELL. TDH BEGAN TO DIE PRETTY QUICKLY,MAY HAVE ALOT OF AIR IN SYSTEM DUE TO LOADING OF SOLIDS. WILL FLUSH SYSTEM NOW.

Version: 20050627

S228 -04 12/17/04

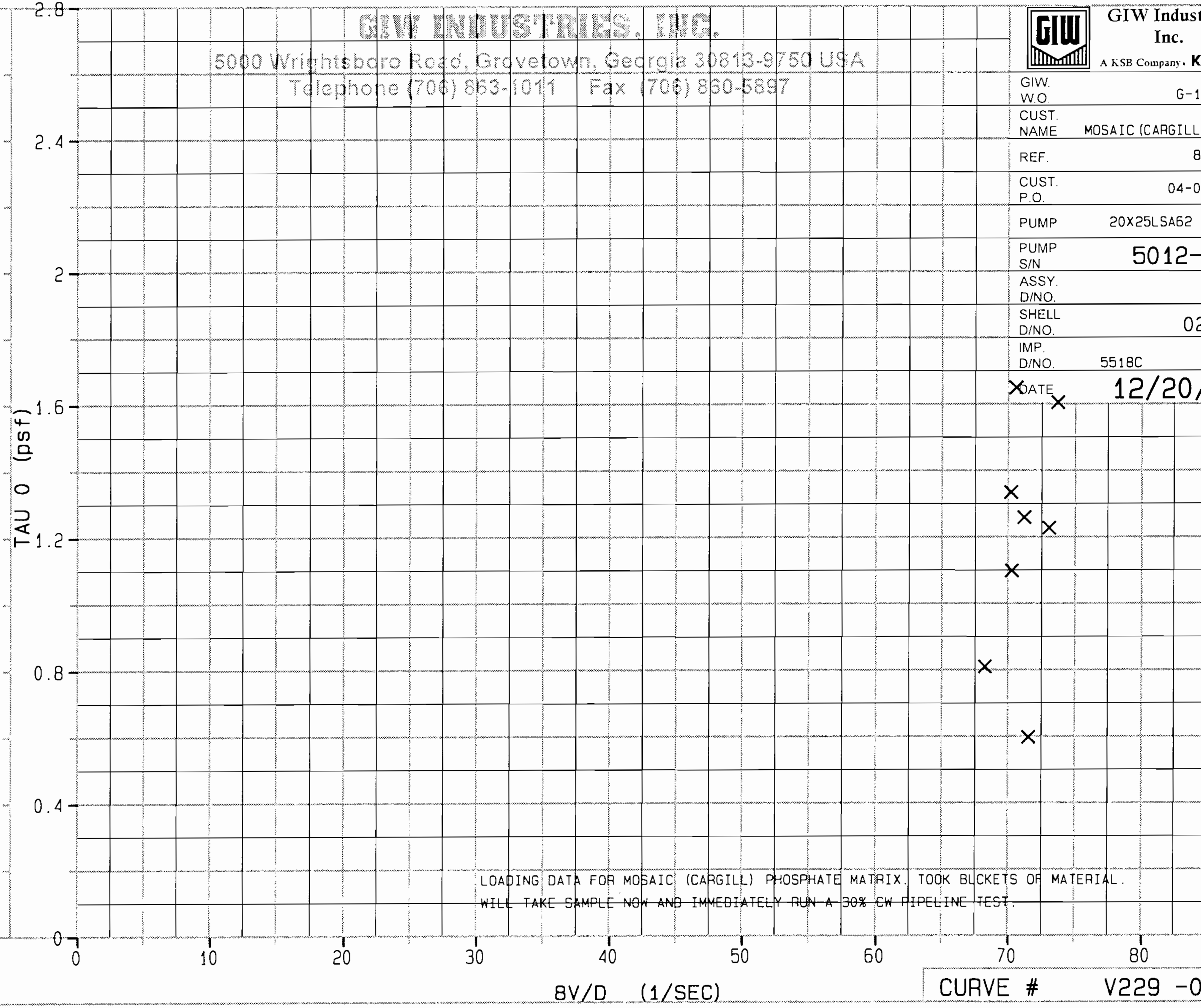
20050627

GIW INDUSTRIES, INC.

5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011   Fax (706) 860-5897

GIW Industries Inc.
A KSB Company. KSB

GIW. W.O.	G-128286
CUST. NAME	FIPR MOSAIC (CARGILL) MATR
REF.	80H578
CUST. P.O.	04-04-069
PUMP	20X25LSA62 C/3ME
PUMP S/N	5012-LAB
ASSY. D/NO.	NA
SHELL D/NO.	0275D
IMP. D/NO.	5518C 62"
DATE	12/20/04



CURVE # V229 -04

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE	RDG	SOURCE	INSTRUMENT
1	NULL	SUCTION	#1	YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2	YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3	ROSEMOUNT 4 12'H2O 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4	ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5.		DISCHARGE	#5	ROSEMONT 6 239'H2O 1E1 07093B 1.000
6S		DIFHEAD	#6	ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7	ROSEMOUNT 5 60'H2O 1E2 07093B 0.000
8.		FLOWBEND	#8	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
9P		LOSS 20	#9	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
10S		FLOWBEND	#10	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
11.		FLOWBEND	#11	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
12S	NULL	LOSS 20"	#12	ROSEMOUNT 4 12'H2O 1E2 07134B 0.000
13S		LOSS 20"	#13	ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14	ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15P		DIFHEAD	#15	ROSEMOUNT 5 60'H2O 1E2 01164E 1.000
16S	NULL	DISCHARGE	#16	ROSEMONT 7 692'H2O 1E1 07093B 0.000
17		SUCTION	#17	ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P		TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23	RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO V229 -04 DATE 12/20/04

PUMP TEST DATA FOR	FIPR
	MOSAIC(CARGILL)MATR
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS
1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.80"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 530.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

NO	VELOCITY Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME CONC. Cv %	WEIGHT CONC. Cw %	MASS Ms TON/HR	PIPELINE LOSSES Im FT/FT	Iw FT/FT	dp/dx psf	Tau 0 psf	8V/D 1/SEC	Tau 0 ln psf	8V/D ln 1/SEC	TIME t HH.MM
1	14.42	13244.8	61.4	1.000	1.008	0.5	1.3	43.3	0.0238	0.0216	1.4841	0.5989	71.469	-.5127	4.2693	13.15
2	13.76	12638.2	61.4	1.000	1.044	2.7	6.8	225.5	0.0322	0.0198	2.0106	0.8114	68.196	-.2090	4.2224	13.21
3	14.17	13011.8	61.5	1.000	1.078	4.7	11.6	408.4	0.0437	0.0209	2.7256	1.0999	70.212	0.0952	4.2515	13.24
4	14.73	13530.0	61.5	1.000	1.103	6.3	15.0	560.9	0.0488	0.0224	3.0441	1.2284	73.008	0.2057	4.2906	13.27
5	14.35	13180.5	61.7	1.000	1.130	7.9	18.5	690.6	0.0500	0.0214	3.1221	1.2599	71.123	0.2310	4.2644	13.30
6	14.35	13180.5	61.7	1.000	1.130	7.9	18.5	690.6	0.0500	0.0214	3.1221	1.2599	71.123	0.2310	4.2644	13.30
7	14.35	13180.5	61.7	1.000	1.130	7.9	18.5	690.6	0.0500	0.0214	3.1221	1.2599	71.123	0.2310	4.2644	13.30
8	14.15	12999.8	61.8	1.000	1.150	9.1	21.0	785.8	0.0531	0.0208	3.3106	1.3360	70.147	0.2897	4.2506	13.33
9	14.86	13650.5	62.0	1.000	1.189	11.5	25.6	1040.0	0.0638	0.0228	3.9800	1.6061	73.659	0.4738	4.2994	13.36
10	14.23	13068.1	62.1	1.000	1.234	14.2	30.4	1227.9	0.0656	0.0210	4.0905	1.6507	70.516	0.5012	4.2558	13.38

TESTED BY LEE WHITLOCK DATE 12/20/04 COMMENTS: LOADING DATA FOR MOSAIC (CARGILL) PHOSPHATE MATRIX. TOOK BUCKETS OF MATERIAL. WILL TAKE SAMPLE NOW AND IMMEDIATELY RUN A 30% CW PIPELINE TEST.

WITNESSED BY GRAEME ADDIE FOR FIPR

Version: 20050627

V229 -04 12/20/04

PUMP DETAIL

PUMP 20X25LSA62 C/3ME

SERIAL NUMBER 5012-LAB
ASSEMBLY DRAWING NO NA
SHELL DRAWING NO 0275D
IMPELLER DRAWING NO 5518C
IMPELLER DIAMETER 62"
OUTLET ANGLE
OUTLET WIDTH
ROTATION CLOCKWISE
HYDROSTATIC PRESS. STD

DRIVER DETAIL

TYPE VARIABLE SPEED DRIVE
MAKE GENERAL ELECTRIC
SERIAL NO 5511957
FRAME SIZE 5368480
RPM = 450 BHP = 2450.
4160 VOLTS 3 PHASE 60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO 225.000

IMP TURN DOWN RATIO 1.000
MERIDINAL WIDTH RATIO 1.000
SCALE RATIO 1.000
BEP REF 0.GPM, 0.RPM
EFFICIENCY 0.0% BY 1.000

CH	USE	RDG	SOURCE	INSTRUMENT
1	NULL	SUCTION	#1	YOKOGAWA-30-30 H20-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2	YOKOGAWA -4-8' H20-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3	ROSEMOUNT 4 12'H20 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4	ROSEMONT4 -4-8'H20-1E2 07134B 0.500
5.		DISCHARGE	#5	ROSEMONT 6 239'H20 1E1 07093B 1.000
6S		DIFHEAD	#6	ROSEMONT 6 236'H20 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7	ROSEMONT 5 60'H20 1E2 07093B 0.000
8.		FLOWBEND	#8	ROSEMOUNT 5 24'H20 1E2 07093B 1.000
9P		LOSS 20	#9	ROSEMOUNT 5 24'H20 1E2 07093B 1.000
10S		FLOWBEND	#10	ROSEMOUNT 4 12'H20 1E2 07134B 1.000
11.		FLOWBEND	#11	ROSEMOUNT 4 12'H20 1E2 07134B 1.000
12S	NULL	LOSS 20"	#12	ROSEMOUNT 4 12'H20 1E2 07134B 0.000
13S		LOSS 20"	#13	ROSEMONT4 -4-8'H20-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14	ROSEMOUNT 5 24'H20 1E2 07134B 0.000
15P		DIFHEAD	#15	ROSEMOUNT 5 60'H20 1E2 01164E 1.000
16S	NULL	DISCHARGE	#16	ROSEMONT 7 692'H20 1E1 07093B 0.000
17		SUCTION	#17	ROSE. 5 -30-30'H20-1E2 07093B 1.000
18P		TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23	RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO M229 -04 DATE 12/20/04

PUMP TEST DATA FOR FIPR

------------------ MOSAIC(CARGILL)MATR

PROJECT 80H578
GIW WORK ORDER NO G-128286
CUSTOMER ORDER NO 04-04-069

TEST CONSTANTS
1 FT H20 = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.80"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 530.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

NO	VELOCITY Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME CONC. Cv %	WEIGHT CONC. Cw %	MASS Ms TON/HR	REYNOLDS NUMBER Re	PIPELINE LOSSES Im FT/FT	Iw FT/FT	FRICTION FACTRS Fm	Fw SAME Re	HAZEN WLLMS C	Im-Iw ----- Sm-Sw	TIME t HH.MM
1	14.42	13244.8	61.4	1.000	1.008	0.5	1.3	43.3	0.195E+07	0.0238	0.0216	0.0118	0.0108	147.	0.2734	13.15
2	13.76	12638.2	61.4	1.000	1.044	2.7	6.8	225.5	0.186E+07	0.0322	0.0198	0.0169	0.0108	121.	0.2807	13.21
3	14.17	13011.8	61.5	1.000	1.078	4.7	11.6	408.4	0.192E+07	0.0437	0.0209	0.0210	0.0108	108.	0.2922	13.24
4	14.73	13530.0	61.5	1.000	1.103	6.3	15.0	560.9	0.199E+07	0.0488	0.0224	0.0211	0.0107	107.	0.2555	13.27
5	14.35	13180.5	61.7	1.000	1.130	7.9	18.5	690.6	0.195E+07	0.0500	0.0214	0.0223	0.0108	104.	0.2200	13.30
6	14.35	13180.5	61.7	1.000	1.130	7.9	18.5	690.6	0.195E+07	0.0500	0.0214	0.0223	0.0108	104.	0.2200	13.30
7	14.35	13180.5	61.7	1.000	1.130	7.9	18.5	690.6	0.195E+07	0.0500	0.0214	0.0223	0.0108	104.	0.2200	13.30
8	14.15	12999.8	61.8	1.000	1.150	9.1	21.0	785.8	0.192E+07	0.0531	0.0208	0.0239	0.0108	100.	0.2144	13.33
9	14.86	13650.5	62.0	1.000	1.189	11.5	25.6	1040.0	0.203E+07	0.0638	0.0228	0.0252	0.0107	97.	0.2163	13.36
10	14.23	13068.1	62.1	1.000	1.234	14.2	30.4	1227.9	0.194E+07	0.0656	0.0210	0.0272	0.0108	93.	0.1906	13.38

TESTED BY LEE WHITLOCK DATE 12/20/04 COMMENTS: LOADING DATA FOR MOSAIC (CARGILL) PHOSPHATE MATRIX. TOOK BUCKETS OF MATERIAL. WILL TAKE SAMPLE NOW AND IMMEDIATELY RUN A 30% CW PIPELINE TEST.

WITNESSED BY GRAEME ADDIE FOR FIPR
Version: 20050627

M229 -04 12/20/04

PUMP DETAIL

PUMP 20X25LSA62 C/3ME

SERIAL NUMBER 5012-LAB
ASSEMBLY DRAWING NO NA
SHELL DRAWING NO 0275D
IMPELLER DRAWING NO 5518C
IMPELLER DIAMETER 62"
OUTLET ANGLE
OUTLET WIDTH
ROTATION CLOCKWISE
HYDROSTATIC PRESS. STD

DRIVER DETAIL

TYPE VARIABLE SPEED DRIVE
MAKE GENERAL ELECTRIC
SERIAL NO 5511957
FRAME SIZE 5368480
RPM = 450 BHP = 2450.
4160 VOLTS 3 PHASE 60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO 225.000

IMP TURN DOWN RATIO 1.000
MERIDINAL WIDTH RATIO 1.000
SCALE RATIO 1.000
BEP REF 0.GPM, 0.RPM
EFFICIENCY 0.0% BY 1.000

CH	USE	RDG	SOURCE INSTRUMENT
1	NULL	SUCTION	#1 YOKOGAWA-30-30 H20-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2 YOKOGAWA -4-8' H20-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3 ROSEMOUNT 4 12'H20 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4 ROSEMONT4 -4-8'H20-1E2 07134B 0.500
5.		DISCHARGE	#5 ROSEMONT 6 239'H20 1E1 07093B 1.000
6S		DIFHEAD	#6 ROSEMONT 6 236'H20 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7 ROSEMOUNT 5 60'H20 1E2 07093B 0.000
8.		FLOWBEND	#8 ROSEMOUNT 5 24'H20 1E2 07093B 1.000
9P		LOSS 20	#9 ROSEMOUNT 5 24'H20 1E2 07093B 1.000
10S		FLOWBEND	#10ROSEMOUNT 4 12'H20 1E2 07134B 1.000
11.		FLOWBEND	#11ROSEMOUNT 4 12'H20 1E2 07134B 1.000
12S	NULL	LOSS 20"	#12ROSEMOUNT 4 12'H20 1E2 07134B 0.000
13S		LOSS 20"	#13ROSEMONT4 -4-8'H20-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14ROSEMOUNT 5 24'H20 1E2 07134B 0.000
15P		DIFHEAD	#15ROSEMOUNT 5 60'H20 1E2 01164E 1.000
16S	NULL	DISCHARGE	#16ROSEMONT 7 692'H20 1E1 07093B 0.000
17		SUCTION	#17ROSE. 5 -30-30'H20-1E2 07093B 1.000
18P		TEMPTANK	#18 RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19 RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20 BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21 DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22 BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23 RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24 LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25 18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26 LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27 LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO# 6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29 6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30 LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31 LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32 LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO T229 -04 DATE 12/20/04

PUMP TEST DATA FOR FIPR
------------------ MOSAIC(CARGILL)MATR
PROJECT 80H578
GIW WORK ORDER NO G-128286
CUSTOMER ORDER NO 04-04-069

TEST CONSTANTS
1 FT H20 = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.80"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 530.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

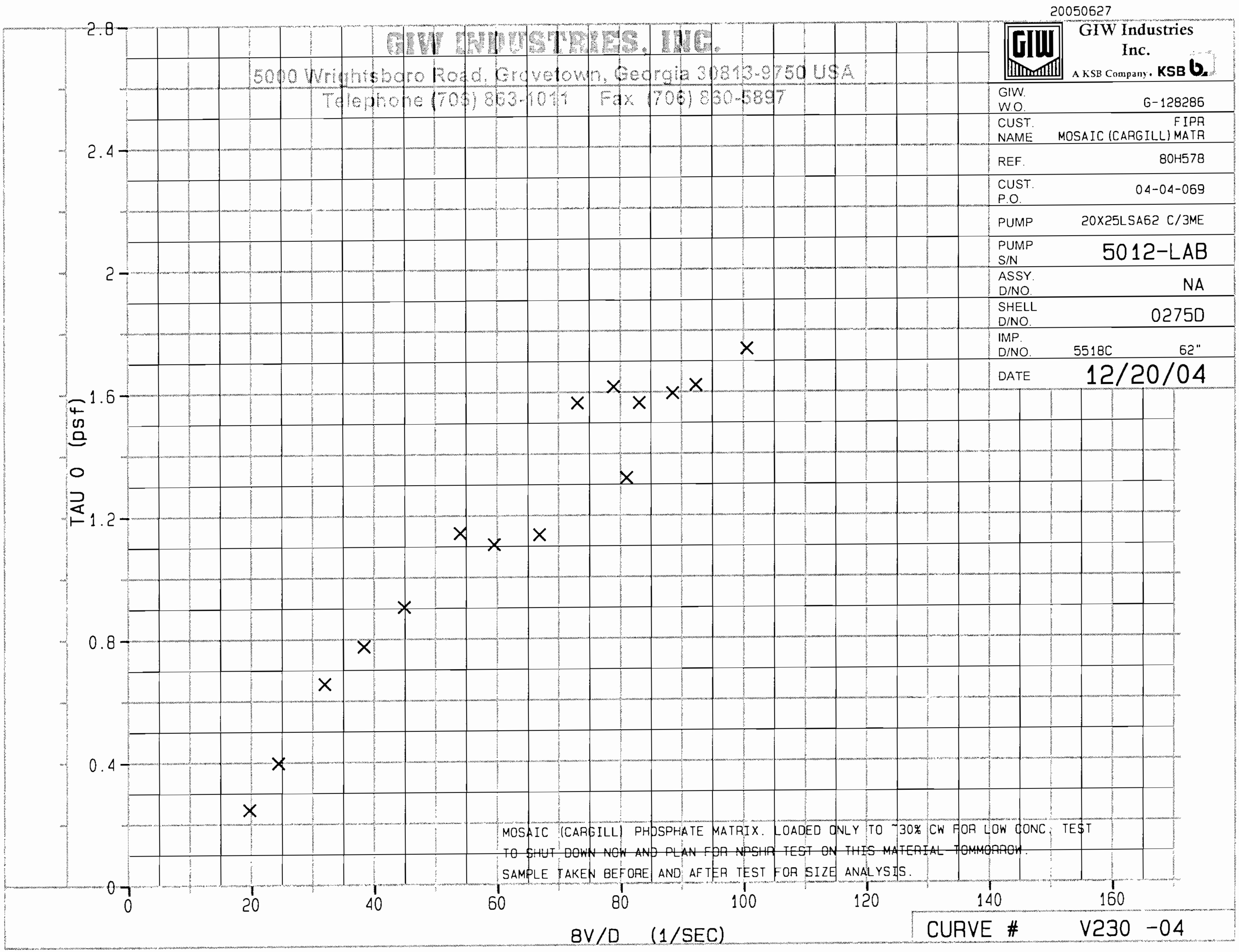
TEST RESULTS

NO	FLOW MEASUREMENT: FLOW GPM	Q:VELOCITY FT/S	HEAD MEASUREMENT: DISCH: PSI	SUCTN: " HG	TOT HD: H FT	S.G.	DRIVER POWER: INPUT: KW	OUTPUT: BHP	SPEED: N RPM	PUMP: OUTPUT: WHP	EFF: n %	TEMP: Tm F	SCALED PERFORMANCE: FLOW GPM	HEAD: FT	POWER: BHP	EFF: %	TIME: t H.MM	MAG18": C 25 *1.000	BEND12: S 10 *1.000
1	13244.8	14.42	4.63	-4.11	17.35	1.01	0.0	73.0	125.5	58.5	80.2	61.4	23752.	55.8	420.9	80.2	13.15	13245.	13020.
2	12638.2	13.76	6.11	-3.83	19.52	1.04	0.0	83.5	132.0	65.0	77.9	61.4	21537.	56.7	413.3	77.9	13.21	12638.	12357.
3	13011.8	14.17	8.09	-3.59	22.99	1.08	0.0	104.0	143.0	81.4	78.3	61.5	20472.	56.9	405.2	78.3	13.24	13012.	12609.
4	13530.0	14.73	9.56	-3.43	25.53	1.10	0.0	122.5	150.5	96.2	78.5	61.5	20226.	57.1	409.3	78.5	13.27	13530.	13162.
5	13180.5	14.35	9.95	-3.35	25.51	1.13	0.0	121.9	150.2	96.0	78.7	61.7	19741.	57.2	409.5	78.7	13.30	13181.	12885.
6	13180.5	14.35	9.95	-3.35	25.51	1.13	0.0	121.9	150.2	96.0	78.7	61.7	19741.	57.2	409.5	78.7	13.30	13181.	12885.
7	13180.5	14.35	9.95	-3.35	25.51	1.13	0.0	121.9	150.2	96.0	78.7	61.7	19741.	57.2	409.5	78.7	13.30	13181.	12885.
8	12999.8	14.15	10.36	-3.39	25.86	1.15	0.0	122.6	149.9	97.6	79.6	61.8	19517.	58.3	415.0	79.6	13.33	13000.	12582.
9	13650.5	14.86	12.11	-2.99	28.22	1.19	0.0	145.5	156.7	115.7	79.5	62.0	19598.	58.2	430.5	79.5	13.36	13651.	12980.
10	13068.1	14.23	12.65	-3.02	28.06	1.23	0.0	146.3	156.0	114.2	78.1	62.1	18848.	58.4	439.0	78.1	13.38	13068.	12357.

TESTED BY LEE WHITLOCK DATE 12/20/04 COMMENTS: LOADING DATA FOR MOSAIC (CARGILL) PHOSPHATE MATRIX. TOOK BUCKETS OF MATERIAL. WILL TAKE SAMPLE NOW AND IMMEDIATELY RUN A 30% CW PIPELINE TEST.

WITNESSED BY GRAEME ADDIE FOR FIPR
Version: 20050627

T229 -04 12/20/04


20050627
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW Industries Inc.
A KSB Company. KSB
GIW. W.O. G-128286
CUST. NAME FIPR MOSAIC (CARGILL) MATR
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/20/04
TAU 0 (psf)
2.8
2.4
2
1.6
1.2
0.8
0.4
0
0
20
40
60
80
100
120
140
160
8V/D (1/SEC)
MOSAIC (CARGILL) PHOSPHATE MATRIX. LOADED ONLY TO ~30% CW FOR LOW CONC. TEST
TO SHUT DOWN NOW AND PLAN FOR NPSHR TEST ON THIS MATERIAL TOMMORROW.
SAMPLE TAKEN BEFORE AND AFTER TEST FOR SIZE ANALYSIS.
CURVE # V230 -04

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE	RDG	SOURCE	INSTRUMENT
1	NULL	SUCTION	#1	YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2	YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3	ROSEMOUNT 4 12'H2O 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4	ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5.		DISCHARGE	#5	ROSEMONT 6 239'H2O 1E1 07093B 1.000
6S		DIFHEAD	#6	ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7	ROSEMOUNT 5 60'H2O 1E2 07093B 0.000
8.		FLOWBEND	#8	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
9P		LOSS 20	#9	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
10S		FLOWBEND	#10	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
11.		FLOWBEND	#11	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
12S	NULL	LOSS 20"	#12	ROSEMOUNT 4 12'H2O 1E2 07134B 0.000
13S		LOSS 20"	#13	ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14	ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15P		DIFHEAD	#15	ROSEMOUNT 5 60'H2O 1E2 01164E 1.000
16S	NULL	DISCHARGE	#16	ROSEMONT 7 692'H2O 1E1 07093B 0.000
17		SUCTION	#17	ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P		TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23	RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO V230 -04 DATE 12/20/04

PUMP TEST DATA FOR	FIPR
	MOSAIC(CARGILL)MATR
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.80"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 245.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

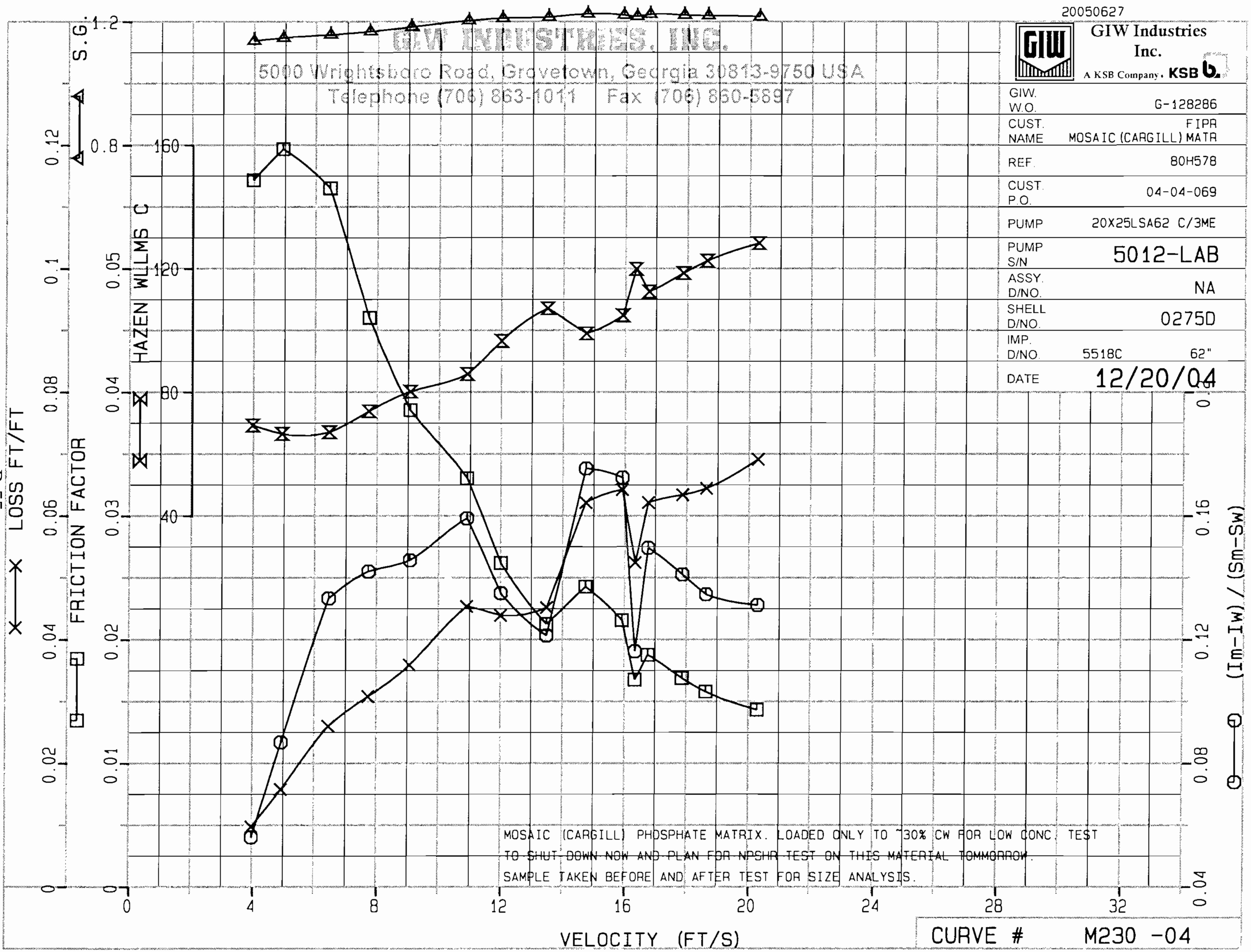
TEST RESULTS

NO	VELOCITY	FLOW	TEMP	S.G.	S.G.	VOLUME	WEIGHT	MASS	PIPELINE LOSSES		dp/dx	Tau 0	8V/D	Tau 0	8V/D	TIME
	Vm	Qm	Tm	Sw	Sm	CONC.	CONC.	Ms	Im	Iw				ln	ln	t
	FT/S	GPM	F			Cv %	Cw %	TON/HR	FT/FT	FT/FT	psf	psf	1/SEC	psf	1/SEC	HH.MM
1	14.71	13513.9	62.2	1.000	1.227	13.8	29.7	1234.4	0.0622	0.0223	3.8826	1.5668	72.922	0.4490	4.2894	13.39
2	15.89	14594.5	62.3	1.000	1.223	13.5	29.3	1309.2	0.0643	0.0258	4.0125	1.6192	78.752	0.4819	4.3663	13.40
3	16.74	15373.8	62.4	1.000	1.225	13.7	29.6	1394.4	0.0622	0.0284	3.8826	1.5668	82.958	0.4490	4.4183	13.41
4	17.84	16386.1	62.5	1.000	1.223	13.5	29.3	1467.6	0.0635	0.0320	3.9605	1.5982	88.420	0.4689	4.4821	13.43
5	18.61	17089.1	62.6	1.000	1.222	13.4	29.2	1523.6	0.0645	0.0346	4.0255	1.6245	92.213	0.4852	4.5241	13.44
6	20.26	18611.5	62.7	1.000	1.218	13.2	28.7	1629.8	0.0692	0.0406	4.3180	1.7425	100.43	0.5553	4.6094	13.45
7	16.32	14988.2	63.0	1.000	1.219	13.3	28.8	1318.4	0.0525	0.0271	3.2781	1.3229	80.877	0.2798	4.3929	13.47
8	13.46	12365.1	63.1	1.000	1.217	13.1	28.6	1077.9	0.0452	0.0189	2.8231	1.1393	66.722	0.1304	4.2005	13.49
9	11.98	11003.3	63.1	1.000	1.213	12.9	28.2	941.4	0.0440	0.0152	2.7451	1.1078	59.374	0.1024	4.0839	13.50
10	10.88	9991.0	63.2	1.000	1.205	12.4	27.4	824.6	0.0455	0.0127	2.8361	1.1445	53.912	0.1350	3.9874	13.51
11	9.04	8299.9	63.2	1.000	1.184	11.2	25.1	616.4	0.0360	0.0090	2.2446	0.9058	44.786	-.0989	3.8019	13.53
12	7.71	7082.7	63.2	1.000	1.169	10.3	23.3	483.2	0.0309	0.0067	1.9261	0.7773	38.219	-.2520	3.6433	13.54
13	6.43	5901.7	63.2	1.000	1.159	9.7	22.1	377.8	0.0261	0.0048	1.6271	0.6566	31.846	-.4207	3.4609	13.55
14	4.90	4499.8	63.1	1.000	1.149	9.0	20.8	269.2	0.0159	0.0029	0.9900	0.3995	24.281	-.9175	3.1897	13.57
15	3.95	3632.1	63.1	1.000	1.139	8.5	19.7	203.9	0.0098	0.0020	0.6129	0.2473	19.599	-1.397	2.9755	13.58

TESTED BY LEE WHITLOCK DATE 12/20/04 COMMENTS: MOSAIC (CARGILL) PHOSPHATE MATRIX. LOADED ONLY TO ~30% CW FOR LOW CONC. TEST TO SHUT DOWN NOW AND PLAN FOR NPSHR TEST ON THIS MATERIAL TOMMORROW.

WITNESSED BY GRAEME ADDIE FOR FIPR SAMPLE TAKEN BEFORE AND AFTER TEST FOR SIZE ANALYSIS.

Version: 20050627 V230 -04 12/20/04


20050627
GIW Industries Inc.
A KSB Company. KSB
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW. W.O. G-128286
CUST. NAME FIPR MOSAIC (CARGILL) MATR
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/20/04
S.G.
HAZEN WLLMS C
FRICTION FACTOR
LOSS FT/FT
(Im-Iw) / (Sm-Sw)
VELOCITY (FT/S)
MOSAIC (CARGILL) PHOSPHATE MATRIX. LOADED ONLY TO ~30% CW FOR LOW CONC. TEST
TO SHUT DOWN NOW AND PLAN FOR NPSHR TEST ON THIS MATERIAL TOMMORROW.
SAMPLE TAKEN BEFORE AND AFTER TEST FOR SIZE ANALYSIS.
CURVE # M230 -04

PUMP DETAIL

PUMP 20X25LSA62 C/3ME
SERIAL NUMBER 5012-LAB
ASSEMBLY DRAWING NO NA
SHELL DRAWING NO 0275D
IMPELLER DRAWING NO 5518C
IMPELLER DIAMETER 62"
OUTLET ANGLE
OUTLET WIDTH
ROTATION CLOCKWISE
HYDROSTATIC PRESS. STD

DRIVER DETAIL

TYPE VARIABLE SPEED DRIVE
MAKE GENERAL ELECTRIC
SERIAL NO 5511957
FRAME SIZE 5368480
RPM = 450 BHP = 2450.
4160 VOLTS 3 PHASE 60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO 225.000

IMP TURN DOWN RATIO 1.000
MERIDINAL WIDTH RATIO 1.000
SCALE RATIO 1.000
BEP REF 0.GPM, 0.RPM
EFFICIENCY 0.0% BY 1.000

CH	USE	RDG	SOURCE	INSTRUMENT
1	NULL	SUCTION	#1	YOKOGAWA-30-30 H20-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2	YOKOGAWA -4-8' H20-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3	ROSEMOUNT 4 12'H20 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4	ROSEMONT4 -4-8'H20-1E2 07134B 0.500
5.		DISCHARGE	#5	ROSEMONT 6 239'H20 1E1 07093B 1.000
6S		DIFHEAD	#6	ROSEMONT 6 236'H20 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7	ROSEMONT 5 60'H20 1E2 07093B 0.000
8.		FLOWBEND	#8	ROSEMONT 5 24'H20 1E2 07093B 1.000
9P		LOSS 20	#9	ROSEMONT 5 24'H20 1E2 07093B 1.000
10S		FLOWBEND	#10	ROSEMOUNT 4 12'H20 1E2 07134B 1.000
11.		FLOWBEND	#11	ROSEMOUNT 4 12'H20 1E2 07134B 1.000
12S	NULL	LOSS 20"	#12	ROSEMOUNT 4 12'H20 1E2 07134B 0.000
13S		LOSS 20"	#13	ROSEMONT4 -4-8'H20-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14	ROSEMOUNT 5 24'H20 1E2 07134B 0.000
15P		DIFHEAD	#15	ROSEMOUNT 5 60'H20 1E2 01164E 1.000
16S	NULL	DISCHARGE	#16	ROSEMONT 7 692'H20 1E1 07093B 0.000
17		SUCTION	#17	ROSE. 5 -30-30'H20-1E2 07093B 1.000
18P		TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23	RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO M230 -04 DATE 12/20/04

PUMP TEST DATA FOR FIPR
------------------ MOSAIC(CARGILL)MATR
PROJECT 80H578
GIW WORK ORDER NO G-128286
CUSTOMER ORDER NO 04-04-069

TEST CONSTANTS
1 FT H20 = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.80"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 245.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

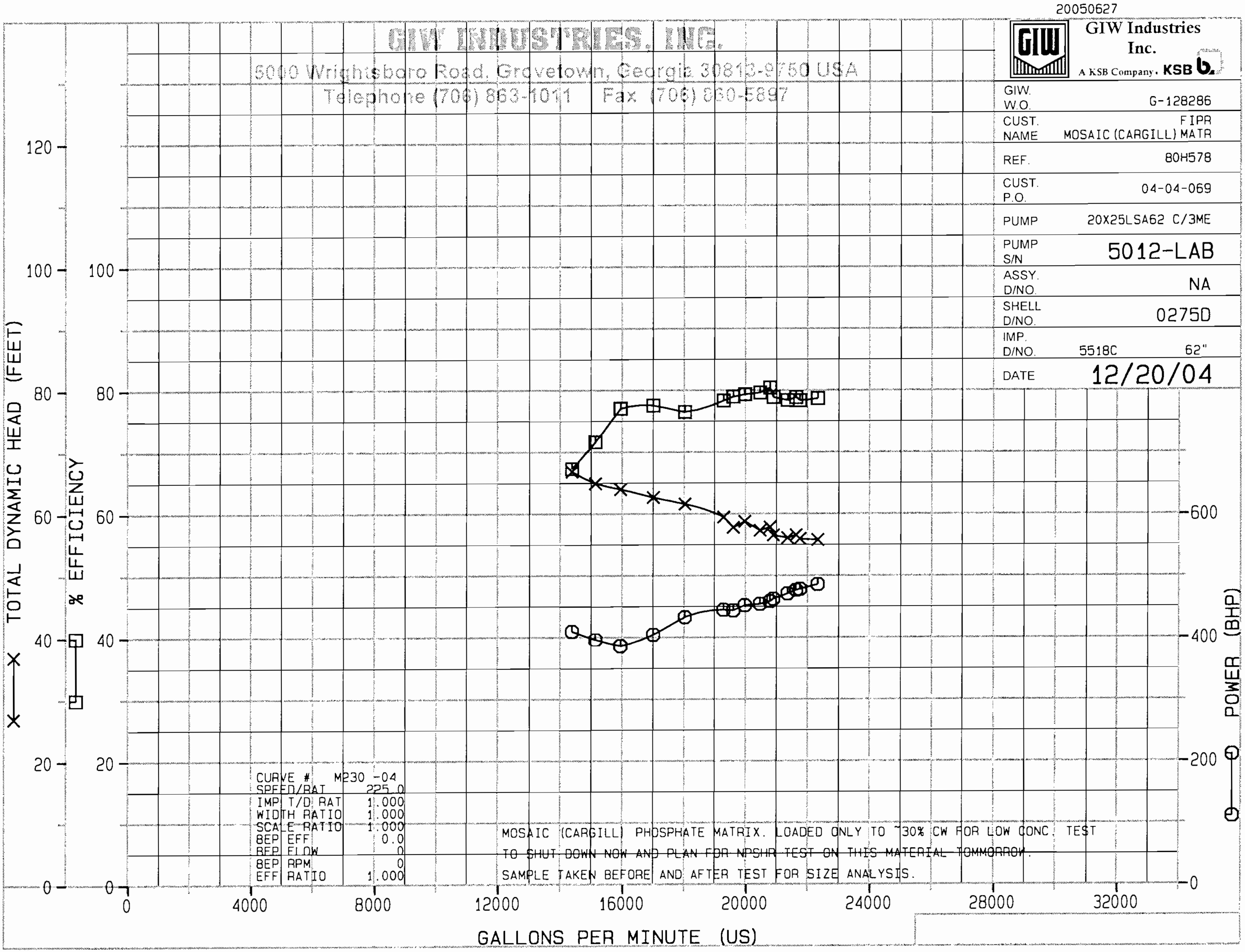
TEST RESULTS

NO	VELOCITY Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME CONC. Cv %	WEIGHT CONC. Cw %	MASS Ms TON/HR	REYNOLDS NUMBER Re	PIPELINE LOSSES Im FT/FT	PIPELINE LOSSES Iw FT/FT	FRICTION FACTRS Fm	FRICTION FACTRS Fw SAME Re	HAZEN WLLMS C	Im-Iw ----- Sm-Sw	TIME t HH.MM
1	14.71	13513.9	62.2	1.000	1.227	13.8	29.7	1234.4	0.201E+07	0.0622	0.0223	0.0243	0.0107	99.	0.1754	13.39
2	15.89	14594.5	62.3	1.000	1.223	13.5	29.3	1309.2	0.217E+07	0.0643	0.0258	0.0216	0.0106	105.	0.1725	13.40
3	16.74	15373.8	62.4	1.000	1.225	13.7	29.6	1394.4	0.229E+07	0.0622	0.0284	0.0188	0.0105	113.	0.1498	13.41
4	17.84	16386.1	62.5	1.000	1.223	13.5	29.3	1467.6	0.245E+07	0.0635	0.0320	0.0169	0.0104	119.	0.1412	13.43
5	18.61	17089.1	62.6	1.000	1.222	13.4	29.2	1523.6	0.256E+07	0.0645	0.0346	0.0158	0.0104	123.	0.1348	13.44
6	20.26	18611.5	62.7	1.000	1.218	13.2	28.7	1629.8	0.279E+07	0.0692	0.0406	0.0144	0.0103	128.	0.1313	13.45
7	16.32	14988.2	63.0	1.000	1.219	13.3	28.8	1318.4	0.226E+07	0.0525	0.0271	0.0168	0.0105	120.	0.1164	13.47
8	13.46	12365.1	63.1	1.000	1.217	13.1	28.6	1077.9	0.186E+07	0.0452	0.0189	0.0213	0.0108	107.	0.1214	13.49
9	11.98	11003.3	63.1	1.000	1.213	12.9	28.2	941.4	0.166E+07	0.0440	0.0152	0.0262	0.0110	97.	0.1352	13.50
10	10.88	9991.0	63.2	1.000	1.205	12.4	27.4	824.6	0.151E+07	0.0455	0.0127	0.0331	0.0112	86.	0.1594	13.51
11	9.04	8299.9	63.2	1.000	1.184	11.2	25.1	616.4	0.125E+07	0.0360	0.0090	0.0386	0.0115	80.	0.1458	13.53
12	7.71	7082.7	63.2	1.000	1.169	10.3	23.3	483.2	0.107E+07	0.0309	0.0067	0.0461	0.0117	74.	0.1422	13.54
13	6.43	5901.7	63.2	1.000	1.159	9.7	22.1	377.8	0.891E+06	0.0261	0.0048	0.0565	0.0121	67.	0.1335	13.55
14	4.90	4499.8	63.1	1.000	1.149	9.0	20.8	269.2	0.679E+06	0.0159	0.0029	0.0597	0.0126	67.	0.0869	13.57
15	3.95	3632.1	63.1	1.000	1.139	8.5	19.7	203.9	0.548E+06	0.0098	0.0020	0.0572	0.0131	69.	0.0562	13.58

TESTED BY LEE WHITLOCK DATE 12/20/04 COMMENTS: MOSAIC (CARGILL) PHOSPHATE MATRIX. LOADED ONLY TO ~30% CW FOR LOW CONC. TEST TO SHUT DOWN NOW AND PLAN FOR NPSHR TEST ON THIS MATERIAL TOMMORROW.

WITNESSED BY GRAEME ADDIE FOR FIPR SAMPLE TAKEN BEFORE AND AFTER TEST FOR SIZE ANALYSIS.

Version: 20050627 M230 -04 12/20/04


20050627
GIW Industries Inc.
A KSB Company. KSB
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW. W.O. G-128286
CUST. NAME FIPR MOSAIC (CARGILL) MATR
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/20/04
TOTAL DYNAMIC HEAD (FEET)
% EFFICIENCY
POWER (BHP)
GALLONS PER MINUTE (US)
CURVE # M230 -04
SPEED/RAT 225.0
IMP T/D RAT 1.000
WIDTH RATIO 1.000
SCALE RATIO 1.000
BEP EFF 0.0
BEP FLOW 0
BEP RPM 0
EFF RATIO 1.000
MOSAIC (CARGILL) PHOSPHATE MATRIX. LOADED ONLY TO ~30% CW FOR LOW CONC. TEST
TO SHUT DOWN NOW AND PLAN FOR NPSHR TEST ON THIS MATERIAL TOMMORROW.
SAMPLE TAKEN BEFORE AND AFTER TEST FOR SIZE ANALYSIS.

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE RDG	SOURCE INSTRUMENT			
1	NULLSUCTION	#1 YOKOGAWA-30-30 H20-1E2	06011B	0.000	
2S	NULLLOSS 20"	#2 YOKOGAWA -4-8' H20-1E2	12040B	0.000	
3	AVE S.G.U-SECUP	#3 ROSEMOUNT 4 12'H20 1E2	07093B	0.500	
4	AVE S.G.U-SECDN	#4 ROSEMONT4 -4-8'H20-1E2	07134B	0.500	
5.	DISCHARGE	#5 ROSEMONT 6 239'H20 1E1	07093B	1.000	
6S	DIFHEAD	#6 ROSEMONT 6 236'H20 1E1	07093B	1.000	
7.	NULLFLOWORIFICE	#7 ROSEMOUNT 5 60'H20 1E2	07093B	0.000	
8.	FLOWBEND	#8 ROSEMOUNT 5 24'H20 1E2	07093B	1.000	
9P	LOSS 20	#9 ROSEMOUNT 5 24'H20 1E2	07093B	1.000	
10S	FLOWBEND	#10ROSEMOUNT 4 12'H20 1E2	07134B	1.000	
11.	FLOWBEND	#11ROSEMOUNT 4 12'H20 1E2	07134B	1.000	
12S	NULLLOSS 20"	#12ROSEMOUNT 4 12'H20 1E2	07134B	0.000	
13S	LOSS 20"	#13ROSEMONT4 -4-8'H20-1E2	01164E	1.000	
14.	NULLDISCHARGE	#14ROSEMOUNT 5 24'H20 1E2	07134B	0.000	
15P	DIFHEAD	#15ROSEMOUNT 5 60'H20 1E2	01164E	1.000	
16S	NULLDISCHARGE	#16ROSEMONT 7 692'H20 1E1	07093B	0.000	
17	SUCTION	#17ROSE. 5 -30-30'H20-1E2	07093B	1.000	
18P	TEMPTANK	#18 RTD TANK F 1E1	10204D	1.000	
19S	TEMPAMBIENT	#19 RTD AMBIENT F 1E1	10204B	1.000	
20P	BHP TRQ*RPM	#20 BENSFELD 30K FTLB1E-1	02122B	1.000	
21	RPM TRQ BAR	#21 DAYTRONIC 300 RPM 1E1	02122D	1.000	
22S	BHP TRQ BAR	#22 BENSFELD 3000HP 1E1	02122F	1.000	
23S	NULLTEMPAMBIENT	#23 RTD7 100OHM F 1E1	04088B	0.000	
24P	NULLBHP TRQ*RPM	#24 LEBOW DAY 166 FTLB1E1	12211B	0.000	
25P	FLOW18" MAG	#25 18" F&P 32000 GPM 1E-1	11164B	1.000	
26S	NULLBHP TRQ BAR	#26 LEBOW, DAY 75HP 1E2	12211D	0.000	
27P	NULLFLOW3"MAG	#27 LOAD CELL 100LB 1E2	01101B	0.000	
28S	NULLFLOWORIFICE	TECO# 6158 21.80 FPS 1E2	09256C	0.000	
29.	NULLFLOW6"MAG	#29 6" YOKO 2800 GPM 1E1	12281A	0.000	
30P	NULLBHP TRQ*RPM	#30 LEBOW,DAY 833 FTLB1E1	05098C	0.000	
31	NULLRPM TRQ BAR	#31 LEBOW,DAY1500 RPM 1E0	05024C	0.000	
32S	NULLBHP TRQ BAR	#32 LEBOW,DAY 300 HP 1E1	07287C	0.000	

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO T230 -04 DATE 12/20/04

PUMP TEST DATA FOR FIPR MOSAIC(CARGILL)MATR

PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.80"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 245.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

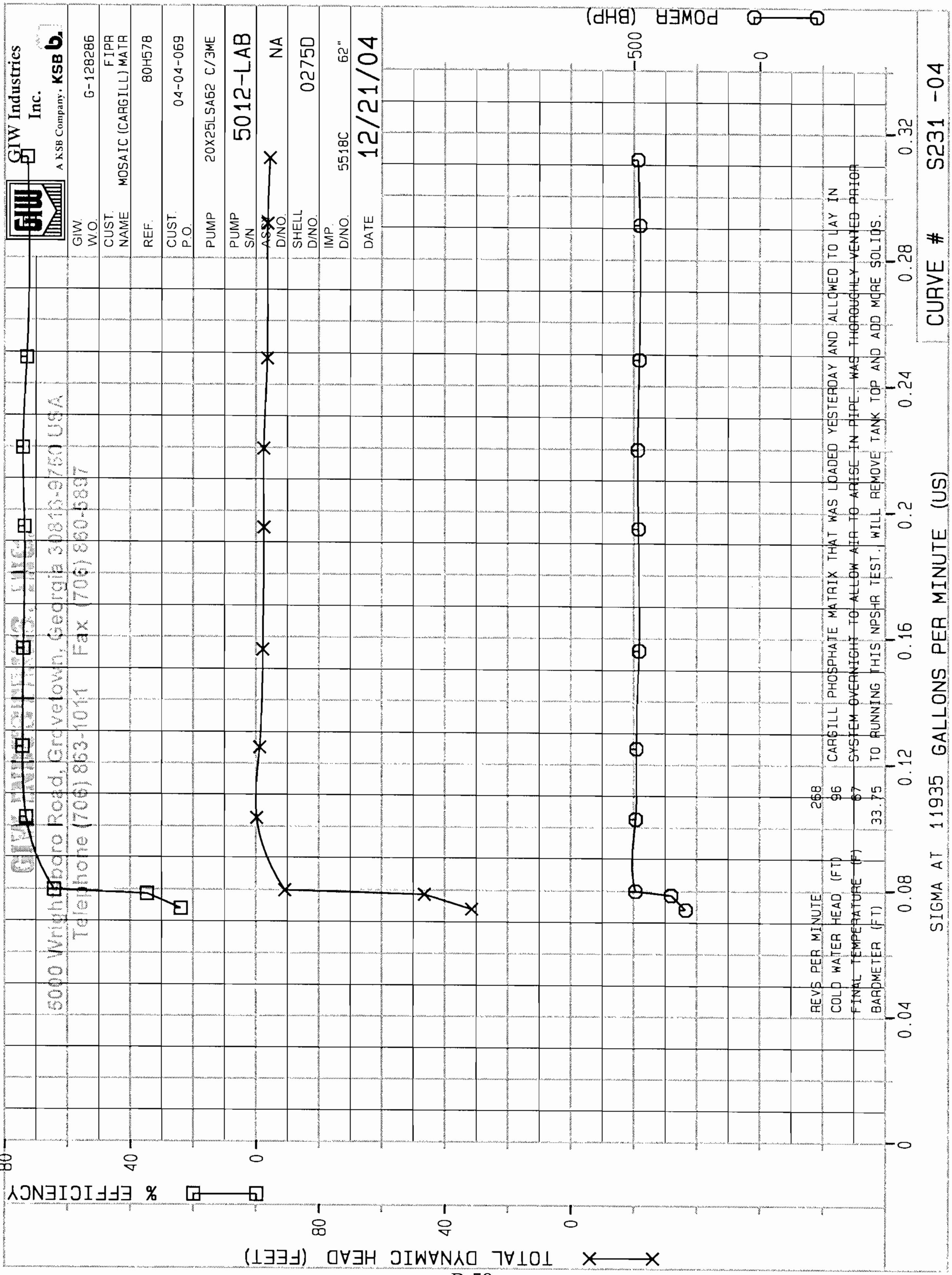
NO	FLOW MEASUREMENT FLOW Q GPM	VELOCITY FT/S	HEAD MEASUREMENT DISCH PSI	SUCTN " HG	TOT HD H FT	S.G.	DRIVER POWER INPUT KW	OUTPUT BHP	SPEED N RPM	PUMP OUTPUT WHP	EFF n %	TEMP Tm F	SCALED PERFORMANCE FLOW GPM	HEAD FT	POWER BHP	EFF %	TIME t H.MM	MAG18" C 25 *1.000	BEND12 S 10 *1.000
1	13513.9	14.71	12.37	-2.74	27.56	1.23	0.0	146.1	155.3	115.4	79.0	62.2	19582.	57.9	444.4	79.0	13.39	13514.	12917.
2	14594.5	15.89	13.14	-2.48	29.25	1.22	0.0	165.4	160.6	131.8	79.7	62.3	20444.	57.4	454.8	79.7	13.40	14595.	13884.
3	15373.8	16.74	13.81	-2.44	30.71	1.23	0.0	185.1	165.7	146.1	79.0	62.4	20870.	56.6	463.0	79.0	13.41	15374.	14845.
4	16386.1	17.84	14.90	-2.35	33.14	1.22	0.0	213.7	172.8	167.6	78.5	62.5	21334.	56.2	471.5	78.5	13.43	16386.	16098.
5	17089.1	18.61	15.58	-2.24	34.64	1.22	0.0	232.9	176.9	182.6	78.4	62.6	21732.	56.0	478.9	78.4	13.44	17089.	16836.
6	18611.5	20.26	17.45	-2.18	38.90	1.22	0.0	282.7	187.8	222.6	78.7	62.7	22303.	55.9	486.5	78.7	13.45	18612.	18346.
7	14988.2	16.32	12.22	-1.93	27.25	1.22	0.0	159.3	156.1	125.7	78.9	63.0	21608.	56.6	477.2	78.9	13.47	14988.	14658.
8	12365.1	13.46	9.21	-1.75	20.53	1.22	0.0	96.9	134.0	78.0	80.5	63.1	20765.	57.9	458.9	80.5	13.49	12365.	11849.
9	11003.3	11.98	8.02	-1.69	17.90	1.21	0.0	75.9	124.1	60.3	79.4	63.1	19951.	58.8	452.6	79.4	13.50	11003.	10636.
10	9991.0	10.88	7.20	-1.50	16.01	1.21	0.0	62.1	116.7	48.7	78.4	63.2	19270.	59.5	445.3	78.4	13.51	9991.0	9633.3
11	8299.9	9.04	5.74	-1.54	13.11	1.18	0.0	42.5	103.7	32.5	76.6	63.2	18002.	61.7	433.6	76.6	13.53	8299.9	8071.8
12	7082.7	7.71	4.70	-1.42	10.92	1.17	0.0	29.4	93.8	22.8	77.6	63.2	16981.	62.7	405.3	77.6	13.54	7082.7	6974.2
13	5901.7	6.43	3.75	-1.28	8.80	1.16	0.0	19.7	83.4	15.2	77.1	63.2	15925.	64.1	387.2	77.1	13.55	5901.7	5951.1
14	4499.8	4.90	2.42	-0.98	5.76	1.15	0.0	10.5	67.0	7.5	71.7	63.1	15111.	65.0	397.2	71.7	13.57	4499.8	4611.8
15	3632.1	3.95	1.55	-1.28	4.28	1.14	0.0	6.6	56.9	4.5	67.4	63.1	14364.	66.9	410.5	67.4	13.58	3632.1	3714.8

TESTED BY LEE WHITLOCK DATE 12/20/04 COMMENTS: MOSAIC (CARGILL) PHOSPHATE MATRIX. LOADED ONLY TO ~30% CW FOR LOW CONC. TEST TO SHUT DOWN NOW AND PLAN FOR NPSHR TEST ON THIS MATERIAL TOMMORROW.

WITNESSED BY GRAEME ADDIE FOR FIPR SAMPLE TAKEN BEFORE AND AFTER TEST FOR SIZE ANALYSIS.

Version: 20050627 T230 -04 12/20/04

2005O627


GIW Industries Inc.
A KSB Company. KSB
6000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW W.O. G-128286
CUST. NAME FIPR MOSAIC (CARGILL) MATR
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/21/04
% EFFICIENCY
80
40
0
TOTAL DYNAMIC HEAD (FEET)
80
40
0
POWER (BHP)
500
0
REVS PER MINUTE 268
COLD WATER HEAD (FT) 96
FINAL TEMPERATURE (F) 67
BAROMETER (FT) 33.75
CARGILL PHOSPHATE MATRIX THAT WAS LOADED YESTERDAY AND ALLOWED TO LAY IN
SYSTEM OVERNIGHT TO ALLOW AIR TO ARISE IN PIPE. WAS THOROUGHLY VENTED PRIOR
TO RUNNING THIS NPSHR TEST. WILL REMOVE TANK TOP AND ADD MORE SOLIDS.
0
0.04
0.08
0.12
0.16
0.2
0.24
0.28
0.32
SIGMA AT 11935 GALLONS PER MINUTE (US)
CURVE # S231 -04

PUMP DETAIL

PUMP 20X25LSA62 C/3ME

SERIAL NUMBER 5012-LAB
ASSEMBLY DRAWING NO NA
SHELL DRAWING NO 0275D
IMPELLER DRAWING NO 5518C
IMPELLER DIAMETER 62"
OUTLET ANGLE
OUTLET WIDTH
ROTATION CLOCKWISE
HYDROSTATIC PRESS. STD

DRIVER DETAIL

TYPE VARIABLE SPEED DRIVE
MAKE GENERAL ELECTRIC
SERIAL NO 5511957
FRAME SIZE 5368480
RPM = 450 BHP = 2450.
4160 VOLTS 3 PHASE 60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO 225.000

IMP TURN DOWN RATIO 1.000
MERIDINAL WIDTH RATIO 1.000
SCALE RATIO 1.000
BEP REF 0.GPM, 0.RPM
EFFICIENCY 0.0% BY 1.000

CH	USE	RDG	SOURCE	INSTRUMENT
1	NULL	SUCTION	#1	YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2	YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3	ROSEMOUNT 4 12'H2O 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4	ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5.		DISCHARGE	#5	ROSEMONT 6 239'H2O 1E1 07093B 1.000
6P		DIFHEAD	#6	ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7	ROSEMOUNT 5 60'H2O 1E2 07093B 0.000
8.		FLOWBEND	#8	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
9S		LOSS 20	#9	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
10S		FLOWBEND	#10	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
11.		FLOWBEND	#11	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
12S	NULL	LOSS 20"	#12	ROSEMOUNT 4 12'H2O 1E2 07134B 0.000
13P		LOSS 20"	#13	ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14	ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15S		DIFHEAD	#15	ROSEMOUNT 5 60'H2O 1E2 01164E 1.000
16S	NULL	DISCHARGE	#16	ROSEMONT 7 692'H2O 1E1 07093B 0.000
17		SUCTION	#17	ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P		TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23	RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO S231 -04 DATE 12/21/04

PUMP TEST DATA FOR FIPR
----------------- MOSAIC(CARGILL)MATR
PROJECT 80H578
GIW WORK ORDER NO G-128286
CUSTOMER ORDER NO 04-04-069

TEST CONSTANTS
1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.80"
G = 32.14 FT/S/S

TEST RESULTS

	FLOW MEASUREMENT		HEAD MEASUREMENT			S.G.	DRIVER POWER		SPEED	PUMP		TEMP	CAVITATION		SCALED PERFORMANCE				TIME	MAG18"
	FLOW Q	VELOCITY	DISCH	SUCTN	TOT HD		INPUT	OUTPUT	N	OUTPUT	EFF	Tm	NPSH	SIGMA	FLOW	HEAD	POWER	EFF	t	C 25
NO	GPM	FT/S	PSI	" HG	H FT		KW	BHP	RPM	WHP	n %	F	FT		GPM	FT	BHP	%	H.MM	*1.000
1	11935.3	12.99	47.96	-4.56	95.73	1.23	0.0	485.9	268.3	353.9	72.8	61.8	29.8	0.311	10010.	67.3	286.7	72.8	12.04	11935.
2	11609.9	12.64	47.18	-6.62	96.48	1.22	0.0	477.7	268.3	345.5	72.3	62.2	27.8	0.291	9738.	67.9	281.9	72.3	12.05	11610.
3	11762.5	12.81	45.00	-11.04	96.53	1.22	0.0	479.5	268.2	350.1	73.0	62.6	23.7	0.248	9868.	67.9	283.1	73.0	12.07	11763.
4	12075.9	13.15	43.73	-13.91	97.64	1.21	0.0	485.9	268.3	360.8	74.3	63.5	21.0	0.220	10128.	68.7	286.7	74.3	12.11	12076.
5	11951.3	13.01	42.43	-16.42	97.61	1.21	0.0	483.2	268.4	356.4	73.8	64.1	18.6	0.194	10019.	68.6	284.6	73.8	12.13	11951.
6	11838.9	12.89	40.88	-20.43	97.95	1.22	0.0	479.8	268.4	355.8	74.1	64.9	14.9	0.156	9924.	68.8	282.7	74.1	12.17	11839.
7	11923.2	12.98	40.18	-23.80	98.97	1.22	0.0	490.8	268.3	365.0	74.4	65.6	12.0	0.125	9998.	69.6	289.3	74.4	12.20	11923.
8	11826.8	12.88	39.16	-25.82	99.89	1.21	0.0	493.7	268.1	361.8	73.3	66.5	9.8	0.102	9925.	70.3	291.8	73.3	12.24	11827.
9	11577.8	12.61	32.96	-27.74	90.98	1.20	0.0	494.7	268.0	318.4	64.4	67.3	7.6	0.080	9718.	64.1	292.6	64.4	12.27	11578.
10	8569.0	9.33	10.68	-27.95	46.59	1.22	0.0	353.0	269.9	123.0	34.8	67.3	7.5	0.078	7143.	32.4	204.5	34.8	12.27	8569.0
11	7384.0	8.04	2.68	-27.99	31.61	1.21	0.0	295.6	270.4	71.1	24.1	67.3	7.1	0.074	6145.	21.9	170.4	24.1	12.27	7384.0

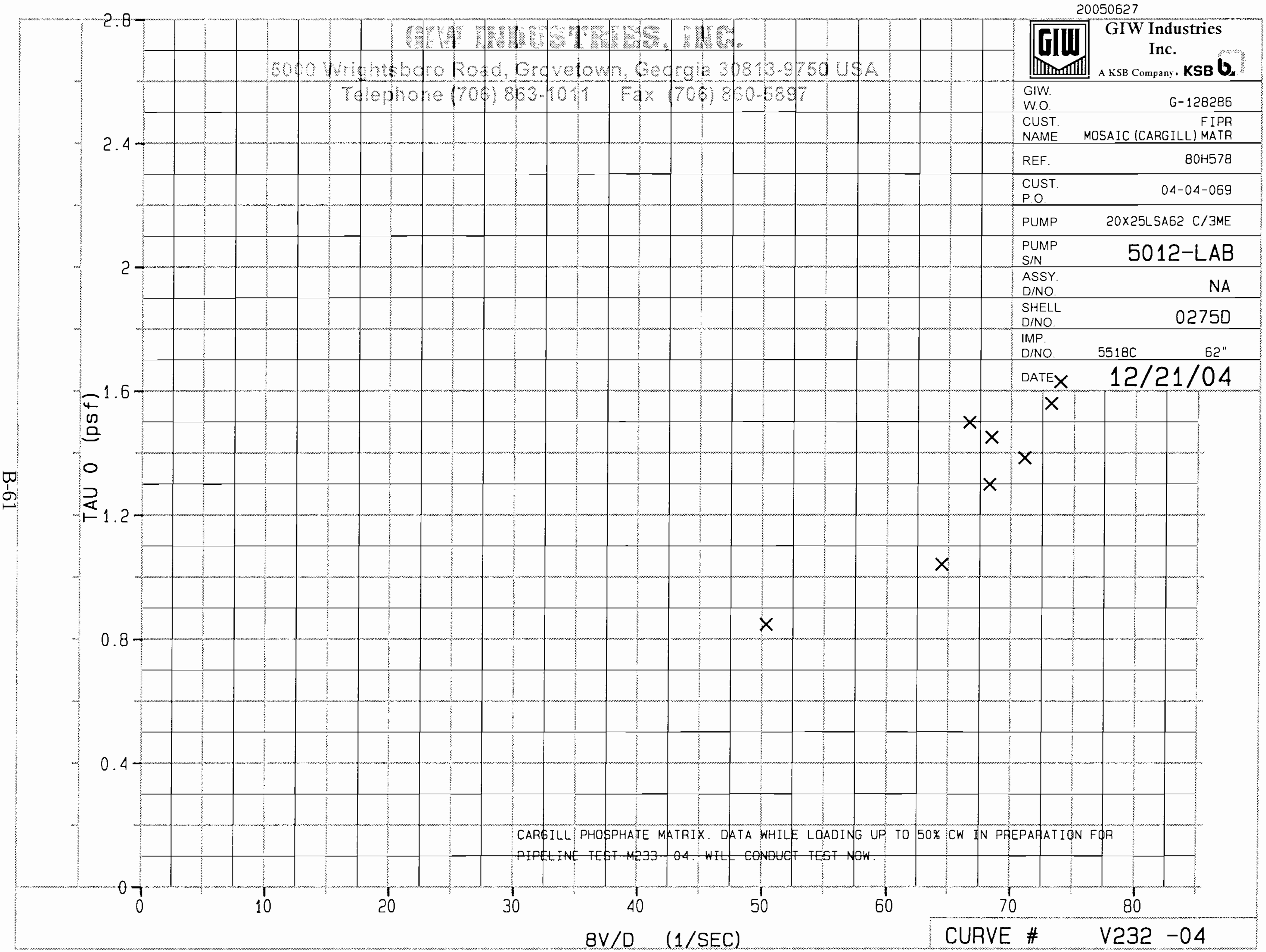
TESTED BY LEE WHITLOCK DATE 12/21/04

WITNESSED BY GRAEME ADDIE FOR FIPR

COMMENTS: CARGILL PHOSPHATE MATRIX THAT WAS LOADED YESTERDAY AND ALLOWED TO LAY IN SYSTEM OVERNIGHT TO ALLOW AIR TO ARISE IN PIPE. WAS THOROUGHLY VENTED PRIOR TO RUNNING THIS NPSHR TEST. WILL REMOVE TANK TOP AND ADD MORE SOLIDS.

Version: 20050627

S231 -04 12/21/04


20050627
GIW Industries Inc.
A KSB Company. KSB
GIW W.O. G-128286
CUST. NAME FIPR MOSAIC (CARGILL) MATR
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/21/04
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
TAU 0 (psf)
2.8
2.4
2
1.6
1.2
0.8
0.4
0
0
10
20
30
40
50
60
70
80
8V/D (1/SEC)
CARGILL PHOSPHATE MATRIX. DATA WHILE LOADING UP TO 50% CW IN PREPARATION FOR
PIPELINE TEST M233-04. WILL CONDUCT TEST NOW.
CURVE # V232 -04

PUMP DETAIL

PUMP 20X25LSA62 C/3ME

SERIAL NUMBER 5012-LAB
ASSEMBLY DRAWING NO NA
SHELL DRAWING NO 0275D
IMPELLER DRAWING NO 5518C
IMPELLER DIAMETER 62"
OUTLET ANGLE
OUTLET WIDTH
ROTATION CLOCKWISE
HYDROSTATIC PRESS. STD

DRIVER DETAIL

TYPE VARIABLE SPEED DRIVE
MAKE GENERAL ELECTRIC
SERIAL NO 5511957
FRAME SIZE 5368480
RPM = 450 BHP = 2450.
4160 VOLTS 3 PHASE 60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO 225.000

IMP TURN DOWN RATIO 1.000
MERIDINAL WIDTH RATIO 1.000
SCALE RATIO 1.000
BEP REF 0.GPM, 0.RPM
EFFICIENCY 0.0% BY 1.000

CH	USE	RDG	SOURCE	INSTRUMENT
1	NULL	SUCTION	#1	YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2	YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3	ROSEMOUNT 4 12'H2O 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4	ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5.		DISCHARGE	#5	ROSEMONT 6 239'H2O 1E1 07093B 1.000
6P		DIFHEAD	#6	ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7	ROSEMOUNT 5 60'H2O 1E2 07093B 0.000
8.		FLOWBEND	#8	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
9S		LOSS 20	#9	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
10S		FLOWBEND	#10	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
11.		FLOWBEND	#11	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
12S	NULL	LOSS 20"	#12	ROSEMOUNT 4 12'H2O 1E2 07134B 0.000
13P		LOSS 20"	#13	ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14	ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15S		DIFHEAD	#15	ROSEMOUNT 5 60'H2O 1E2 01164E 1.000
16S	NULL	DISCHARGE	#16	ROSEMONT 7 692'H2O 1E1 07093B 0.000
17		SUCTION	#17	ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P		TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23	RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO V232 -04 DATE 12/21/04

PUMP TEST DATA FOR FIPR
------------------ MOSAIC(CARGILL)MATR
PROJECT 80H578
GIW WORK ORDER NO G-128286
CUSTOMER ORDER NO 04-04-069

TEST CONSTANTS
1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.80"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 245.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

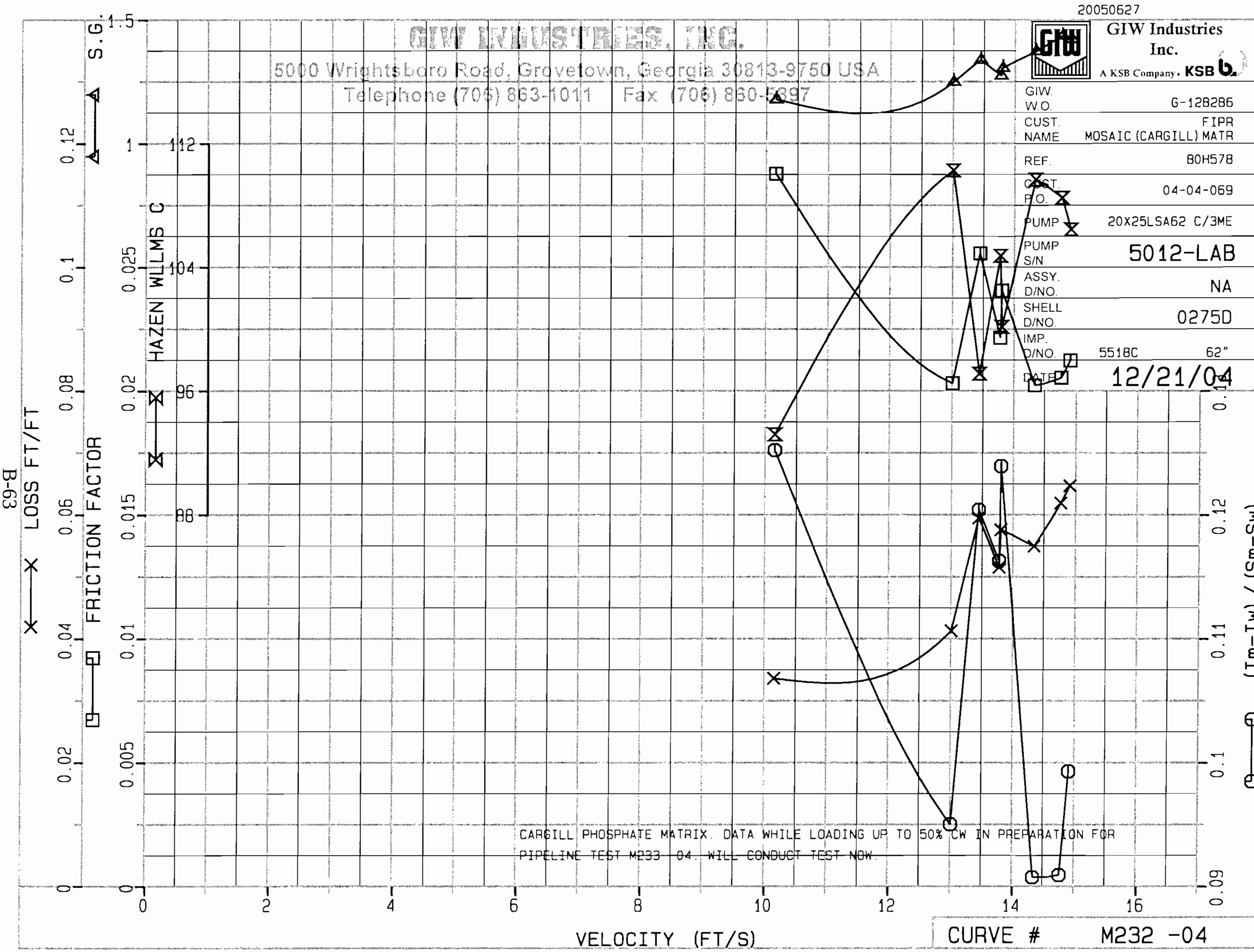
TEST RESULTS

NO	VELOCITY: Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME: CONC.: Cv %	WEIGHT: CONC.: Cw %	MASS Ms TON/HR	PIPELINE LOSSES: Im FT/FT	Iw FT/FT	dp/dx psf	Tau 0 psf	8V/D 1/SEC	Tau 0 ln psf	8V/D ln 1/SEC	TIME t HH.MM
1	10.14	9316.2	69.6	0.999	1.180	11.0	24.6	677.7	0.0337	0.0110	2.1025	0.8485	50.270	-.1643	3.9174	14.02
2	12.99	11935.3	69.2	0.999	1.250	15.2	32.3	1205.5	0.0414	0.0175	2.5816	1.0418	64.403	0.0409	4.1652	14.08
3	13.76	12642.3	69.1	0.999	1.276	16.8	34.8	1404.8	0.0516	0.0195	3.2215	1.3000	68.218	0.2624	4.2227	14.11
4	13.79	12666.4	68.9	0.999	1.307	18.6	37.8	1564.9	0.0577	0.0195	3.5977	1.4518	68.348	0.3728	4.2246	14.13
5	13.43	12337.0	68.8	0.999	1.339	20.6	40.8	1685.5	0.0596	0.0186	3.7167	1.4998	66.571	0.4054	4.1983	14.16
6	14.33	13160.4	68.9	0.999	1.374	22.7	43.8	1983.2	0.0550	0.0210	3.4337	1.3856	71.014	0.3262	4.2629	14.23
7	14.90	13686.7	68.8	0.999	1.424	25.7	47.9	2335.7	0.0648	0.0226	4.0415	1.6309	73.854	0.4892	4.3021	14.31
8	14.76	13554.1	68.9	0.999	1.437	26.5	48.9	2384.3	0.0620	0.0222	3.8679	1.5608	73.138	0.4452	4.2924	14.34

TESTED BY LEE WHITLOCK DATE 12/21/04 COMMENTS: CARGILL PHOSPHATE MATRIX. DATA WHILE LOADING UP TO 50% CW IN PREPARATION FOR PIPELINE TEST M233 -04. WILL CONDUCT TEST NOW.

WITNESSED BY GRAEME ADDIE FOR FIPR
Version: 20050627

V232 -04 12/21/04


20050627
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW Industries Inc.
A KSB Company. KSB
GIW. W.O. G-128286
CUST. NAME FIPR MOSAIC (CARGILL) MATR
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/21/04
S.G.
FRICTION FACTOR
LOSS FT/FT
HAZEN WLLMS C
(Im-Iw)/(Sm-Sw)
CARGILL PHOSPHATE MATRIX. DATA WHILE LOADING UP TO 50% CW IN PREPARATION FOR
PIPELINE TEST M233 04. WILL CONDUCT TEST NOW.
VELOCITY (FT/S)
CURVE # M232 -04

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE RDG SOURCE	INSTRUMENT
1	NULLSUCTION	#1 YOKOGAWA-30-30 H20-1E2 06011B 0.000
2S	NULLLOSS 20"	#2 YOKOGAWA -4-8' H20-1E2 12040B 0.000
3	AVE S.G.U-SECUP	#3 ROSEMOUNT 4 12'H20 1E2 07093B 0.500
4	AVE S.G.U-SECDN	#4 ROSEMONT4 -4-8'H20-1E2 07134B 0.500
5.	DISCHARGE	#5 ROSEMONT 6 239'H20 1E1 07093B 1.000
6P	DIFHEAD	#6 ROSEMONT 6 236'H20 1E1 07093B 1.000
7.	NULLFLOWORIFICE	#7 ROSEMOUNT 5 60'H20 1E2 07093B 0.000
8.	FLOWBEND	#8 ROSEMOUNT 5 24'H20 1E2 07093B 1.000
9S	LOSS 20	#9 ROSEMOUNT 5 24'H20 1E2 07093B 1.000
10S	FLOWBEND	#10ROSEMOUNT 4 12'H20 1E2 07134B 1.000
11.	FLOWBEND	#11ROSEMOUNT 4 12'H20 1E2 07134B 1.000
12S	NULLLOSS 20"	#12ROSEMOUNT 4 12'H20 1E2 07134B 0.000
13P	LOSS 20"	#13ROSEMONT4 -4-8'H20-1E2 01164E 1.000
14.	NULLDISCHARGE	#14ROSEMOUNT 5 24'H20 1E2 07134B 0.000
15S	DIFHEAD	#15ROSEMOUNT 5 60'H20 1E2 01164E 1.000
16S	NULLDISCHARGE	#16ROSEMONT 7 692'H20 1E1 07093B 0.000
17	SUCTION	#17ROSE. 5 -30-30'H20-1E2 07093B 1.000
18P	TEMPTANK	#18 RTD TANK F 1E1 10204D 1.000
19S	TEMPAMBIENT	#19 RTD AMBIENT F 1E1 10204B 1.000
20P	BHP TRQ*RPM	#20 BENSFELD 30K FTLB1E-102122B 1.000
21	RPM TRQ BAR	#21 DAYTRONIC 300 RPM 1E1 02122D 1.000
22S	BHP TRQ BAR	#22 BENSFELD 3000HP 1E1 02122F 1.000
23S	NULLTEMPAMBIENT	#23 RTD7 100OHM F 1E1 04088B 0.000
24P	NULLBHP TRQ*RPM	#24 LEBOW DAY 166 FTLB1E1 12211B 0.000
25P	FLOW18" MAG	#25 18" F&P 32000 GPM 1E-111164B 1.000
26S	NULLBHP TRQ BAR	#26 LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULLFLOW3"MAG	#27 LOAD CELL 100LB 1E2 01101B 0.000
28S	NULLFLOWORIFICE	TECO# 6158 21.80 FPS 1E2 09256C 0.000
29.	NULLFLOW6"MAG	#29 6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULLBHP TRQ*RPM	#30 LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULLRPM TRQ BAR	#31 LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULLBHP TRQ BAR	#32 LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO M232 -04 DATE 12/21/04

PUMP TEST DATA FOR	FIPR
	MOSAIC(CARGILL)MATR
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.80"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 245.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

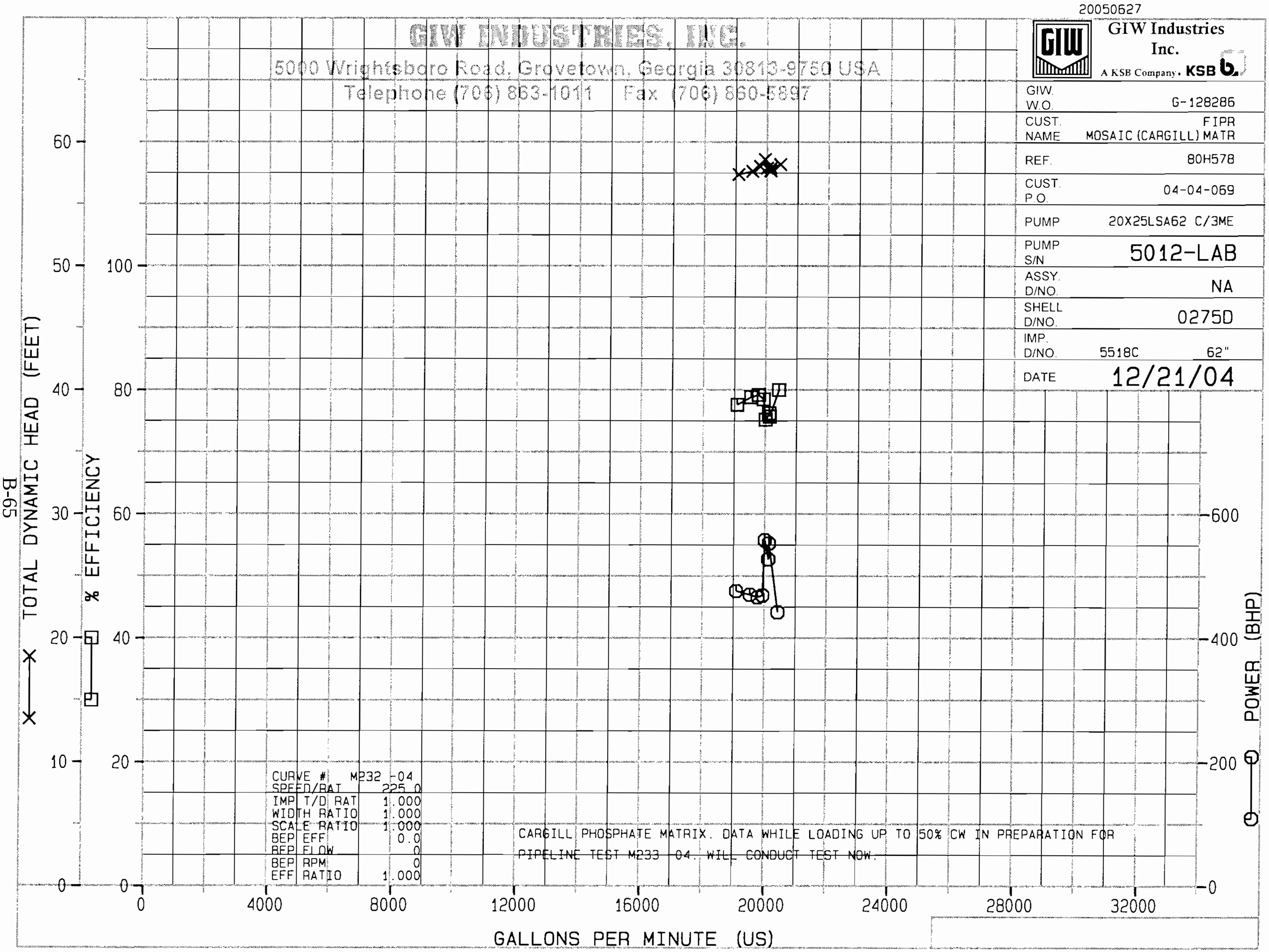
NO	VELOCITY Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME CONC. Cv %	WEIGHT CONC. Cw %	MASS Ms TON/HR	REYNOLDS NUMBER Re	PIPELINE LOSSES Im FT/FT	Iw FT/FT	FRICTION FACTRS Fm	Fw SAME Re	HAZEN WLLMS C	Im-Iw ----- Sm-Sw	TIME t HH.MM
1	10.14	9316.2	69.6	0.999	1.180	11.0	24.6	677.7	0.154E+07	0.0337	0.0110	0.0288	0.0111	93.	0.1252	14.02
2	12.99	11935.3	69.2	0.999	1.250	15.2	32.3	1205.5	0.197E+07	0.0414	0.0175	0.0203	0.0107	110.	0.0951	14.08
3	13.76	12642.3	69.1	0.999	1.276	16.8	34.8	1404.8	0.208E+07	0.0516	0.0195	0.0222	0.0107	105.	0.1163	14.11
4	13.79	12666.4	68.9	0.999	1.307	18.6	37.8	1564.9	0.208E+07	0.0577	0.0195	0.0241	0.0107	100.	0.1240	14.13
5	13.43	12337.0	68.8	0.999	1.339	20.6	40.8	1685.5	0.202E+07	0.0596	0.0186	0.0256	0.0107	97.	0.1204	14.16
6	14.33	13160.4	68.9	0.999	1.374	22.7	43.8	1983.2	0.216E+07	0.0550	0.0210	0.0202	0.0106	110.	0.0908	14.23
7	14.90	13686.7	68.8	0.999	1.424	25.7	47.9	2335.7	0.224E+07	0.0648	0.0226	0.0213	0.0106	106.	0.0993	14.31
8	14.76	13554.1	68.9	0.999	1.437	26.5	48.9	2384.3	0.223E+07	0.0620	0.0222	0.0206	0.0106	109.	0.0909	14.34

TESTED BY LEE WHITLOCK DATE 12/21/04 COMMENTS: CARGILL PHOSPHATE MATRIX. DATA WHILE LOADING UP TO 50% CW IN PREPARATION FOR PIPELINE TEST M233 -04. WILL CONDUCT TEST NOW.

WITNESSED BY GRAEME ADDIE FOR FIPR

Version: 20050627

M232 -04 12/21/04


20050627
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW Industries Inc.
A KSB Company. KSB
GIW W.O. G-128286
CUST. NAME FIPR MOSAIC (CARGILL) MATR
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/21/04
CURVE # M232 -04
SPEED/RAT 225.0
IMP T/D RAT 1.000
WIDTH RATIO 1.000
SCALE RATIO 1.000
BEP EFF 0.0
BEP FLOW 0
BEP RPM 0
EFF RATIO 1.000
CARGILL PHOSPHATE MATRIX. DATA WHILE LOADING UP TO 50% CW IN PREPARATION FOR
PIPELINE TEST M233 -04. WILL CONDUCT TEST NOW.
TOTAL DYNAMIC HEAD (FEET)
% EFFICIENCY
POWER (BHP)
GALLONS PER MINUTE (US)
0
10
20
30
40
50
60
0
20
40
60
80
100
0
200
400
600
0
4000
8000
12000
16000
20000
24000
28000
32000

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE	RDG	SOURCE	INSTRUMENT
1	NULL	SUCTION	#1	YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2	YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3	ROSEMOUNT 4 12'H2O 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4	ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5.		DISCHARGE	#5	ROSEMONT 6 239'H2O 1E1 07093B 1.000
6P		DIFHEAD	#6	ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7	ROSEMOUNT 5 60'H2O 1E2 07093B 0.000
8.		FLOWBEND	#8	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
9S		LOSS 20	#9	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
10S		FLOWBEND	#10	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
11.		FLOWBEND	#11	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
12S	NULL	LOSS 20"	#12	ROSEMOUNT 4 12'H2O 1E2 07134B 0.000
13P		LOSS 20"	#13	ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14	ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15S		DIFHEAD	#15	ROSEMOUNT 5 60'H2O 1E2 01164E 1.000
16S	NULL	DISCHARGE	#16	ROSEMONT 7 692'H2O 1E1 07093B 0.000
17		SUCTION	#17	ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P		TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23	RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO T232 -04 DATE 12/21/04

PUMP TEST DATA FOR	FIPR
------------------	MOSAIC(CARGILL)MATR
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.80"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 245.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

	FLOW MEASUREMENT		HEAD MEASUREMENT			S.G.	DRIVER POWER		SPEED	PUMP		TEMP	SCALED PERFORMANCE				TIME	MAG18"	BEND12
	FLOW Q	VELOCITY	DISCH	SUCTN	TOT HD		INPUT	OUTPUT	N	OUTPUT	EFF	Tm	FLOW	HEAD	POWER	EFF	t	C 25	S 10
NO	GPM	FT/S	PSI	" HG	H FT		KW	BHP	RPM	WHP	n %	F	GPM	FT	BHP	%	H.MM	*1.000	*1.000
1	9316.2	10.14	3.32	-5.18	12.14	1.18	0.0	42.1	102.7	33.7	80.1	69.6	20405.	58.2	442.2	80.1	14.02	9316.2	9039.2
2	11935.3	12.99	7.42	-6.76	21.06	1.25	0.0	101.1	134.8	79.4	78.6	69.2	19914.	58.6	469.4	78.6	14.08	11935.	11334.
3	12642.3	13.76	9.13	-6.58	23.77	1.28	0.0	122.1	143.9	96.8	79.3	69.1	19761.	58.1	466.4	79.3	14.11	12642.	11883.
4	12666.4	13.79	9.75	-6.58	24.30	1.31	0.0	128.7	146.0	101.6	78.9	68.9	19515.	57.7	470.8	78.9	14.13	12666.	11702.
5	12337.0	13.43	9.97	-6.67	24.05	1.34	0.0	129.1	145.6	100.3	77.7	68.8	19064.	57.4	476.5	77.7	14.16	12337.	11683.
6	13160.4	14.33	10.40	-7.10	24.75	1.37	0.0	148.1	147.3	113.0	76.3	68.9	20098.	57.7	527.5	76.3	14.23	13160.	12745.
7	13686.7	14.90	12.53	-6.26	26.84	1.42	0.0	174.3	153.1	132.1	75.8	68.8	20113.	58.0	553.3	75.8	14.31	13687.	12812.
8	13554.1	14.76	12.75	-5.94	26.65	1.44	0.0	174.2	152.6	131.1	75.3	68.9	19984.	57.9	558.3	75.3	14.34	13554.	12620.

TESTED BY LEE WHITLOCK DATE 12/21/04 COMMENTS: CARGILL PHOSPHATE MATRIX. DATA WHILE LOADING UP TO 50% CW IN PREPARATION FOR PIPELINE TEST M233 -04. WILL CONDUCT TEST NOW.

WITNESSED BY GRAEME ADDIE FOR FIPR

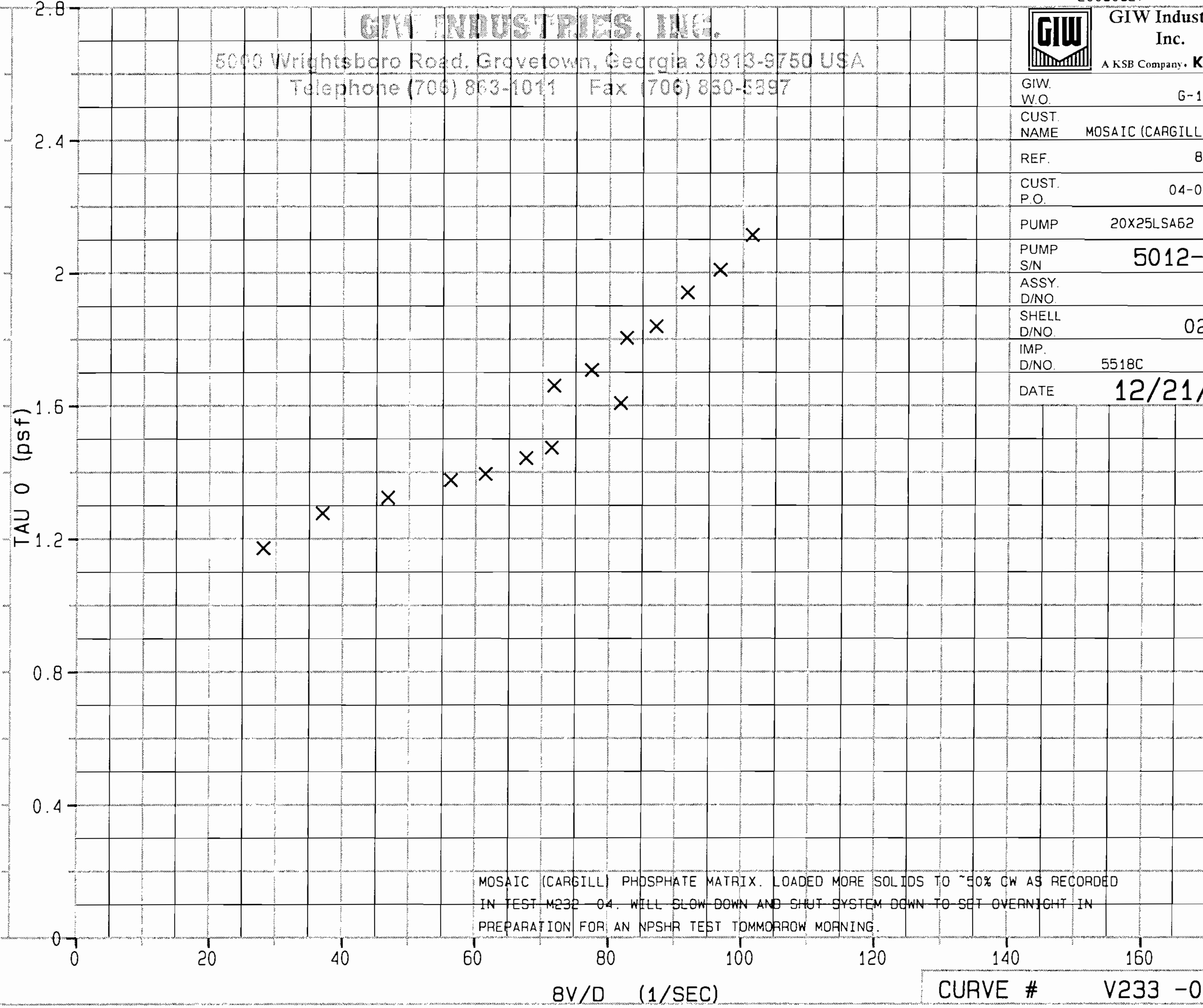
Version: 20050627

T232 -04 12/21/04

20050627

GIW Industries Inc.
A KSB Company. KSB

GIW. W.O.	G-128286
CUST. NAME	FIPR MOSAIC (CARGILL) MATR
REF.	80H578
CUST. P.O.	04-04-069
PUMP	20X25LSA62 C/3ME
PUMP S/N	5012-LAB
ASSY. D/NO.	NA
SHELL D/NO.	0275D
IMP. D/NO.	5518C 62"
DATE	12/21/04



CURVE # V233 -04

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE	RDG	SOURCE	INSTRUMENT
1	NULL	SUCTION	#1	YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2	YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3	ROSEMOUNT 4 12'H2O 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4	ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5.		DISCHARGE	#5	ROSEMONT 6 239'H2O 1E1 07093B 1.000
6P		DIFHEAD	#6	ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7	ROSEMOUNT 5 60'H2O 1E2 07093B 0.000
8.		FLOWBEND	#8	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
9P		LOSS 20	#9	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
10S		FLOWBEND	#10	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
11.		FLOWBEND	#11	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
12S	NULL	LOSS 20"	#12	ROSEMOUNT 4 12'H2O 1E2 07134B 0.000
13S		LOSS 20"	#13	ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14	ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15S		DIFHEAD	#15	ROSEMOUNT 5 60'H2O 1E2 01164E 1.000
16S	NULL	DISCHARGE	#16	ROSEMONT 7 692'H2O 1E1 07093B 0.000
17		SUCTION	#17	ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P		TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23	RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO V233 -04 DATE 12/21/04

PUMP TEST DATA FOR	FIPR
	MOSAIC(CARGILL)MATR
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.80"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 245.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

NO	VELOCITY Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME CONC. Cv %	WEIGHT CONC. Cw %	MASS Ms TON/HR	PIPELINE LOSSES Im FT/FT	Iw FT/FT	dp/dx psf	Tau 0 psf	8V/D 1/SEC	Tau 0 ln psf	8V/D ln 1/SEC	TIME t HH.MM
1	14.44	13264.9	68.7	0.999	1.448	27.2	49.7	2390.4	0.0660	0.0213	4.1165	1.6612	71.578	0.5075	4.2708	14.37
2	15.58	14313.3	68.4	0.999	1.449	27.3	49.9	2588.9	0.0678	0.0246	4.2335	1.7084	77.235	0.5356	4.3469	14.39
3	16.64	15281.4	68.8	0.999	1.451	27.4	50.0	2775.9	0.0717	0.0277	4.4740	1.8054	82.459	0.5908	4.4123	14.40
4	17.53	16096.9	69.1	0.999	1.445	27.0	49.6	2885.6	0.0731	0.0305	4.5584	1.8395	86.859	0.6095	4.4643	14.42
5	18.47	16964.5	69.3	0.999	1.448	27.2	49.7	3057.4	0.0771	0.0337	4.8119	1.9418	91.541	0.6636	4.5168	14.43
6	19.46	17876.4	69.6	0.999	1.448	27.2	49.7	3221.0	0.0798	0.0371	4.9809	2.0100	96.462	0.6981	4.5691	14.45
7	20.43	18764.2	70.1	0.999	1.444	27.0	49.5	3354.9	0.0840	0.0406	5.2408	2.1149	101.25	0.7490	4.6176	14.46
8	16.46	15120.7	69.9	0.999	1.434	26.4	48.7	2642.5	0.0639	0.0271	3.9865	1.6087	81.592	0.4754	4.4017	14.50
9	14.38	13204.6	69.3	0.999	1.446	27.0	49.6	2368.4	0.0586	0.0211	3.6551	1.4750	71.253	0.3886	4.2662	14.52
10	13.59	12485.6	68.9	0.999	1.444	26.9	49.4	2229.7	0.0573	0.0190	3.5771	1.4435	67.373	0.3671	4.2102	14.53
11	12.37	11364.9	68.8	0.999	1.441	26.8	49.2	2017.7	0.0555	0.0160	3.4601	1.3963	61.325	0.3338	4.1162	14.55
12	11.32	10396.8	68.6	0.999	1.440	26.7	49.1	1839.6	0.0547	0.0135	3.4146	1.3779	56.101	0.3206	4.0272	14.57
13	9.41	8645.4	68.2	0.999	1.440	26.7	49.2	1531.6	0.0526	0.0096	3.2846	1.3255	46.651	0.2818	3.8427	15.02
14	7.44	6829.7	68.1	0.999	1.445	27.0	49.6	1224.4	0.0508	0.0062	3.1676	1.2783	36.853	0.2455	3.6069	15.04
15	5.65	5186.7	68.0	0.999	1.474	28.8	51.7	990.2	0.0466	0.0037	2.9076	1.1734	27.988	0.1599	3.3318	15.06

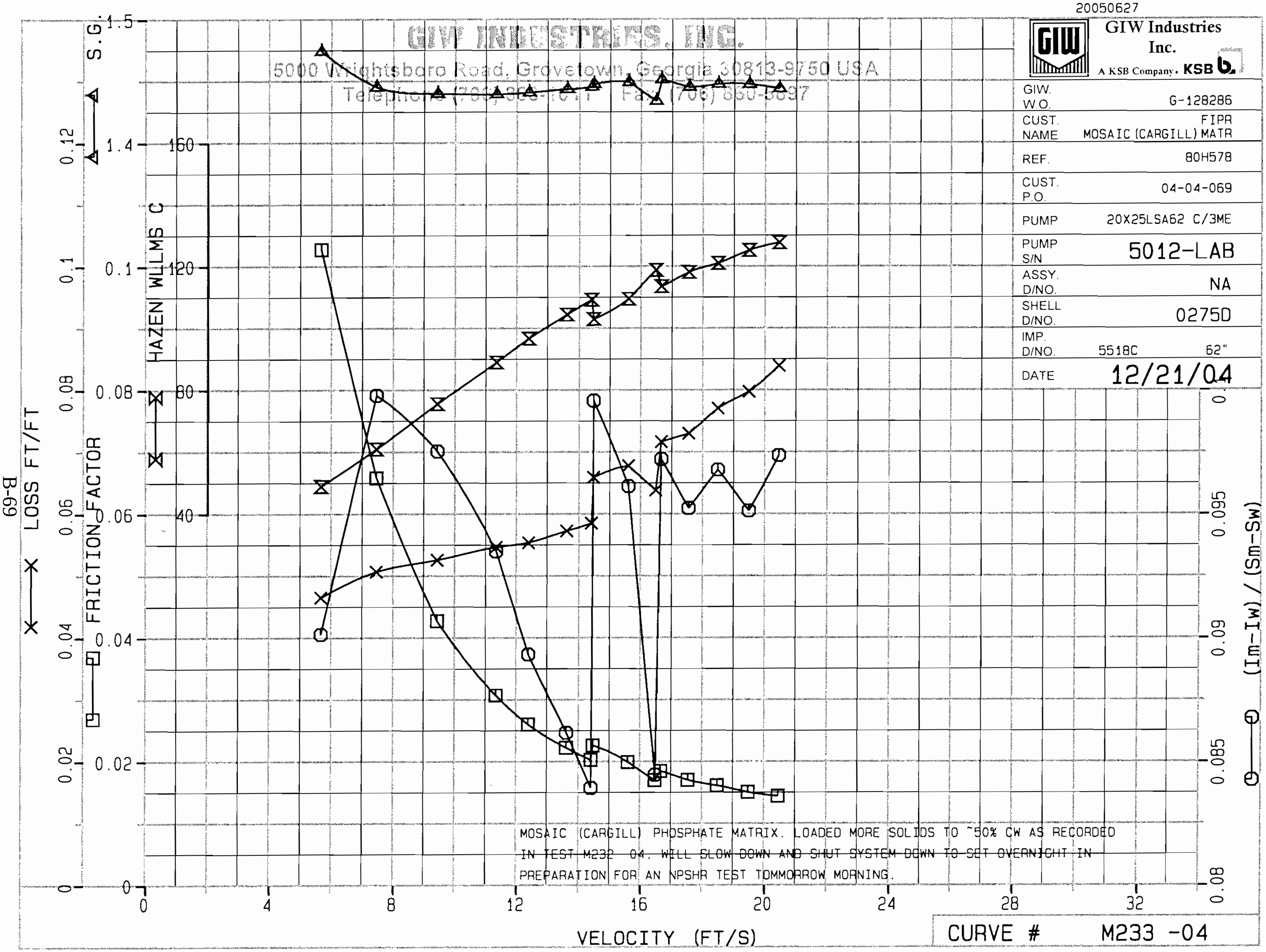
TESTED BY LEE WHITLOCK DATE 12/21/04

WITNESSED BY GRAEME ADDIE FOR FIPR

COMMENTS: MOSAIC (CARGILL) PHOSPHATE MATRIX. LOADED MORE SOLIDS TO ~50% CW AS RECORDED IN TEST M232 -04. WILL SLOW DOWN AND SHUT SYSTEM DOWN TO SET OVERNIGHT IN PREPARATION FOR AN NPSHR TEST TOMMORROW MORNING.

Version: 20050627

V233 -04 12/21/04


20050627
GIW Industries Inc.
A KSB Company. KSB
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
GIW. W.O. G-128286
CUST. NAME FIPR MOSAIC (CARGILL) MATR
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/21/04
S.G.
HAZEN WLLMS C
FRICTION FACTOR
LOSS FT/FT
(Im-Iw) / (Sm-Sw)
VELOCITY (FT/S)
MOSAIC (CARGILL) PHOSPHATE MATRIX. LOADED MORE SOLIDS TO ~50% CW AS RECORDED
IN TEST M232 04. WILL SLOW DOWN AND SHUT SYSTEM DOWN TO SET OVERNIGHT IN
PREPARATION FOR AN NPSHR TEST TOMMORROW MORNING.
CURVE # M233 -04

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO M233 -04 DATE 12/21/04

PUMP TEST DATA FOR FIPR
MOSAIC(CARGILL)MATR

PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480

RPM = 450 BHP = 2450.
4160 VOLTS 3 PHASE 60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000

BEP REF 0.GPM, 0.RPM
EFFICIENCY 0.0% BY 1.000

INSTRUMENTATION

CH	USE RDG	SOURCE INSTRUMENT
1	NULLSUCTION	#1 YOKOGAWA-30-30 H20-1E2 06011B 0.000
2S	NULLLOSS 20"	#2 YOKOGAWA -4-8' H20-1E2 12040B 0.000
3	AVE S.G.U-SECUP	#3 ROSEMOUNT 4 12'H20 1E2 07093B 0.500
4	AVE S.G.U-SECDN	#4 ROSEMONT4 -4-8'H20-1E2 07134B 0.500
5.	DISCHARGE	#5 ROSEMONT 6 239'H20 1E1 07093B 1.000
6P	DIFHEAD	#6 ROSEMONT 6 236'H20 1E1 07093B 1.000
7.	NULLFLOWORIFICE	#7 ROSEMOUNT 5 60'H20 1E2 07093B 0.000
8.	FLOWBEND	#8 ROSEMOUNT 5 24'H20 1E2 07093B 1.000
9P	LOSS 20	#9 ROSEMOUNT 5 24'H20 1E2 07093B 1.000
10S	FLOWBEND	#10ROSEMOUNT 4 12'H20 1E2 07134B 1.000
11.	FLOWBEND	#11ROSEMOUNT 4 12'H20 1E2 07134B 1.000
12S	NULLLOSS 20"	#12ROSEMOUNT 4 12'H20 1E2 07134B 0.000
13S	LOSS 20"	#13ROSEMONT4 -4-8'H20-1E2 01164E 1.000
14.	NULLDISCHARGE	#14ROSEMOUNT 5 24'H20 1E2 07134B 0.000
15S	DIFHEAD	#15ROSEMOUNT 5 60'H20 1E2 01164E 1.000
16S	NULLDISCHARGE	#16ROSEMONT 7 692'H20 1E1 07093B 0.000
17	SUCTION	#17ROSE. 5 -30-30'H20-1E2 07093B 1.000
18P	TEMPTANK	#18 RTD TANK F 1E1 10204D 1.000
19S	TEMPAMBIENT	#19 RTD AMBIENT F 1E1 10204B 1.000
20P	BHP TRQ*RPM	#20 BENSFELD 30K FTLB1E-102122B 1.000
21	RPM TRQ BAR	#21 DAYTRONIC 300 RPM 1E1 02122D 1.000
22S	BHP TRQ BAR	#22 BENSFELD 3000HP 1E1 02122F 1.000
23S	NULLTEMPAMBIENT	#23 RTD7 100OHM F 1E1 04088B 0.000
24P	NULLBHP TRQ*RPM	#24 LEBOW DAY 166 FTLB1E1 12211B 0.000
25P	FLOW18" MAG	#25 18" F&P 32000 GPM 1E-111164B 1.000
26S	NULLBHP TRQ BAR	#26 LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULLFLOW3"MAG	#27 LOAD CELL 100LB 1E2 01101B 0.000
28S	NULLFLOWORIFICE	TECO# 6158 21.80 FPS 1E2 09256C 0.000
29.	NULLFLOW6"MAG	#29 6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULLBHP TRQ*RPM	#30 LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULLRPM TRQ BAR	#31 LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULLBHP TRQ BAR	#32 LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

TEST CONSTANTS

1 FT H20 = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.80"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 245.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

NO	VELOCITY Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME CONC. Cv %	WEIGHT CONC. Cw %	MASS Ms TON/HR	REYNOLDS NUMBER Re	PIPELINE LOSSES Im FT/FT	PIPELINE LOSSES Iw FT/FT	FRICTION FACTRS Fm	FRICTION FACTRS Fw SAME Re	HAZEN WLLMS C	Im-Iw / Sm-Sw	TIME t HH.MM
1	14.44	13264.9	68.7	0.999	1.448	27.2	49.7	2390.4	0.217E+07	0.0660	0.0213	0.0227	0.0106	103.	0.0996	14.37
2	15.58	14313.3	68.4	0.999	1.449	27.3	49.9	2588.9	0.233E+07	0.0678	0.0246	0.0200	0.0105	110.	0.0961	14.39
3	16.64	15281.4	68.8	0.999	1.451	27.4	50.0	2775.9	0.250E+07	0.0717	0.0277	0.0185	0.0104	114.	0.0972	14.40
4	17.53	16096.9	69.1	0.999	1.445	27.0	49.6	2885.6	0.265E+07	0.0731	0.0305	0.0171	0.0103	118.	0.0952	14.42
5	18.47	16964.5	69.3	0.999	1.448	27.2	49.7	3057.4	0.280E+07	0.0771	0.0337	0.0162	0.0103	121.	0.0968	14.43
6	19.46	17876.4	69.6	0.999	1.448	27.2	49.7	3221.0	0.296E+07	0.0798	0.0371	0.0151	0.0102	125.	0.0951	14.45
7	20.43	18764.2	70.1	0.999	1.444	27.0	49.5	3354.9	0.313E+07	0.0840	0.0406	0.0145	0.0101	128.	0.0974	14.46
8	16.46	15120.7	69.9	0.999	1.434	26.4	48.7	2642.5	0.252E+07	0.0639	0.0271	0.0171	0.0104	119.	0.0845	14.50
9	14.38	13204.6	69.3	0.999	1.446	27.0	49.6	2368.4	0.218E+07	0.0586	0.0211	0.0203	0.0106	109.	0.0840	14.52
10	13.59	12485.6	68.9	0.999	1.444	26.9	49.4	2229.7	0.205E+07	0.0573	0.0190	0.0223	0.0107	105.	0.0862	14.53
11	12.37	11364.9	68.8	0.999	1.441	26.8	49.2	2017.7	0.186E+07	0.0555	0.0160	0.0261	0.0108	97.	0.0893	14.55
12	11.32	10396.8	68.6	0.999	1.440	26.7	49.1	1839.6	0.170E+07	0.0547	0.0135	0.0308	0.0110	89.	0.0935	14.57
13	9.41	8645.4	68.2	0.999	1.440	26.7	49.2	1531.6	0.140E+07	0.0526	0.0096	0.0428	0.0113	76.	0.0975	15.02
14	7.44	6829.7	68.1	0.999	1.445	27.0	49.6	1224.4	0.111E+07	0.0508	0.0062	0.0659	0.0117	61.	0.0998	15.04
15	5.65	5186.7	68.0	0.999	1.474	28.8	51.7	990.2	0.841E+06	0.0466	0.0037	0.1028	0.0122	49.	0.0902	15.06

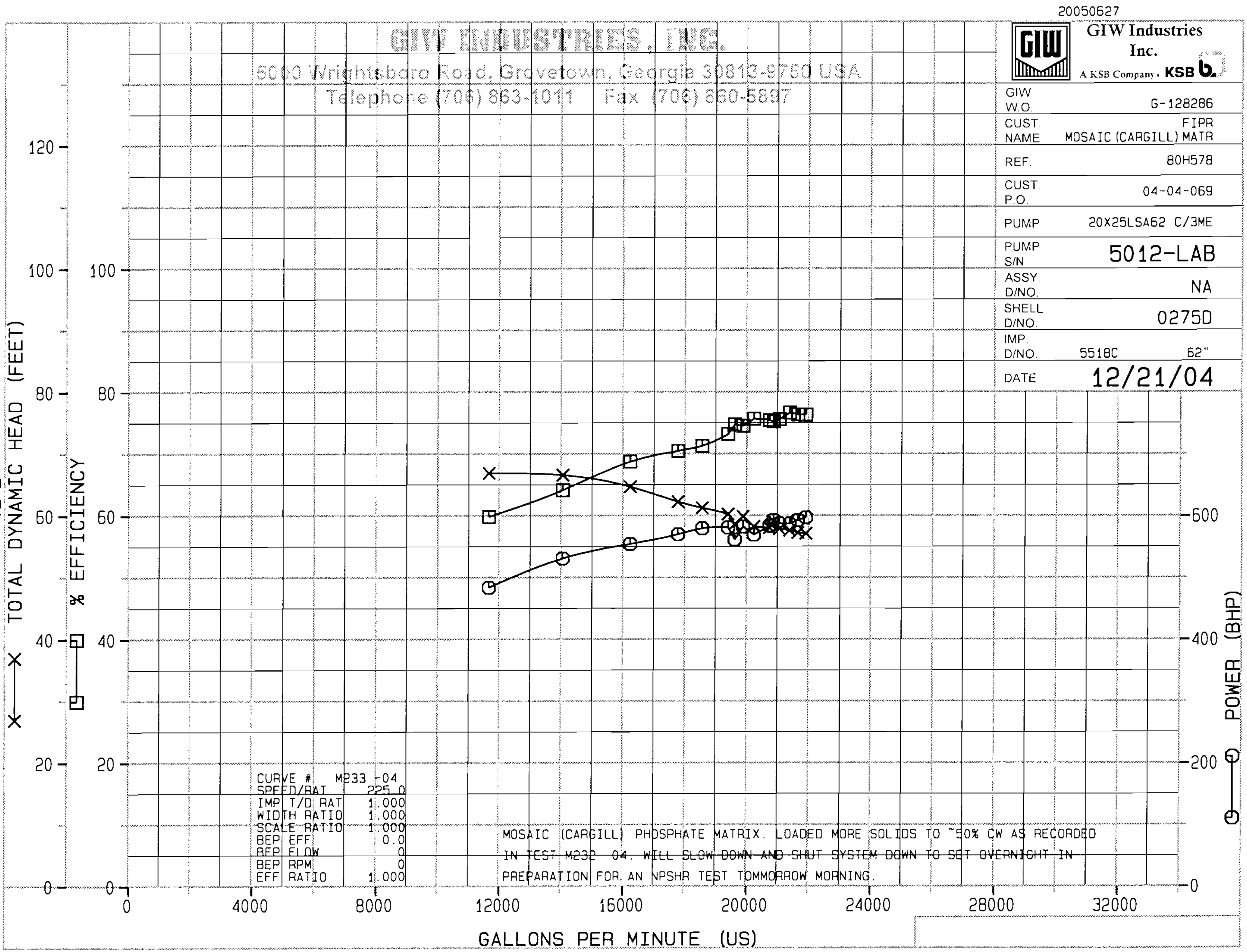
TESTED BY LEE WHITLOCK DATE 12/21/04

COMMENTS: MOSAIC (CARGILL) PHOSPHATE MATRIX. LOADED MORE SOLIDS TO ~50% CW AS RECORDED IN TEST M232 -04. WILL SLOW DOWN AND SHUT SYSTEM DOWN TO SET OVERNIGHT IN PREPARATION FOR AN NPSHR TEST TOMMORROW MORNING.

WITNESSED BY GRAEME ADDIE FOR FIPR

Version: 20050627

M233 -04 12/21/04


20050627
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW Industries Inc.
A KSB Company. KSB
GIW W.O. G-128286
CUST. NAME FIPR MOSAIC (CARGILL) MATR
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/21/04
TOTAL DYNAMIC HEAD (FEET)
% EFFICIENCY
POWER (BHP)
GALLONS PER MINUTE (US)
0
20
40
60
80
100
120
200
400
600
4000
8000
12000
16000
20000
24000
28000
32000
CURVE # M233 -04
SPEED/RAT 225.0
IMP T/D RAT 1.000
WIDTH RATIO 1.000
SCALE RATIO 1.000
BEP EFF 0.0
BEP FLOW 0
BEP RPM 0
EFF RATIO 1.000
MOSAIC (CARGILL) PHOSPHATE MATRIX. LOADED MORE SOLIDS TO ~50% CW AS RECORDED
IN TEST M232 04. WILL SLOW DOWN AND SHUT SYSTEM DOWN TO SET OVERNIGHT IN
PREPARATION FOR AN NPSHR TEST TOMMORROW MORNING.

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE	RDG	SOURCE	INSTRUMENT
1	NULL	SUCTION	#1	YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2	YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3	ROSEMOUNT 4 12'H2O 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4	ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5.		DISCHARGE	#5	ROSEMONT 6 239'H2O 1E1 07093B 1.000
6P		DIFHEAD	#6	ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7	ROSEMOUNT 5 60'H2O 1E2 07093B 0.000
8.		FLOWBEND	#8	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
9P		LOSS 20	#9	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
10S		FLOWBEND	#10	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
11.		FLOWBEND	#11	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
12S	NULL	LOSS 20"	#12	ROSEMOUNT 4 12'H2O 1E2 07134B 0.000
13S		LOSS 20"	#13	ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14	ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15S		DIFHEAD	#15	ROSEMOUNT 5 60'H2O 1E2 01164E 1.000
16S	NULL	DISCHARGE	#16	ROSEMONT 7 692'H2O 1E1 07093B 0.000
17		SUCTION	#17	ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P		TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23	RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO T233 -04 DATE 12/21/04

PUMP TEST DATA FOR	FIPR
------------------	MOSAIC(CARGILL)MATR
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.80"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 245.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

	FLOW MEASUREMENT		HEAD MEASUREMENT			S.G.	DRIVER POWER		SPEED	PUMP		TEMP	SCALED PERFORMANCE				TIME	MAG18"	BEND12
	FLOW Q	VELOCITY	DISCH	SUCTN	TOT HD		INPUT	OUTPUT	N	OUTPUT	EFF	Tm	FLOW	HEAD	POWER	EFF	t	C 25	S 10
NO	GPM	FT/S	PSI	" HG	H FT		KW	BHP	RPM	WHP	n %	F	GPM	FT	BHP	%	H.MM	*1.000	*1.000
1	13264.9	14.44	13.29	-5.50	26.88	1.45	0.0	174.3	152.3	130.3	74.8	68.7	19595.	58.7	561.7	74.8	14.37	13265.	12400.
2	14313.3	15.58	14.56	-5.51	29.23	1.45	0.0	202.2	159.3	153.1	75.7	68.4	20214.	58.3	569.6	75.7	14.39	14313.	13460.
3	15281.4	16.64	15.81	-5.59	31.60	1.45	0.0	234.4	166.0	176.9	75.5	68.8	20718.	58.1	584.1	75.5	14.40	15281.	14298.
4	16096.9	17.53	16.97	-5.61	33.90	1.45	0.0	263.3	172.2	199.2	75.6	69.1	21036.	57.9	587.6	75.6	14.42	16097.	14941.
5	16964.5	18.47	18.35	-5.53	36.33	1.45	0.0	293.7	178.6	225.3	76.7	69.3	21373.	57.7	587.4	76.7	14.43	16965.	14682.
6	17876.4	19.46	19.85	-5.51	39.10	1.45	0.0	334.4	185.9	255.5	76.4	69.6	21638.	57.3	593.0	76.4	14.45	17876.	15719.
7	18764.2	20.43	21.40	-5.40	41.98	1.44	0.0	376.0	192.8	287.2	76.4	70.1	21896.	57.2	597.4	76.4	14.46	18764.	17567.
8	15120.7	16.46	15.42	-5.41	31.14	1.43	0.0	226.5	163.2	170.5	75.3	69.9	20844.	59.2	593.3	75.3	14.50	15121.	13759.
9	13204.6	14.38	13.00	-5.56	26.48	1.45	0.0	171.1	149.6	127.6	74.6	69.3	19863.	59.9	582.5	74.6	14.52	13205.	12399.
10	12485.6	13.59	12.23	-5.52	25.02	1.44	0.0	155.5	145.0	113.9	73.2	68.9	19380.	60.3	581.5	73.2	14.53	12486.	11783.
11	11364.9	12.37	11.15	-5.53	23.02	1.44	0.0	133.5	137.9	95.2	71.3	68.8	18546.	61.3	580.1	71.3	14.55	11365.	10802.
12	10396.8	11.32	10.30	-5.45	21.37	1.44	0.0	114.5	131.7	80.8	70.5	68.6	17756.	62.3	570.4	70.5	14.57	10397.	9877.3
13	8645.4	9.41	8.82	-5.25	18.41	1.44	0.0	84.1	120.0	57.9	68.8	68.2	16213.	64.7	554.9	68.8	15.02	8645.4	8232.2
14	6829.7	7.44	7.59	-4.93	15.78	1.45	0.0	61.3	109.5	39.3	64.2	68.1	14032.	66.6	531.5	64.2	15.04	6829.7	6526.4
15	5186.7	5.65	6.56	-4.56	13.30	1.47	0.0	42.9	100.3	25.7	59.9	68.0	11638.	66.9	484.3	59.9	15.06	5186.7	4895.9

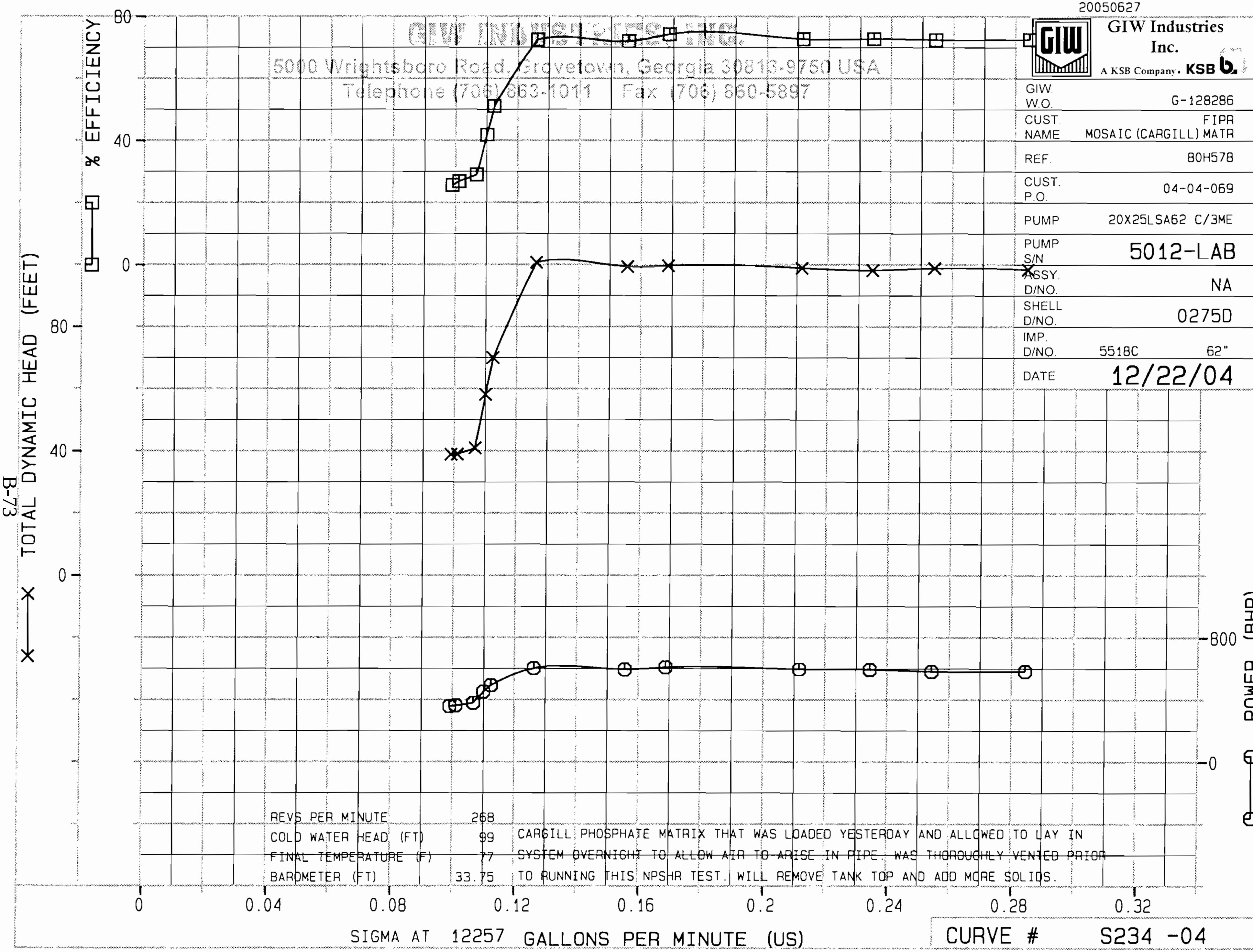
TESTED BY LEE WHITLOCK DATE 12/21/04

COMMENTS: MOSAIC (CARGILL) PHOSPHATE MATRIX. LOADED MORE SOLIDS TO ~50% CW AS RECORDED IN TEST M232 -04. WILL SLOW DOWN AND SHUT SYSTEM DOWN TO SET OVERNIGHT IN PREPARATION FOR AN NPSHR TEST TOMMORROW MORNING.

WITNESSED BY GRAEME ADDIE FOR FIPR

Version: 20050627

T233 -04 12/21/04


20050627
GIW Industries Inc.
A KSB Company. KSB
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW W.O. G-128286
CUST. NAME FIPR MOSAIC (CARGILL) MATR
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/22/04
% EFFICIENCY
TOTAL DYNAMIC HEAD (FEET)
POWER (BHP)
80
40
0
80
40
0
800
0
REVS PER MINUTE 268
COLD WATER HEAD (FT) 99
FINAL TEMPERATURE (F) 77
BAROMETER (FT) 33.75
CARGILL PHOSPHATE MATRIX THAT WAS LOADED YESTERDAY AND ALLOWED TO LAY IN SYSTEM OVERNIGHT TO ALLOW AIR TO ARISE IN PIPE. WAS THOROUGHLY VENTED PRIOR TO RUNNING THIS NPSHR TEST. WILL REMOVE TANK TOP AND ADD MORE SOLIDS.
0
0.04
0.08
0.12
0.16
0.2
0.24
0.28
0.32
SIGMA AT 12257 GALLONS PER MINUTE (US)
CURVE # S234 -04

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE RDG SOURCE	INSTRUMENT
1	NULLSUCTION	#1 YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULLLOSS 20"	#2 YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE S.G.U-SECUP	#3 ROSEMOUNT 4 12'H2O 1E2 07093B 0.500
4	AVE S.G.U-SECDN	#4 ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5.	DISCHARGE	#5 ROSEMONT 6 239'H2O 1E1 07093B 1.000
6P	DIFHEAD	#6 ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.	NULLFLOWORIFICE	#7 ROSEMOUNT 5 60'H2O 1E2 07093B 0.000
8.	FLOWBEND	#8 ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
9S	LOSS 20	#9 ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
10S	FLOWBEND	#10ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
11.	FLOWBEND	#11ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
12S	NULLLOSS 20"	#12ROSEMOUNT 4 12'H2O 1E2 07134B 0.000
13P	LOSS 20"	#13ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULLDISCHARGE	#14ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15S	DIFHEAD	#15ROSEMOUNT 5 60'H2O 1E2 01164E 1.000
16S	NULLDISCHARGE	#16ROSEMONT 7 692'H2O 1E1 07093B 0.000
17	SUCTION	#17ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P	TEMPTANK	#18 RTD TANK F 1E1 10204D 1.000
19S	TEMPAMBIENT	#19 RTD AMBIENT F 1E1 10204B 1.000
20P	BHP TRQ*RPM	#20 BENSFELD 30K FTLB1E-102122B 1.000
21	RPM TRQ BAR	#21 DAYTRONIC 300 RPM 1E1 02122D 1.000
22S	BHP TRQ BAR	#22 BENSFELD 3000HP 1E1 02122F 1.000
23S	NULLTEMPAMBIENT	#23 RTD7 100OHM F 1E1 04088B 0.000
24P	NULLBHP TRQ*RPM	#24 LEBOW DAY 166 FTLB1E1 12211B 0.000
25P	FLOW18" MAG	#25 18" F&P 32000 GPM 1E-111164B 1.000
26S	NULLBHP TRQ BAR	#26 LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULLFLOW3"MAG	#27 LOAD CELL 100LB 1E2 01101B 0.000
28S	NULLFLOWORIFICE	TECO# 6158 21.80 FPS 1E2 09256C 0.000
29.	NULLFLOW6"MAG	#29 6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULLBHP TRQ*RPM	#30 LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULLRPM TRQ BAR	#31 LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULLBHP TRQ BAR	#32 LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO S234 -04 DATE 12/22/04

PUMP TEST DATA FOR	FIPR
	MOSAIC(CARGILL)MATR
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.80"
G = 32.14 FT/S/S

TEST RESULTS

	FLOW MEASUREMENT		HEAD MEASUREMENT			S.G.	DRIVER POWER		SPEED	PUMP		TEMP	CAVITATION		SCALED PERFORMANCE				TIME	MAG18"
	FLOW Q	VELOCITY	DISCH	SUCTN	TOT HD		INPUT	OUTPUT	N	OUTPUT	EFF	Tm	NPSH	SIGMA	FLOW	HEAD	POWER	EFF	t	C 25
NO	GPM	FT/S	PSI	" HG	H FT		KW	BHP	RPM	WHP	n %	F	FT		GPM	FT	BHP	%	H.MM	*1.000
1	12256.6	13.34	55.39	-7.16	98.55	1.40	0.0	585.5	268.3	425.6	72.7	71.6	28.0	0.284	10280.	69.3	345.4	72.7	10.29	12257.
2	12176.3	13.26	53.89	-10.81	99.00	1.40	0.0	585.0	268.4	424.8	72.6	71.9	25.0	0.254	10207.	69.6	344.6	72.6	10.32	12176.
3	12553.9	13.67	52.20	-13.25	98.31	1.40	0.0	596.6	268.5	434.9	72.9	73.2	23.1	0.234	10521.	69.0	351.2	72.9	10.34	12554.
4	12578.0	13.69	51.01	-15.88	99.03	1.39	0.0	599.1	268.4	436.4	72.9	74.5	20.8	0.211	10544.	69.6	352.9	72.9	10.39	12578.
5	13080.1	14.24	48.51	-20.98	99.77	1.38	0.0	611.1	268.2	454.6	74.4	76.2	16.6	0.168	10974.	70.2	360.9	74.4	10.43	13080.
6	12369.1	13.47	48.04	-22.54	99.49	1.39	0.0	597.6	268.4	431.0	72.1	76.1	15.3	0.155	10369.	69.9	352.0	72.1	10.45	12369.
7	12493.6	13.60	46.92	-25.97	100.85	1.38	0.0	605.3	268.4	439.6	72.6	77.0	12.4	0.126	10473.	70.9	356.6	72.6	10.48	12494.
8	10308.4	11.22	28.40	-27.38	70.11	1.39	0.0	494.9	269.6	253.5	51.2	76.9	11.0	0.112	8604.	48.8	287.8	51.2	10.49	10308.
9	9324.2	10.15	21.33	-27.46	58.30	1.39	0.0	454.0	269.9	190.3	41.9	77.1	10.8	0.110	7772.	40.5	262.9	41.9	10.49	9324.2
10	7745.5	8.43	11.06	-27.54	41.08	1.38	0.0	381.4	270.6	111.0	29.1	77.0	10.5	0.106	6441.	28.4	219.3	29.1	10.49	7745.5
11	7363.9	8.02	9.37	-27.59	39.07	1.35	0.0	364.9	270.5	98.3	26.9	77.0	9.9	0.101	6125.	27.0	210.0	26.9	10.50	7363.9
12	6998.4	7.62	9.20	-27.64	38.99	1.35	0.0	360.0	270.4	92.7	25.8	76.9	9.7	0.099	5823.	27.0	207.3	25.8	10.50	6998.4

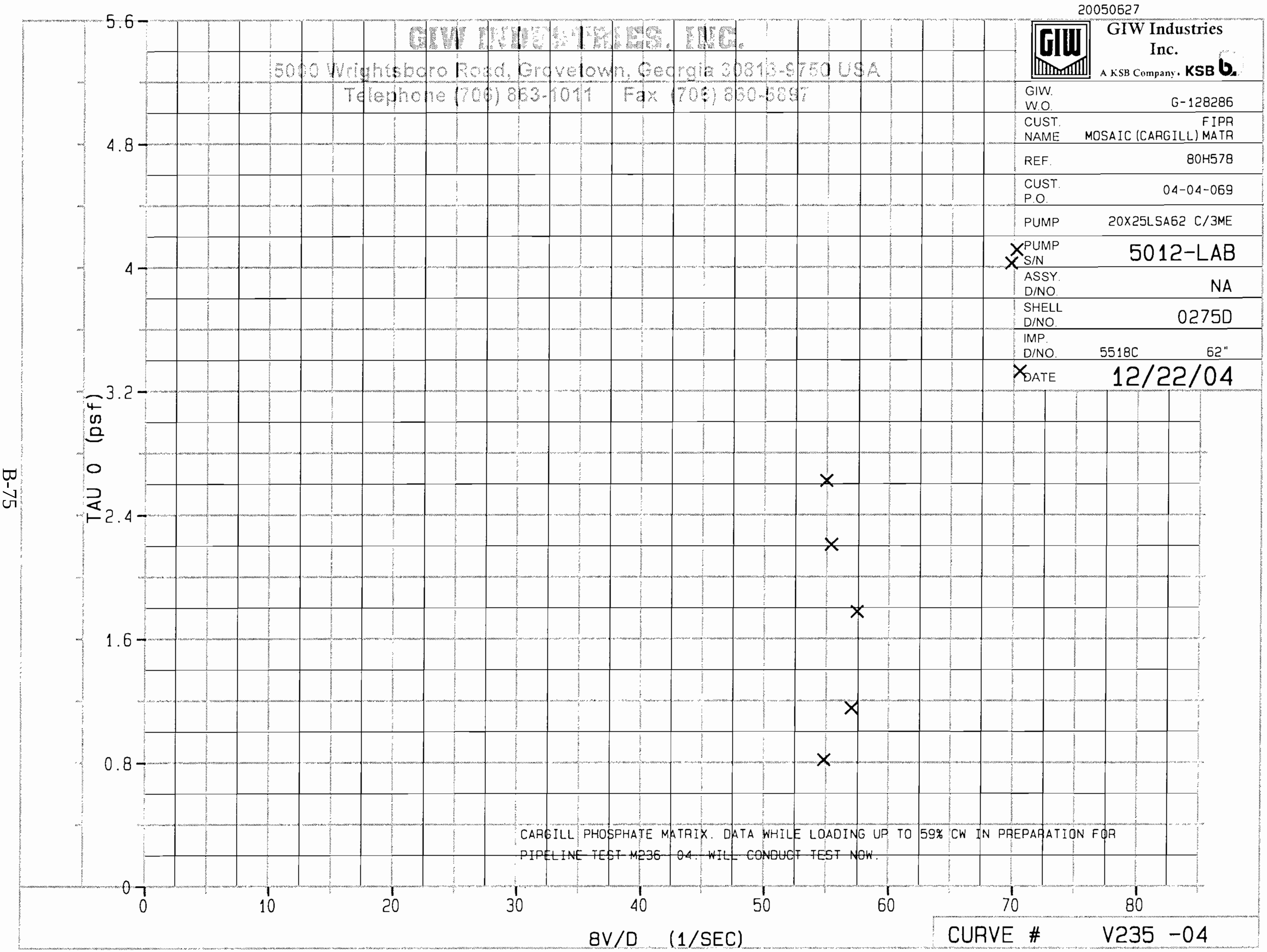
TESTED BY LEE WHITLOCK DATE 12/22/04

WITNESSED BY GRAEME ADDIE FOR FIPR

COMMENTS: CARGILL PHOSPHATE MATRIX THAT WAS LOADED YESTERDAY AND ALLOWED TO LAY IN SYSTEM OVERNIGHT TO ALLOW AIR TO ARISE IN PIPE. WAS THOROUGHLY VENTED PRIOR TO RUNNING THIS NPSHR TEST. WILL REMOVE TANK TOP AND ADD MORE SOLIDS.

Version: 20050627

S234 -04 12/22/04


20050627
GIW Industries Inc.
A KSB Company. KSB
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW. W.O. G-128286
CUST. NAME FIPR MOSAIC (CARGILL) MATR
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/22/04
TAU 0 (psf)
5.6
4.8
4
3.2
2.4
1.6
0.8
0
0
10
20
30
40
50
60
70
80
8V/D (1/SEC)
CARGILL PHOSPHATE MATRIX. DATA WHILE LOADING UP TO 59% CW IN PREPARATION FOR
PIPELINE TEST M236 - 04. WILL CONDUCT TEST NOW.
CURVE # V235 -04

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE	RDG	SOURCE	INSTRUMENT
1	NULL	SUCTION	#1	YOKOGAWA-30-30 H20-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2	YOKOGAWA -4-8' H20-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3	ROSEMOUNT 4 12'H20 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4	ROSEMONT4 -4-8'H20-1E2 07134B 0.500
5.		DISCHARGE	#5	ROSEMONT 6 239'H20 1E1 07093B 1.000
6P		DIFHEAD	#6	ROSEMONT 6 236'H20 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7	ROSEMOUNT 5 60'H20 1E2 07093B 0.000
8.		FLOWBEND	#8	ROSEMOUNT 5 24'H20 1E2 07093B 1.000
9S		LOSS 20	#9	ROSEMOUNT 5 24'H20 1E2 07093B 1.000
10S		FLOWBEND	#10	ROSEMOUNT 4 12'H20 1E2 07134B 1.000
11.		FLOWBEND	#11	ROSEMOUNT 4 12'H20 1E2 07134B 1.000
12S	NULL	LOSS 20"	#12	ROSEMOUNT 4 12'H20 1E2 07134B 0.000
13P		LOSS 20"	#13	ROSEMONT4 -4-8'H20-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14	ROSEMOUNT 5 24'H20 1E2 07134B 0.000
15S		DIFHEAD	#15	ROSEMOUNT 5 60'H20 1E2 01164E 1.000
16S	NULL	DISCHARGE	#16	ROSEMONT 7 692'H20 1E1 07093B 0.000
17		SUCTION	#17	ROSE. 5 -30-30'H20-1E2 07093B 1.000
18P		TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23	RTD7 1000HM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO V235 -04 DATE 12/22/04

PUMP TEST DATA FOR	FIPR
------------------	MOSAIC(CARGILL)MATR
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.80"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 245.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

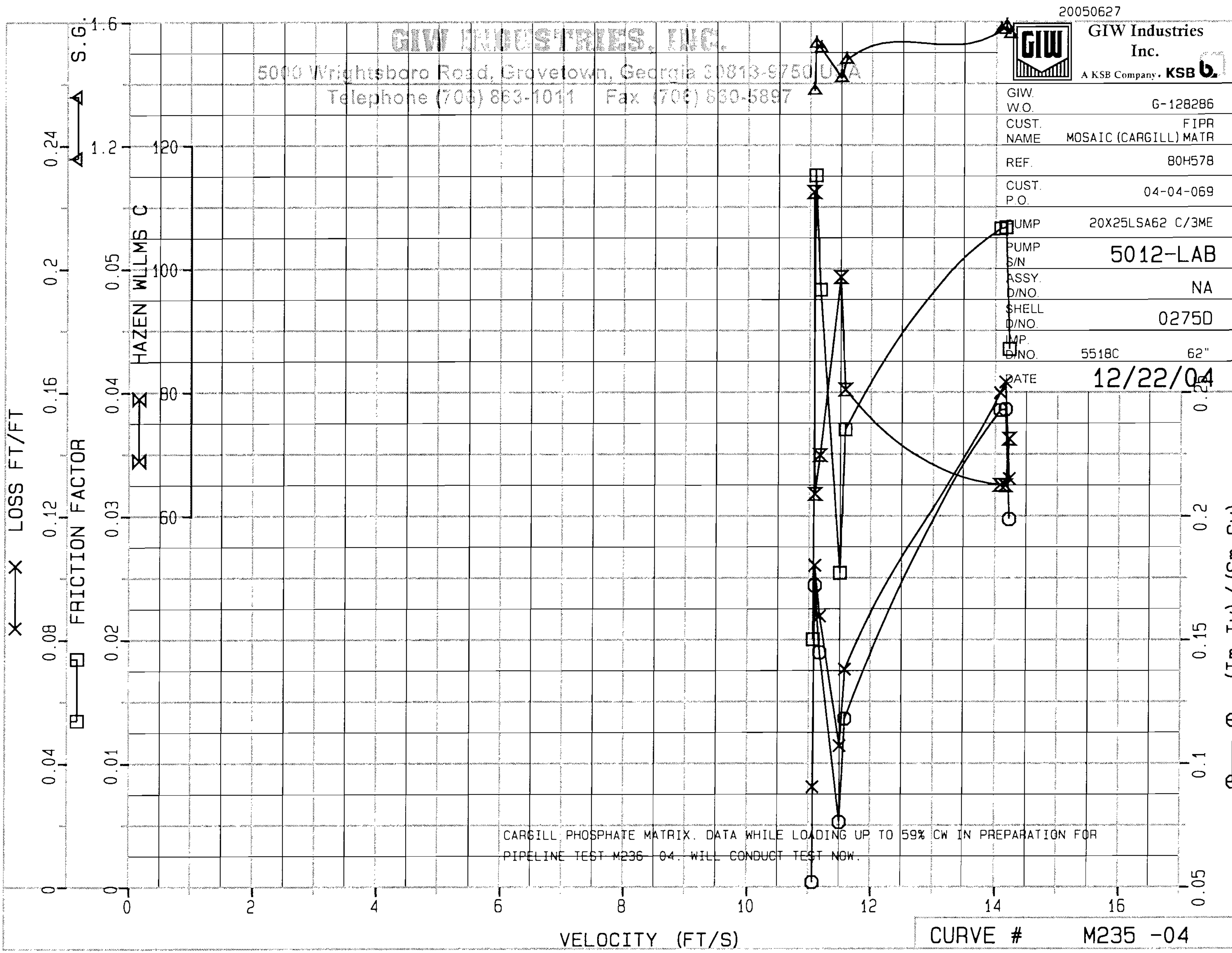
TEST RESULTS

NO	VELOCITY Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME CONC. Cv %	WEIGHT CONC. Cw %	MASS Ms TON/HR	PIPELINE LOSSES Im FT/FT	PIPELINE LOSSES Iw FT/FT	dp/dx psf	Tau 0 psf	8V/D 1/SEC	Tau 0 ln psf	8V/D ln 1/SEC	TIME t HH.MM
1	11.05	10151.7	71.9	0.999	1.377	22.9	44.1	1543.9	0.0326	0.0129	2.0318	0.8199	54.779	-.1986	4.0033	11.51
2	11.49	10549.4	73.7	0.999	1.419	25.4	47.5	1779.2	0.0459	0.0138	2.8613	1.1547	56.925	0.1438	4.0417	12.03
3	11.57	10625.7	76.3	0.998	1.478	29.0	52.1	2045.6	0.0706	0.0139	4.4050	1.7776	57.337	0.5753	4.0489	12.28
4	11.16	10248.1	76.3	0.998	1.514	31.2	54.7	2122.8	0.0878	0.0130	5.4795	2.2112	55.299	0.7935	4.0128	12.33
5	11.08	10175.8	76.3	0.998	1.529	32.2	55.7	2169.6	0.1042	0.0128	6.5027	2.6241	54.909	0.9647	4.0057	12.39
6	14.21	13052.0	76.1	0.998	1.561	34.0	57.8	2946.8	0.1322	0.0204	8.2505	3.3294	70.429	1.2028	4.2546	12.46
7	14.07	12919.4	75.6	0.998	1.574	34.9	58.7	2989.0	0.1600	0.0200	9.9828	4.0285	69.714	1.3934	4.2444	12.51
8	14.15	12995.8	75.0	0.998	1.587	35.6	59.5	3071.4	0.1634	0.0202	10.199	4.1155	70.125	1.4148	4.2503	12.54

TESTED BY LEE WHITLOCK DATE 12/22/04 COMMENTS: CARGILL PHOSPHATE MATRIX. DATA WHILE LOADING UP TO 59% CW IN PREPARATION FOR PIPELINE TEST M236 -04. WILL CONDUCT TEST NOW.

WITNESSED BY GRAEME ADDIE FOR FIPR
Version: 20050627

V235 -04 12/22/04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GIW Industries Inc.
A KSB Company. KSB
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW. W.O. G-128286
CUST. NAME FIPR MOSAIC (CARGILL) MATR
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/22/04
S.G.
LOSS FT/FT
FRICTION FACTOR
HAZEN WLLMS C
(Im-Iw) / (Sm-Sw)
VELOCITY (FT/S)
CARGILL PHOSPHATE MATRIX. DATA WHILE LOADING UP TO 59% CW IN PREPARATION FOR
PIPELINE TEST M236 -04. WILL CONDUCT TEST NOW.
CURVE # M235 -04

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PUMP DETAIL                   CH   USE  RDG  SOURCE INSTRUMENT                                           GIW INDUSTRIES INC.
-----------                   --   ---  ---  ------ ----------                                          5000 WRIGHTSBORO ROAD
PUMP        20X25LSA62 C/3ME   1  NULLSUCTION     #1 YOKOGAWA-30-30 H20-1E2 06011B 0.000           GROVETOWN, GEORGIA 30813-9750
                               2S NULLLOSS 20"    #2 YOKOGAWA -4-8' H20-1E2 12040B 0.000              TELEPHONE (706) 863-1011
SERIAL NUMBER       5012-LAB   3  AVE S.G.U-SECUP #3 ROSEMOUNT 4 12'H20 1E2 07093B 0.500              FAX (Engr) (706) 868-8025
ASSEMBLY DRAWING NO       NA   4  AVE S.G.U-SECDN #4 ROSEMONT4 -4-8'H20-1E2 07134B 0.500              FAX (Sales) (706) 860-5897
SHELL    DRAWING NO    0275D   5.      DISCHARGE  #5 ROSEMONT 6 239'H20 1E1 07093B 1.000
IMPELLER DRAWING NO    5518C   6P      DIFHEAD    #6 ROSEMONT 6 236'H20 1E1 07093B 1.000     TEST CURVE NO M235 -04     DATE 12/22/04
IMPELLER DIAMETER        62"   7. NULLFLOWORIFICE #7 ROSEMONT 5 60'H20 1E2 07093B 0.000
OUTLET ANGLE                   8.      FLOWBEND   #8 ROSEMONT 5 24'H20 1E2 07093B 1.000      PUMP TEST DATA FOR                  FIPR
OUTLET WIDTH                   9S      LOSS 20    #9 ROSEMONT 5 24'H20 1E2 07093B 1.000      ------------------  MOSAIC(CARGILL)MATR
ROTATION           CLOCKWISE  10S      FLOWBEND   #10ROSEMOUNT 4 12'H20 1E2 07134B 1.000     PROJECT                           80H578
HYDROSTATIC PRESS.       STD  11.      FLOWBEND   #11ROSEMOUNT 4 12'H20 1E2 07134B 1.000     GIW WORK ORDER NO               G-128286
                              12S NULLLOSS 20"    #12ROSEMOUNT 4 12'H20 1E2 07134B 0.000     CUSTOMER ORDER NO              04-04-069
DRIVER DETAIL                 13P      LOSS 20"   #13ROSEMONT4 -4-8'H20-1E2 01164E 1.000
-------------                 14. NULLDISCHARGE   #14ROSEMOUNT 5 24'H20 1E2 07134B 0.000
TYPE   VARIABLE SPEED DRIVE   15S      DIFHEAD    #15ROSEMOUNT 5 60'H20 1E2 01164E 1.000     TEST CONSTANTS
MAKE        GENERAL ELECTRIC  16S NULLDISCHARGE   #16ROSEMONT 7 692'H20 1E1 07093B 0.000       1 FT H20 =     0.0 US GPM USING
SERIAL NO            5511957  17       SUCTION    #17ROSE. 5 -30-30'H20-1E2 07093B 1.000     BEND HT CORR = 0.0 FT   CONST = 6201.05
FRAME SIZE           5368480  18P      TEMPTANK   #18 RTD TANK      F 1E1   10204D 1.000     DISCHARGE PIPE DIAMETER = 19.25 INS.
RPM =  450      BHP = 2450.   19S      TEMPAMBIENT #19 RTD AMBIENT  F  1E1  10204B 1.000     METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
4160 VOLTS  3 PHASE  60 CPS   20P      BHP TRQ*RPM #20 BENSFELD  30K FTLB1E-102122B 1.000    SUCTION   PIPE DIAMETER = 25.00 INS.
                              21       RPM TRQ BAR #21 DAYTRONIC 300 RPM 1E1 02122D 1.000    METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
SCALED PERFORMANCE FACTORS    22S      BHP TRQ BAR #22 BENSFELD  3000HP 1E1  02122F 1.000    PREROTATION LIM  0.0'  BAROMETER 29.80"
--------------------------    23S NULLTEMPAMBIENT #23 RTD7 100OHM   F    1E1 04088B 0.000    HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
SPEED OR RATIO       225.000  24P NULLBHP TRQ*RPM #24 LEBOW DAY 166 FTLB1E1 12211B 0.000    S.G. TAPS  8.00' APART  G= 32.14 FT/S/S
                              25P      FLOW18" MAG #25 18" F&P 32000 GPM 1E-111164B 1.000    SOLIDS SG 2.65 OF  245.MICRONS S.D.=0.0
IMP TURN DOWN RATIO     1.000 26S NULLBHP TRQ BAR #26 LEBOW, DAY  75HP  1E2 12211D 0.000    PIPE ROUGHNESS REF M216 -04 E/D=.000010
MERIDINAL WIDTH RATIO 1.000   27P NULLFLOW3"MAG   #27 LOAD CELL  100LB  1E2 01101B 0.000    SAMPLER AREA =  0.00 SQUARE FEET
SCALE RATIO             1.000 28S NULLFLOWORIFICE TECO# 6158  21.80 FPS 1E2 09256C 0.000
BEP REF     0.GPM,     0.RPM  29. NULLFLOW6"MAG   #29 6" YOKO 2800  GPM 1E1 12281A 0.000
EFFICIENCY   0.0%  BY 1.000   30P NULLBHP TRQ*RPM #30 LEBOW,DAY 833 FTLB1E1 05098C 0.000
                              31  NULLRPM TRQ BAR #31 LEBOW,DAY1500 RPM 1E0 05024C 0.000
                              32S NULLBHP TRQ BAR #32 LEBOW,DAY 300  HP 1E1 07287C 0.000
TEST RESULTS                    ^ PRIMARY INSTRUMENTATION USED
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NO	VELOCITY: Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME: CONC.: Cv %	WEIGHT: CONC.: Cw %	MASS Ms TON/HR	REYNOLDS NUMBER Re	PIPELINE LOSSES: Im FT/FT	Iw FT/FT	FRICTION FACTRS: Fm	Fw :SAME Re:	HAZEN: WLLMS: C	Im-Iw ----- Sm-Sw	TIME t HH.MM
1	11.05	10151.7	71.9	0.999	1.377	22.9	44.1	1543.9	0.174E+07	0.0326	0.0129	0.0201	0.0109	112.	0.0520	11.51
2	11.49	10549.4	73.7	0.999	1.419	25.4	47.5	1779.2	0.185E+07	0.0459	0.0138	0.0254	0.0108	99.	0.0764	12.03
3	11.57	10625.7	76.3	0.998	1.478	29.0	52.1	2045.6	0.193E+07	0.0706	0.0139	0.0370	0.0108	81.	0.1183	12.28
4	11.16	10248.1	76.3	0.998	1.514	31.2	54.7	2122.8	0.186E+07	0.0878	0.0130	0.0483	0.0108	70.	0.1451	12.33
5	11.08	10175.8	76.3	0.998	1.529	32.2	55.7	2169.6	0.185E+07	0.1042	0.0128	0.0576	0.0108	64.	0.1721	12.39
6	14.21	13052.0	76.1	0.998	1.561	34.0	57.8	2946.8	0.237E+07	0.1322	0.0204	0.0435	0.0105	73.	0.1989	12.46
7	14.07	12919.4	75.6	0.998	1.574	34.9	58.7	2989.0	0.233E+07	0.1600	0.0200	0.0533	0.0105	65.	0.2429	12.51
8	14.15	12995.8	75.0	0.998	1.587	35.6	59.5	3071.4	0.232E+07	0.1634	0.0202	0.0534	0.0105	65.	0.2433	12.54

```
  TESTED BY   LEE WHITLOCK  DATE 12/22/04   COMMENTS: CARGILL PHOSPHATE MATRIX. DATA WHILE LOADING UP TO 59% CW IN PREPARATION FOR
                                                      PIPELINE TEST M236 -04. WILL CONDUCT TEST NOW.
WITNESSED BY GRAEME ADDIE  FOR                  FIPR
Version: 20050627                                                                                                M235 -04 12/22/04
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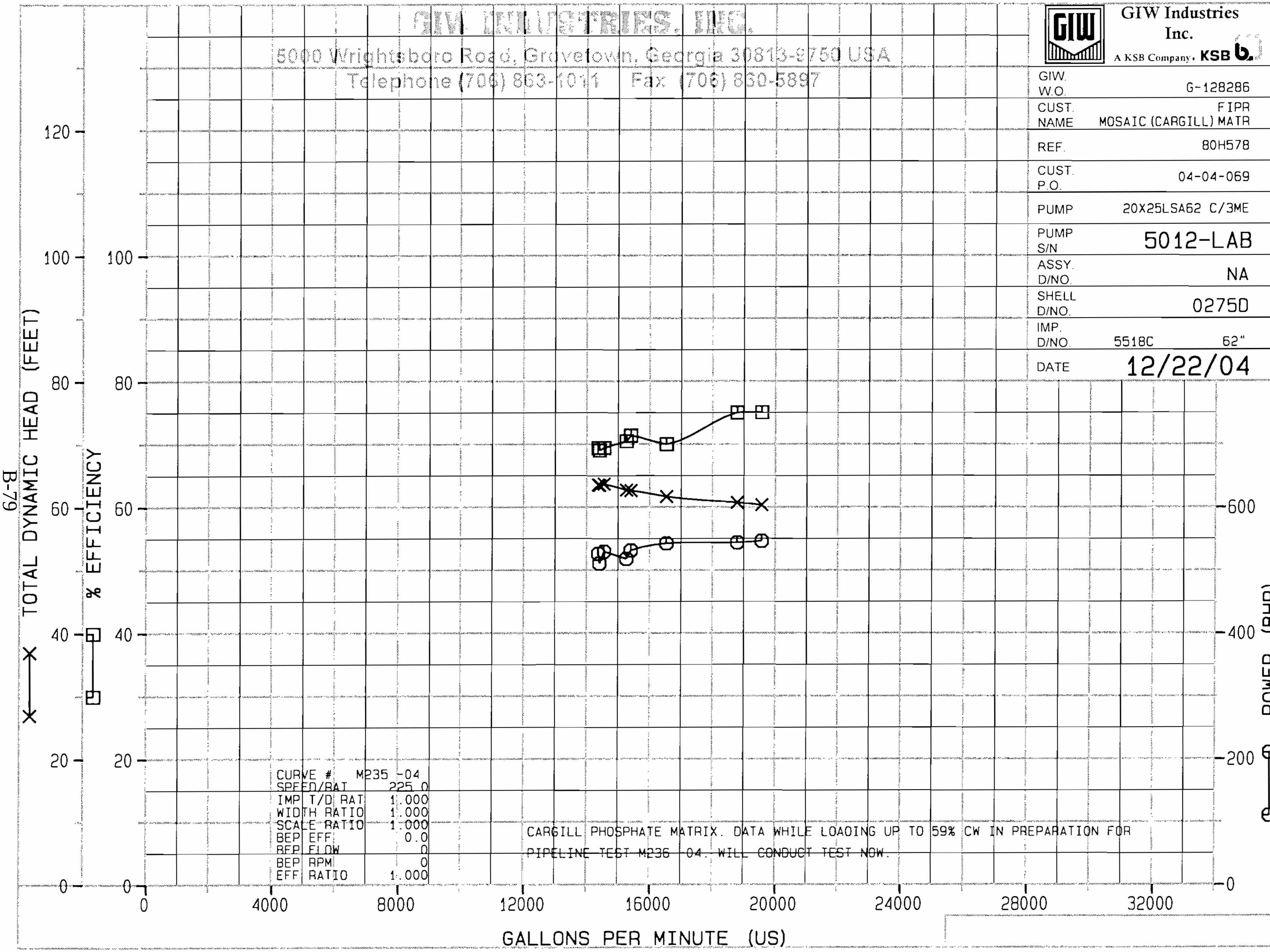
20050627


GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW Industries Inc.
A KSB Company. KSB
GIW W.O. G-128286
CUST. NAME FIPR MOSAIC (CARGILL) MATR
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/22/04
TOTAL DYNAMIC HEAD (FEET)
% EFFICIENCY
POWER (BHP)
GALLONS PER MINUTE (US)
0
4000
8000
12000
16000
20000
24000
28000
32000
20
40
60
80
100
120
200
400
600
CURVE # M235 -04
SPEED/RAT 225.0
IMP T/D RAT 1.000
WIDTH RATIO 1.000
SCALE RATIO 1.000
BEP EFF 0.0
BEP FLOW 0
BEP RPM 0
EFF RATIO 1.000
CARGILL PHOSPHATE MATRIX. DATA WHILE LOADING UP TO 59% CW IN PREPARATION FOR
PIPELINE TEST M236 -04. WILL CONDUCT TEST NOW.

```
PUMP DETAIL                 CH   USE  RDG  SOURCE INSTRUMENT                                            GIW INDUSTRIES INC.
-----------                 --   ---  ---  ------ ----------                                           5000 WRIGHTSBORO ROAD
PUMP       20X25LSA62 C/3ME  1  NULLSUCTION      #1 YOKOGAWA-30-30 H2O-1E2 06011B 0.000          GROVETOWN, GEORGIA 30813-9750
                            2S NULLLOSS 20"     #2 YOKOGAWA -4-8' H2O-1E2 12040B 0.000             TELEPHONE (706) 863-1011
SERIAL NUMBER      5012-LAB  3  AVE S.G.U-SECUP #3 ROSEMOUNT 4 12'H2O 1E2 07093B 0.500             FAX (Engr) (706) 868-8025
ASSEMBLY DRAWING NO      NA  4  AVE S.G.U-SECDN #4 ROSEMONT4 -4-8'H2O-1E2 07134B 0.500             FAX (Sales) (706) 860-5897
SHELL    DRAWING NO   0275D  5.      DISCHARGE  #5 ROSEMONT 6 239'H2O 1E1 07093B 1.000
IMPELLER DRAWING NO   5518C  6P      DIFHEAD    #6 ROSEMONT 6 236'H2O 1E1 07093B 1.000    TEST CURVE NO T235 -04    DATE 12/22/04
IMPELLER DIAMETER       62"  7. NULLFLOWORIFICE #7 ROSEMOUNT 5 60'H2O 1E2 07093B 0.000
OUTLET ANGLE                 8.      FLOWBEND   #8 ROSEMOUNT 5 24'H2O 1E2 07093B 1.000    PUMP TEST DATA FOR                  FIPR
OUTLET WIDTH                 9S      LOSS 20    #9 ROSEMOUNT 5 24'H2O 1E2 07093B 1.000    ------------------  MOSAIC(CARGILL)MATR
ROTATION          CLOCKWISE 10S      FLOWBEND   #10ROSEMOUNT 4 12'H2O 1E2 07134B 1.000    PROJECT                           80H578
HYDROSTATIC PRESS.      STD 11.      FLOWBEND   #11ROSEMOUNT 4 12'H2O 1E2 07134B 1.000    GIW WORK ORDER NO               G-128286
                            12S NULLLOSS 20"    #12ROSEMOUNT 4 12'H2O 1E2 07134B 0.000    CUSTOMER ORDER NO              04-04-069
DRIVER DETAIL               13P      LOSS 20"   #13ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
-------------               14. NULLDISCHARGE   #14ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
TYPE  VARIABLE SPEED DRIVE  15S      DIFHEAD    #15ROSEMOUNT 5 60'H2O 1E2 01164E 1.000    TEST CONSTANTS
MAKE       GENERAL ELECTRIC 16S NULLDISCHARGE   #16ROSEMONT 7 692'H2O 1E1 07093B 0.000      1 FT H2O =     0.0 US GPM USING
SERIAL NO           5511957 17       SUCTION    #17ROSE. 5 -30-30'H2O-1E2 07093B 1.000    BEND HT CORR = 0.0 FT  CONST = 6201.05
FRAME SIZE          5368480 18P      TEMPTANK   #18 RTD TANK      F 1E1   10204D 1.000    DISCHARGE PIPE DIAMETER = 19.25 INS.
RPM =  450      BHP = 2450. 19S      TEMPAMBIENT #19 RTD AMBIENT   F  1E1   10204B 1.000   METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
4160 VOLTS  3 PHASE  60 CPS 20P      BHP TRQ*RPM #20 BENSFELD  30K FTLB1E-102122B 1.000   SUCTION   PIPE DIAMETER = 25.00 INS.
                            21       RPM TRQ BAR #21 DAYTRONIC 300 RPM 1E1 02122D 1.000   METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
SCALED PERFORMANCE FACTORS  22S      BHP TRQ BAR #22 BENSFELD  3000HP 1E1  02122F 1.000   PREROTATION LIM  0.0'  BAROMETER 29.80"
--------------------------  23S NULLTEMPAMBIENT #23 RTD7 100OHM    F    1E1 04088B 0.000   HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
SPEED OR RATIO      225.000 24P NULLBHP TRQ*RPM #24 LEBOW DAY 166 FTLB1E1 12211B 0.000   S.G. TAPS  8.00' APART  G= 32.14 FT/S/S
                            25P      FLOW18" MAG #25 18" F&P 32000 GPM 1E-111164B 1.000   SOLIDS SG 2.65 OF  245.MICRONS S.D.=0.0
IMP TURN DOWN RATIO   1.000 26S NULLBHP TRQ BAR #26 LEBOW, DAY  75HP  1E2 12211D 0.000   PIPE ROUGHNESS REF M216 -04 E/D=.000010
MERIDINAL WIDTH RATIO 1.000 27P NULLFLOW3"MAG   #27 LOAD CELL  100LB  1E2 01101B 0.000   SAMPLER AREA =  0.00 SQUARE FEET
SCALE RATIO           1.000 28S NULLFLOWORIFICE TECO# 6158  21.80 FPS 1E2 09256C 0.000
BEP REF     0.GPM,    0.RPM 29. NULLFLOW6"MAG   #29 6" YOKO 2800  GPM 1E1 12281A 0.000
EFFICIENCY   0.0%  BY 1.000 30P NULLBHP TRQ*RPM #30 LEBOW,DAY 833 FTLB1E1 05098C 0.000
                            31  NULLRPM TRQ BAR #31 LEBOW,DAY1500 RPM 1E0 05024C 0.000
                            32S NULLBHP TRQ BAR #32 LEBOW,DAY 300  HP 1E1 07287C 0.000
TEST RESULTS                  ^ PRIMARY INSTRUMENTATION USED
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  :FLOW MEASUREMENT:  HEAD MEASUREMENT :S.G.:DRIVER POWER:SPEED:    PUMP    : TEMP:  SCALED PERFORMANCE   : TIME:MAG18":BEND12:
  : FLOW Q:VELOCITY:DISCH: SUCTN:TOT HD:    :INPUT:OUTPUT:  N  :OUTPUT: EFF:  Tm : FLOW : HEAD:POWER: EFF:  t  : C 25 : S 10 :
NO:  GPM  :  FT/S  : PSI : " HG : H FT :    :  KW :  BHP : RPM :  WHP : n %: F   : GPM   :  FT : BHP :  % : H.MM: *1.000:*1.000:
 1:10151.7:  11.05 : 6.07: -6.76: 16.31:1.38:  0.0:  76.7:116.9:  57.6:75.1: 71.9:19543.: 60.4:546.9:75.1:11.51:10152.:9310.8:
 2:10549.4:  11.49 : 8.34: -6.29: 19.21:1.42:  0.0:  96.7:126.5:  72.6:75.1: 73.7:18767.: 60.8:544.4:75.1:12.03:10549.: 0.000:
 3:10625.7:  11.57 :13.74: -4.63: 25.58:1.48:  0.0: 144.8:144.8: 101.4:70.1: 76.3:16510.: 61.8:543.0:70.1:12.28:10626.: 0.000:
 4:10248.1:  11.16 :16.55: -3.64: 28.39:1.51:  0.0: 157.7:151.3: 111.3:70.5: 76.3:15239.: 62.8:518.6:70.5:12.33:10248.: 0.000:
 5:10175.8:  11.08 :19.46: -2.69: 31.77:1.53:  0.0: 180.7:159.1: 124.8:69.1: 76.3:14390.: 63.5:511.1:69.1:12.39:10176.: 0.000:
 6:13052.0:  14.21 :28.59: -2.37: 45.19:1.56:  0.0: 325.5:191.0: 232.5:71.4: 76.1:15374.: 62.7:531.9:71.4:12.46:13052.: 0.000:
 7:12919.4:  14.07 :32.74: -1.73: 50.38:1.57:  0.0: 372.5:200.0: 258.8:69.5: 75.6:14532.: 63.7:530.1:69.5:12.51:12919.: 0.000:
 8:12995.8:  14.15 :34.27: -1.59: 52.13:1.59:  0.0: 390.8:203.7: 271.5:69.5: 75.0:14353.: 63.6:526.5:69.5:12.54:12996.: 0.000:



  TESTED BY   LEE WHITLOCK  DATE 12/22/04   COMMENTS: CARGILL PHOSPHATE MATRIX. DATA WHILE LOADING UP TO 59% CW IN PREPARATION FOR
                                                       PIPELINE TEST M236 -04. WILL CONDUCT TEST NOW.
WITNESSED BY GRAEME ADDIE  FOR                 FIPR
Version: 20050627                                                                                              T235 -04 12/22/04
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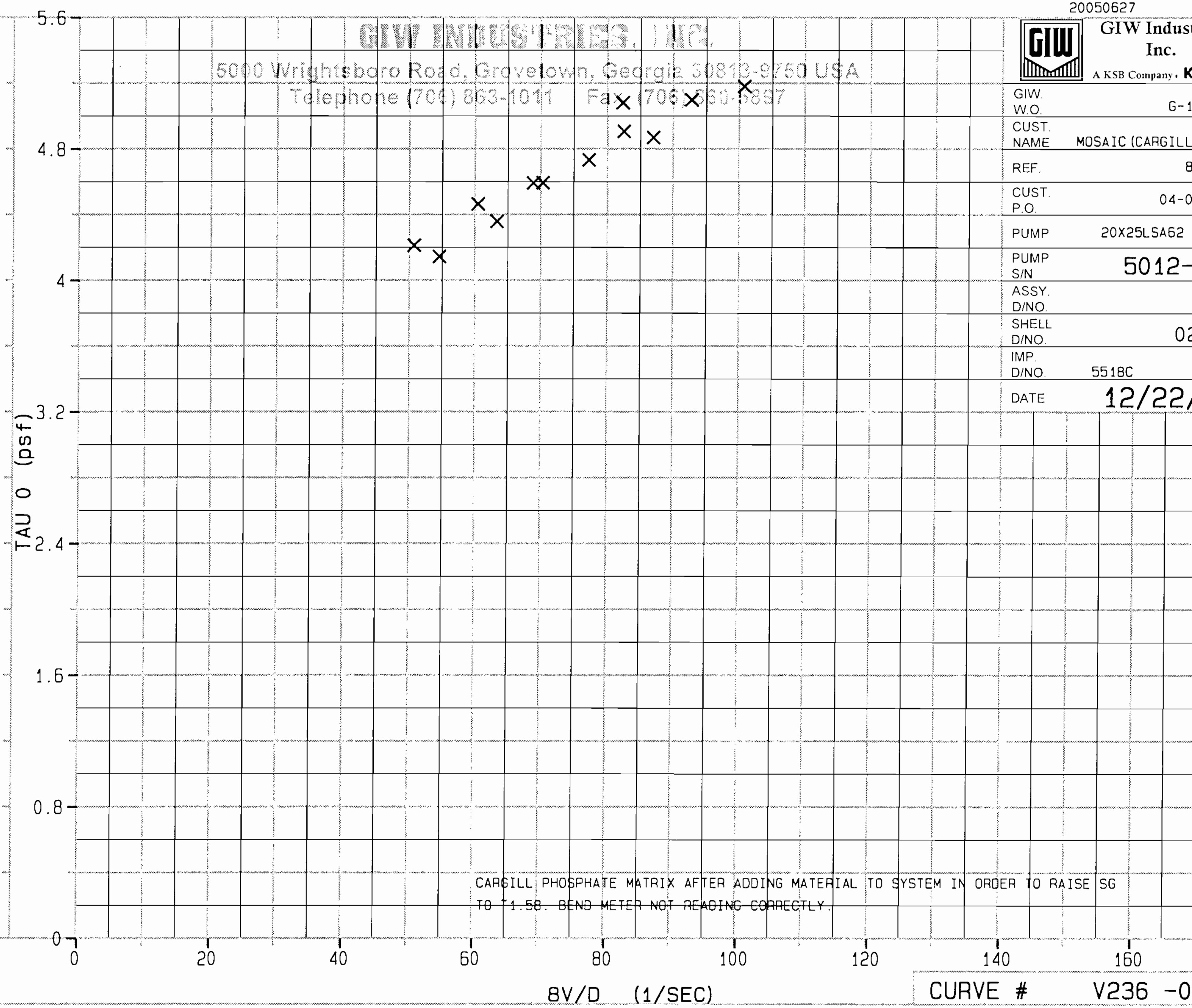
20050627

GIW Industries Inc.
A KSB Company . KSB

GIW. W.O.	G-128286
CUST. NAME	FIPR MOSAIC (CARGILL) MATR
REF.	80H578
CUST. P.O.	04-04-069
PUMP	20X25LSA62 C/3ME
PUMP S/N	5012-LAB
ASSY. D/NO.	NA
SHELL D/NO.	0275D
IMP. D/NO.	5518C 62"
DATE	12/22/04



CARGILL PHOSPHATE MATRIX AFTER ADDING MATERIAL TO SYSTEM IN ORDER TO RAISE SG TO ~1.58. BEND METER NOT READING CORRECTLY.

CURVE # V236 -04

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF	0.GPM, 0.RPM
EFFICIENCY	0.0% BY 1.000

CH	USE RDG SOURCE	INSTRUMENT
1	NULLSUCTION	#1 YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULLLOSS 20"	#2 YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE S.G.U-SECUP	#3 ROSEMOUNT 4 12'H2O 1E2 07093B 0.500
4	AVE S.G.U-SECDN	#4 ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5.	DISCHARGE	#5 ROSEMONT 6 239'H2O 1E1 07093B 1.000
6P	DIFHEAD	#6 ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.	NULLFLOWORIFICE	#7 ROSEMONT 5 60'H2O 1E2 07093B 0.000
8.	FLOWBEND	#8 ROSEMONT 5 24'H2O 1E2 07093B 1.000
9S	LOSS 20	#9 ROSEMONT 5 24'H2O 1E2 07093B 1.000
10S	FLOWBEND	#10ROSEMONT 4 12'H2O 1E2 07134B 1.000
11.	FLOWBEND	#11ROSEMONT 4 12'H2O 1E2 07134B 1.000
12S	NULLLOSS 20"	#12ROSEMONT 4 12'H2O 1E2 07134B 0.000
13P	LOSS 20"	#13ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULLDISCHARGE	#14ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15S	DIFHEAD	#15ROSEMOUNT 5 60'H2O 1E2 01164E 1.000
16S	NULLDISCHARGE	#16ROSEMONT 7 692'H2O 1E1 07093B 0.000
17	SUCTION	#17ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P	TEMPTANK	#18 RTD TANK F 1E1 10204D 1.000
19S	TEMPAMBIENT	#19 RTD AMBIENT F 1E1 10204B 1.000
20P	BHP TRQ*RPM	#20 BENSFELD 30K FTLB1E-102122B 1.000
21	RPM TRQ BAR	#21 DAYTRONIC 300 RPM 1E1 02122D 1.000
22S	BHP TRQ BAR	#22 BENSFELD 3000HP 1E1 02122F 1.000
23S	NULLTEMPAMBIENT	#23 RTD7 100OHM F 1E1 04088B 0.000
24P	NULLBHP TRQ*RPM	#24 LEBOW DAY 166 FTLB1E1 12211B 0.000
25P	FLOW18" MAG	#25 18" F&P 32000 GPM 1E-111164B 1.000
26S	NULLBHP TRQ BAR	#26 LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULLFLOW3"MAG	#27 LOAD CELL 100LB 1E2 01101B 0.000
28S	NULLFLOWORIFICE	TECO# 6158 21.80 FPS 1E2 09256C 0.000
29.	NULLFLOW6"MAG	#29 6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULLBHP TRQ*RPM	#30 LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULLRPM TRQ BAR	#31 LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULLBHP TRQ BAR	#32 LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO V236 -04 DATE 12/22/04

PUMP TEST DATA FOR	FIPR
	MOSAIC(CARGILL)MATR
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.80"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 245.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

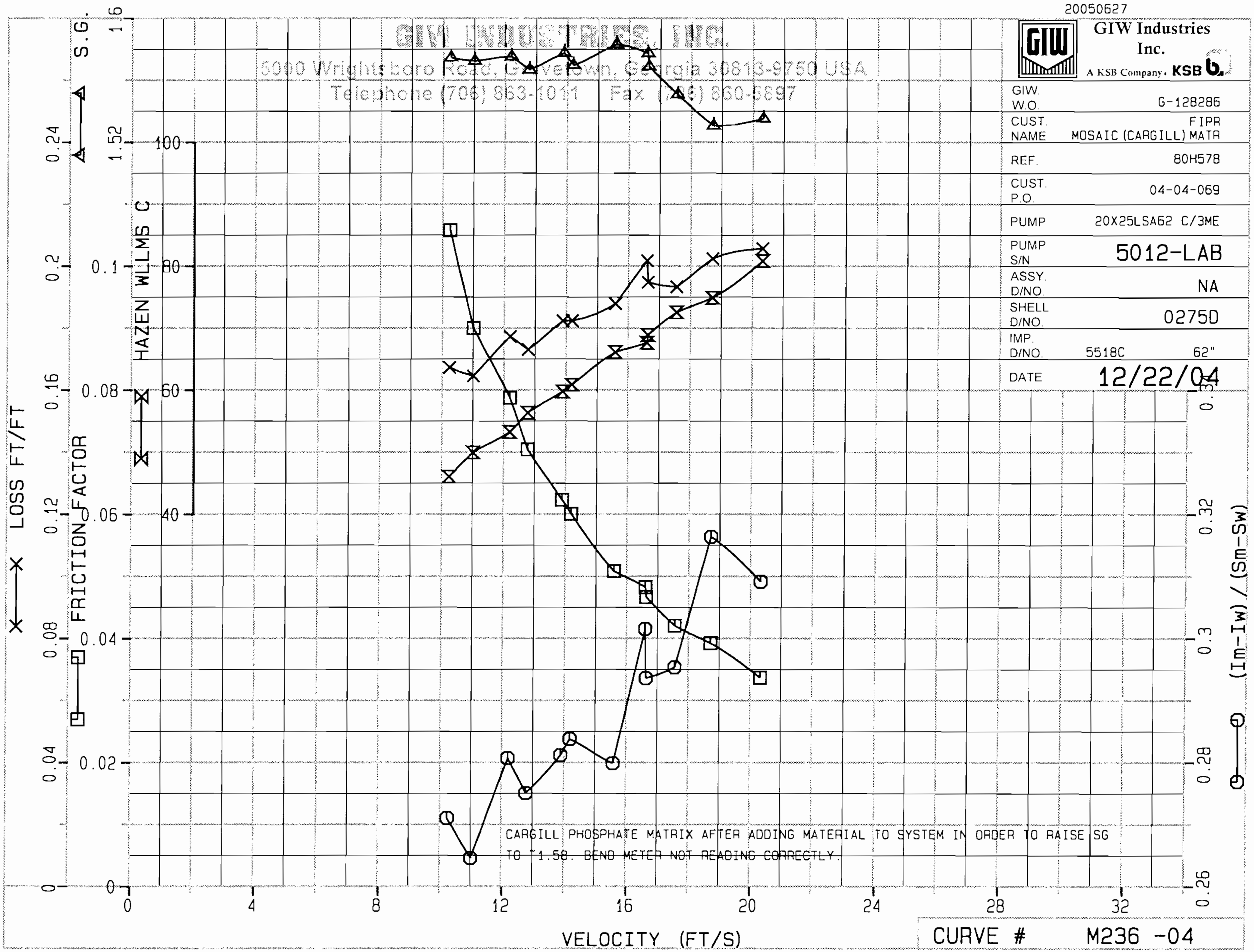
NO	VELOCITY Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME CONC. Cv %	WEIGHT CONC. Cw %	MASS Ms TON/HR	PIPELINE LOSSES Im FT/FT	Iw FT/FT	dp/dx psf	Tau 0 psf	8V/D 1/SEC	Tau 0 ln psf	8V/D ln 1/SEC	TIME t HH.MM
1	14.16	13007.8	75.6	0.998	1.570	34.6	58.4	2986.0	0.1825	0.0203	11.390	4.5965	70.190	1.5253	4.2512	13.03
2	15.56	14289.2	75.6	0.998	1.584	35.4	59.3	3358.2	0.1880	0.0241	11.732	4.7343	77.105	1.5548	4.3452	13.05
3	16.61	15253.3	75.6	0.998	1.569	34.6	58.4	3496.2	0.1949	0.0273	12.164	4.9085	82.307	1.5910	4.4105	13.06
4	17.53	16100.9	75.8	0.998	1.551	33.5	57.2	3573.7	0.1935	0.0302	12.073	4.8721	86.881	1.5835	4.4645	13.07
5	18.69	17165.4	77.4	0.998	1.531	32.3	55.8	3672.3	0.2026	0.0339	12.641	5.1010	92.625	1.6294	4.5286	13.09
6	20.30	18647.7	78.6	0.998	1.536	32.5	56.2	4024.5	0.2058	0.0396	12.844	5.1829	100.62	1.6454	4.6114	13.11
7	16.58	15225.2	79.2	0.998	1.578	35.1	59.0	3543.7	0.2019	0.0270	12.599	5.0841	82.156	1.6261	4.4086	13.15
8	13.87	12738.7	79.2	0.998	1.578	35.1	59.0	2965.9	0.1825	0.0193	11.387	4.5952	68.738	1.5250	4.2303	13.17
9	12.75	11714.3	79.2	0.998	1.567	34.5	58.3	2676.9	0.1732	0.0165	10.807	4.3612	63.211	1.4727	4.1465	13.18
10	12.17	11180.1	79.2	0.998	1.576	35.0	58.8	2592.8	0.1774	0.0152	11.068	4.4665	60.328	1.4966	4.0998	13.20
11	10.98	10087.5	79.1	0.998	1.573	34.8	58.6	2327.9	0.1647	0.0125	10.276	4.1467	54.432	1.4223	3.9970	13.21
12	10.21	9376.4	79.0	0.998	1.575	34.9	58.8	2172.2	0.1674	0.0109	10.447	4.2156	50.596	1.4388	3.9239	13.23

TESTED BY LEE WHITLOCK DATE 12/22/04 COMMENTS: CARGILL PHOSPHATE MATRIX AFTER ADDING MATERIAL TO SYSTEM IN ORDER TO RAISE SG TO ~1.58. BEND METER NOT READING CORRECTLY.

WITNESSED BY GRAEME ADDIE FOR FIPR

Version: 20050627

V236 -04 12/22/04



20050627
GIW Industries Inc.
A KSB Company. KSB
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW. W.O. G-128286
CUST. NAME FIPR MOSAIC (CARGILL) MATR
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/22/04
S.G.
LOSS FT/FT
FRICTION FACTOR
HAZEN WLLMS C
(Im-Iw) / (Sm-Sw)
VELOCITY (FT/S)
CARGILL PHOSPHATE MATRIX AFTER ADDING MATERIAL TO SYSTEM IN ORDER TO RAISE SG
TO ~1.58. BEND METER NOT READING CORRECTLY.
CURVE # M236 -04

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE RDG SOURCE	INSTRUMENT
1	NULLSUCTION	#1 YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULLLOSS 20"	#2 YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE S.G.U-SECUP	#3 ROSEMOUNT 4 12'H2O 1E2 07093B 0.500
4	AVE S.G.U-SECDN	#4 ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5.	DISCHARGE	#5 ROSEMONT 6 239'H2O 1E1 07093B 1.000
6P	DIFHEAD	#6 ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.	NULLFLOWORIFICE	#7 ROSEMOUNT 5 60'H2O 1E2 07093B 0.000
8.	FLOWBEND	#8 ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
9S	LOSS 20	#9 ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
10S	FLOWBEND	#10ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
11.	FLOWBEND	#11ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
12S	NULLLOSS 20"	#12ROSEMOUNT 4 12'H2O 1E2 07134B 0.000
13P	LOSS 20"	#13ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULLDISCHARGE	#14ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15S	DIFHEAD	#15ROSEMOUNT 5 60'H2O 1E2 01164E 1.000
16S	NULLDISCHARGE	#16ROSEMONT 7 692'H2O 1E1 07093B 0.000
17	SUCTION	#17ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P	TEMPTANK	#18 RTD TANK F 1E1 10204D 1.000
19S	TEMPAMBIENT	#19 RTD AMBIENT F 1E1 10204B 1.000
20P	BHP TRQ*RPM	#20 BENSFELD 30K FTLB1E-102122B 1.000
21	RPM TRQ BAR	#21 DAYTRONIC 300 RPM 1E1 02122D 1.000
22S	BHP TRQ BAR	#22 BENSFELD 3000HP 1E1 02122F 1.000
23S	NULLTEMPAMBIENT	#23 RTD7 100OHM F 1E1 04088B 0.000
24P	NULLBHP TRQ*RPM	#24 LEBOW DAY 166 FTLB1E1 12211B 0.000
25P	FLOW18" MAG	#25 18" F&P 32000 GPM 1E-111164B 1.000
26S	NULLBHP TRQ BAR	#26 LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULLFLOW3"MAG	#27 LOAD CELL 100LB 1E2 01101B 0.000
28S	NULLFLOWORIFICE	TECO# 6158 21.80 FPS 1E2 09256C 0.000
29.	NULLFLOW6"MAG	#29 6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULLBHP TRQ*RPM	#30 LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULLRPM TRQ BAR	#31 LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULLBHP TRQ BAR	#32 LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO M236 -04 DATE 12/22/04

PUMP TEST DATA FOR	FIPR
	MOSAIC(CARGILL)MATR
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.80"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 245.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

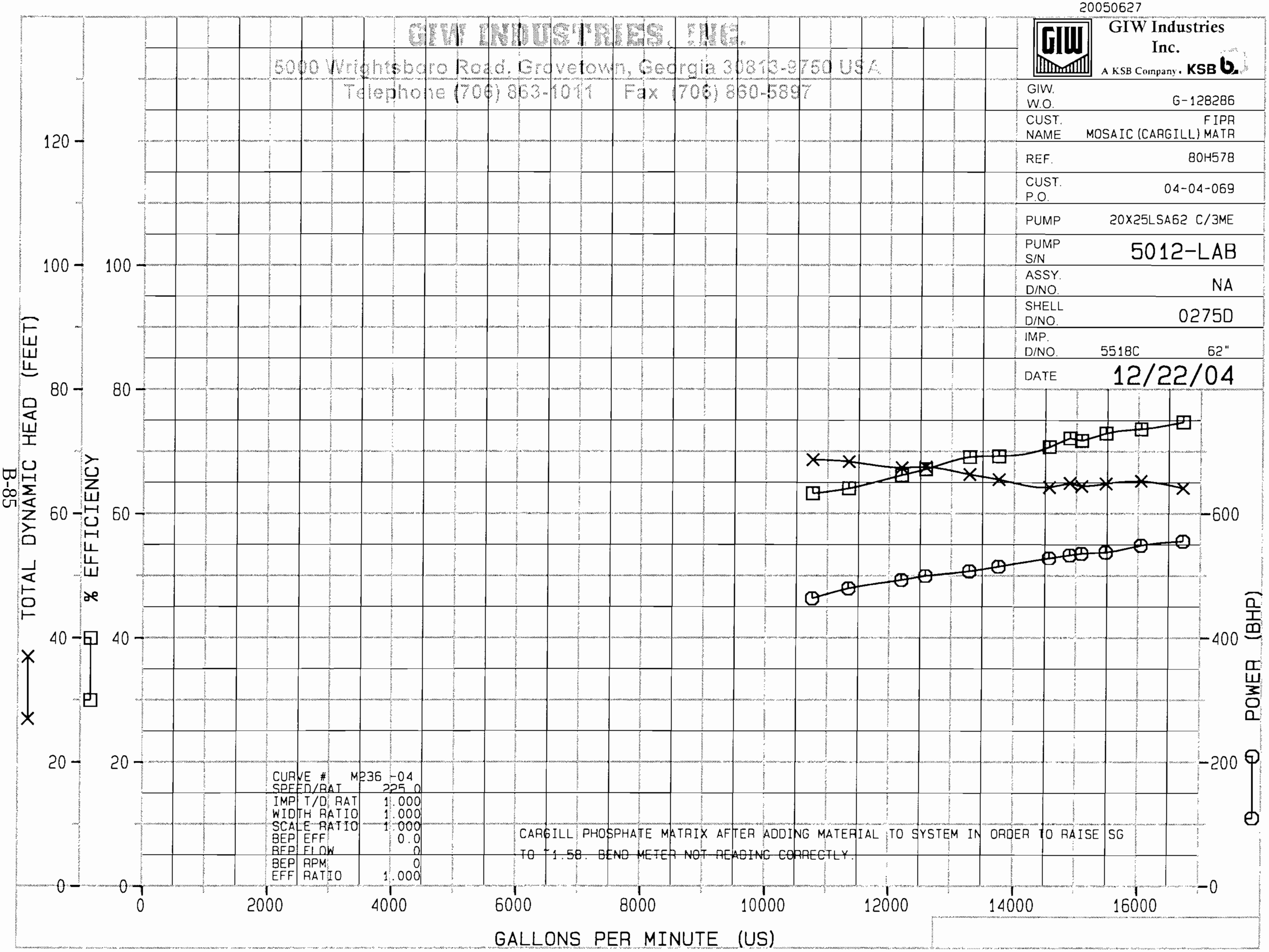
TEST RESULTS

NO	VELOCITY Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME CONC. Cv %	WEIGHT CONC. Cw %	MASS Ms TON/HR	REYNOLDS NUMBER Re	PIPELINE LOSSES Im FT/FT	PIPELINE LOSSES Iw FT/FT	FRICTION FACTRS Fm	FRICTION FACTRS Fw SAME Re:	HAZEN WLLMS C	Im-Iw / Sm-Sw	TIME t HH.MM
1	14.16	13007.8	75.6	0.998	1.570	34.6	58.4	2986.0	0.234E+07	0.1825	0.0203	0.0601	0.0105	61.	0.2838	13.03
2	15.56	14289.2	75.6	0.998	1.584	35.4	59.3	3358.2	0.258E+07	0.1880	0.0241	0.0509	0.0104	66.	0.2800	13.05
3	16.61	15253.3	75.6	0.998	1.569	34.6	58.4	3496.2	0.275E+07	0.1949	0.0273	0.0467	0.0103	69.	0.2937	13.06
4	17.53	16100.9	75.8	0.998	1.551	33.5	57.2	3573.7	0.291E+07	0.1935	0.0302	0.0421	0.0102	73.	0.2954	13.07
5	18.69	17165.4	77.4	0.998	1.531	32.3	55.8	3672.3	0.317E+07	0.2026	0.0339	0.0393	0.0101	75.	0.3164	13.09
6	20.30	18647.7	78.6	0.998	1.536	32.5	56.2	4024.5	0.350E+07	0.2058	0.0396	0.0337	0.0100	81.	0.3092	13.11
7	16.58	15225.2	79.2	0.998	1.578	35.1	59.0	3543.7	0.288E+07	0.2019	0.0270	0.0483	0.0102	68.	0.3016	13.15
8	13.87	12738.7	79.2	0.998	1.578	35.1	59.0	2965.9	0.241E+07	0.1825	0.0193	0.0624	0.0105	60.	0.2812	13.17
9	12.75	11714.3	79.2	0.998	1.567	34.5	58.3	2676.9	0.221E+07	0.1732	0.0165	0.0705	0.0106	56.	0.2751	13.18
10	12.17	11180.1	79.2	0.998	1.576	35.0	58.8	2592.8	0.211E+07	0.1774	0.0152	0.0788	0.0106	53.	0.2807	13.20
11	10.98	10087.5	79.1	0.998	1.573	34.8	58.6	2327.9	0.190E+07	0.1647	0.0125	0.0901	0.0108	50.	0.2646	13.21
12	10.21	9376.4	79.0	0.998	1.575	34.9	58.8	2172.2	0.177E+07	0.1674	0.0109	0.1058	0.0109	46.	0.2711	13.23

TESTED BY LEE WHITLOCK DATE 12/22/04 COMMENTS: CARGILL PHOSPHATE MATRIX AFTER ADDING MATERIAL TO SYSTEM IN ORDER TO RAISE SG TO ~1.58. BEND METER NOT READING CORRECTLY.

WITNESSED BY GRAEME ADDIE FOR FIPR
Version: 20050627

M236 -04 12/22/04


20050627
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW Industries Inc.
A KSB Company · KSB
GIW. W.O. G-128286
CUST. NAME FIPR MOSAIC (CARGILL) MATR
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/22/04
TOTAL DYNAMIC HEAD (FEET)
% EFFICIENCY
POWER (BHP)
GALLONS PER MINUTE (US)
CURVE # M236 -04
SPEED/RAT 225.0
IMP T/D RAT 1.000
WIDTH RATIO 1.000
SCALE RATIO 1.000
BEP EFF 0.0
BEP FLOW 0
BEP RPM 0
EFF RATIO 1.000
CARGILL PHOSPHATE MATRIX AFTER ADDING MATERIAL TO SYSTEM IN ORDER TO RAISE SG
TO ~1.58. BEND METER NOT READING CORRECTLY.

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE	RDG SOURCE	INSTRUMENT
1	NULL	SUCTION	#1 YOKOGAWA-30-30 H20-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2 YOKOGAWA -4-8' H20-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3 ROSEMOUNT 4 12'H20 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4 ROSEMONT4 -4-8'H20-1E2 07134B 0.500
5.		DISCHARGE	#5 ROSEMONT 6 239'H20 1E1 07093B 1.000
6P		DIFHEAD	#6 ROSEMONT 6 236'H20 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7 ROSEMOUNT 5 60'H20 1E2 07093B 0.000
8.		FLOWBEND	#8 ROSEMOUNT 5 24'H20 1E2 07093B 1.000
9S		LOSS 20	#9 ROSEMOUNT 5 24'H20 1E2 07093B 1.000
10S		FLOWBEND	#10ROSEMOUNT 4 12'H20 1E2 07134B 1.000
11.		FLOWBEND	#11ROSEMOUNT 4 12'H20 1E2 07134B 1.000
12S	NULL	LOSS 20"	#12ROSEMOUNT 4 12'H20 1E2 07134B 0.000
13P		LOSS 20"	#13ROSEMONT4 -4-8'H20-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14ROSEMOUNT 5 24'H20 1E2 07134B 0.000
15S		DIFHEAD	#15ROSEMOUNT 5 60'H20 1E2 01164E 1.000
16S	NULL	DISCHARGE	#16ROSEMONT 7 692'H20 1E1 07093B 0.000
17		SUCTION	#17ROSE. 5 -30-30'H20-1E2 07093B 1.000
18P		TEMPTANK	#18 RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19 RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20 BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21 DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22 BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23 RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24 LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25 18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26 LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27 LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO# 6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29 6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30 LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31 LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32 LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO T236 -04 DATE 12/22/04

PUMP TEST DATA FOR	FIPR
	MOSAIC(CARGILL)MATR
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H20 = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.80"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 245.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

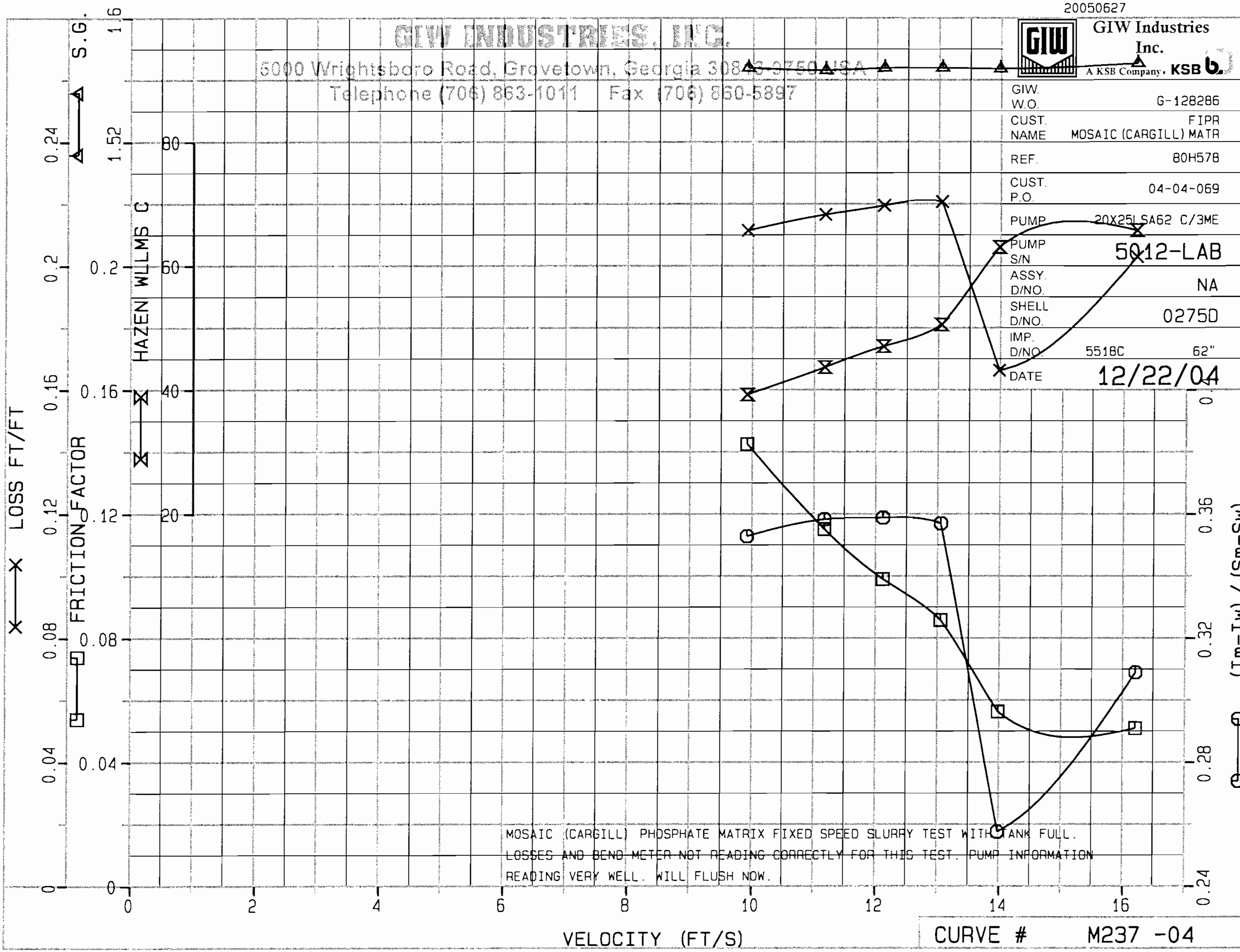
TEST RESULTS

NO:	FLOW MEASUREMENT: FLOW Q: GPM	VELOCITY: FT/S	HEAD MEASUREMENT: DISCH: PSI	SUCTN: " HG	TOT HD: H FT	S.G.	DRIVER POWER: INPUT: KW	OUTPUT: BHP	SPEED: N: RPM	PUMP OUTPUT: WHP	EFF: n %	TEMP: Tm: F	SCALED PERFORMANCE FLOW: GPM	HEAD: FT	POWER: BHP	EFF: %	TIME: t: H.MM	MAG18": C 25: *1.000	BEND12: S 10: *1.000
1	13007.8	14.16	38.68	-0.94	58.72	1.57	0.0	436.9	213.0	302.8	69.3	75.6	13743.	65.5	515.3	69.3	13.03	13008.	0.000
2	14289.2	15.56	40.76	-1.37	61.97	1.58	0.0	500.3	220.9	354.1	70.8	75.6	14554.	64.3	528.7	70.8	13.05	14289.	0.000
3	15253.3	16.61	42.60	-1.91	65.98	1.57	0.0	555.3	227.6	398.8	71.8	75.6	15078.	64.5	536.4	71.8	13.06	15253.	0.000
4	16100.9	17.53	44.67	-2.14	70.34	1.55	0.0	607.5	234.3	443.6	73.0	75.8	15465.	64.9	538.3	73.0	13.07	16101.	0.000
5	17165.4	18.69	46.65	-2.44	74.88	1.53	0.0	674.4	240.9	496.9	73.7	77.4	16033.	65.3	549.5	73.7	13.09	17165.	0.000
6	18647.7	20.30	49.62	-2.64	79.91	1.54	0.0	772.7	251.1	577.8	74.8	78.6	16711.	64.2	556.0	74.8	13.11	18648.	0.000
7	15225.2	16.58	44.20	-1.88	67.94	1.58	0.0	570.7	230.1	412.1	72.2	79.2	14890.	65.0	533.8	72.2	13.15	15225.	0.000
8	12738.7	13.87	40.49	-1.06	61.07	1.58	0.0	448.2	215.8	310.0	69.2	79.2	13279.	66.4	507.7	69.2	13.17	12739.	0.000
9	11714.3	12.75	38.97	-0.64	58.64	1.57	0.0	404.5	209.6	271.8	67.2	79.2	12573.	67.5	500.1	67.2	13.18	11714.	0.000
10	11180.1	12.17	38.15	-0.38	56.78	1.58	0.0	381.3	206.5	252.6	66.2	79.2	12184.	67.4	493.5	66.2	13.20	11180.	0.000
11	10087.5	10.98	36.71	-0.02	54.23	1.57	0.0	338.8	200.3	217.2	64.1	79.1	11330.	68.4	480.1	64.1	13.21	10087.	0.000
12	9376.4	10.21	35.73	0.26	52.34	1.57	0.0	308.4	196.4	195.2	63.3	79.0	10744.	68.7	464.0	63.3	13.23	9376.4	0.000

TESTED BY LEE WHITLOCK DATE 12/22/04 COMMENTS: CARGILL PHOSPHATE MATRIX AFTER ADDING MATERIAL TO SYSTEM IN ORDER TO RAISE SG TO ~1.58. BEND METER NOT READING CORRECTLY.

WITNESSED BY GRAEME ADDIE FOR FIPR

Version: 20050627 T236 -04 12/22/04


20050627
GIW Industries Inc.
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GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW. W.O. G-128286
CUST. NAME FIPR MOSAIC (CARGILL) MATR
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/22/04
S.G.
HAZEN WLLMS C
FRICTION FACTOR
LOSS FT/FT
(Im-Iw) / (Sm-Sw)
VELOCITY (FT/S)
MOSAIC (CARGILL) PHOSPHATE MATRIX FIXED SPEED SLURRY TEST WITH TANK FULL.
LOSSES AND BEND METER NOT READING CORRECTLY FOR THIS TEST. PUMP INFORMATION
READING VERY WELL. WILL FLUSH NOW.
CURVE # M237 -04

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE	RDG	SOURCE	INSTRUMENT
1	NULL	SUCTION	#1	YOKOGAWA-30-30 H20-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2	YOKOGAWA -4-8' H20-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3	ROSEMOUNT 4 12'H20 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4	ROSEMONT4 -4-8'H20-1E2 07134B 0.500
5.		DISCHARGE	#5	ROSEMONT 6 239'H20 1E1 07093B 1.000
6P		DIFHEAD	#6	ROSEMONT 6 236'H20 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7	ROSEMOUNT 5 60'H20 1E2 07093B 0.000
8.		FLOWBEND	#8	ROSEMOUNT 5 24'H20 1E2 07093B 1.000
9P		LOSS 20	#9	ROSEMOUNT 5 24'H20 1E2 07093B 1.000
10S		FLOWBEND	#10	ROSEMOUNT 4 12'H20 1E2 07134B 1.000
11.		FLOWBEND	#11	ROSEMOUNT 4 12'H20 1E2 07134B 1.000
12S	NULL	LOSS 20"	#12	ROSEMOUNT 4 12'H20 1E2 07134B 0.000
13S		LOSS 20"	#13	ROSEMONT4 -4-8'H20-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14	ROSEMOUNT 5 24'H20 1E2 07134B 0.000
15S		DIFHEAD	#15	ROSEMOUNT 5 60'H20 1E2 01164E 1.000
16S	NULL	DISCHARGE	#16	ROSEMONT 7 692'H20 1E1 07093B 0.000
17		SUCTION	#17	ROSE. 5 -30-30'H20-1E2 07093B 1.000
18P		TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23	RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO T237 -04 DATE 12/22/04

PUMP TEST DATA FOR	FIPR
	MOSAIC(CARGILL)MATR
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H20 = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.80"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 245.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

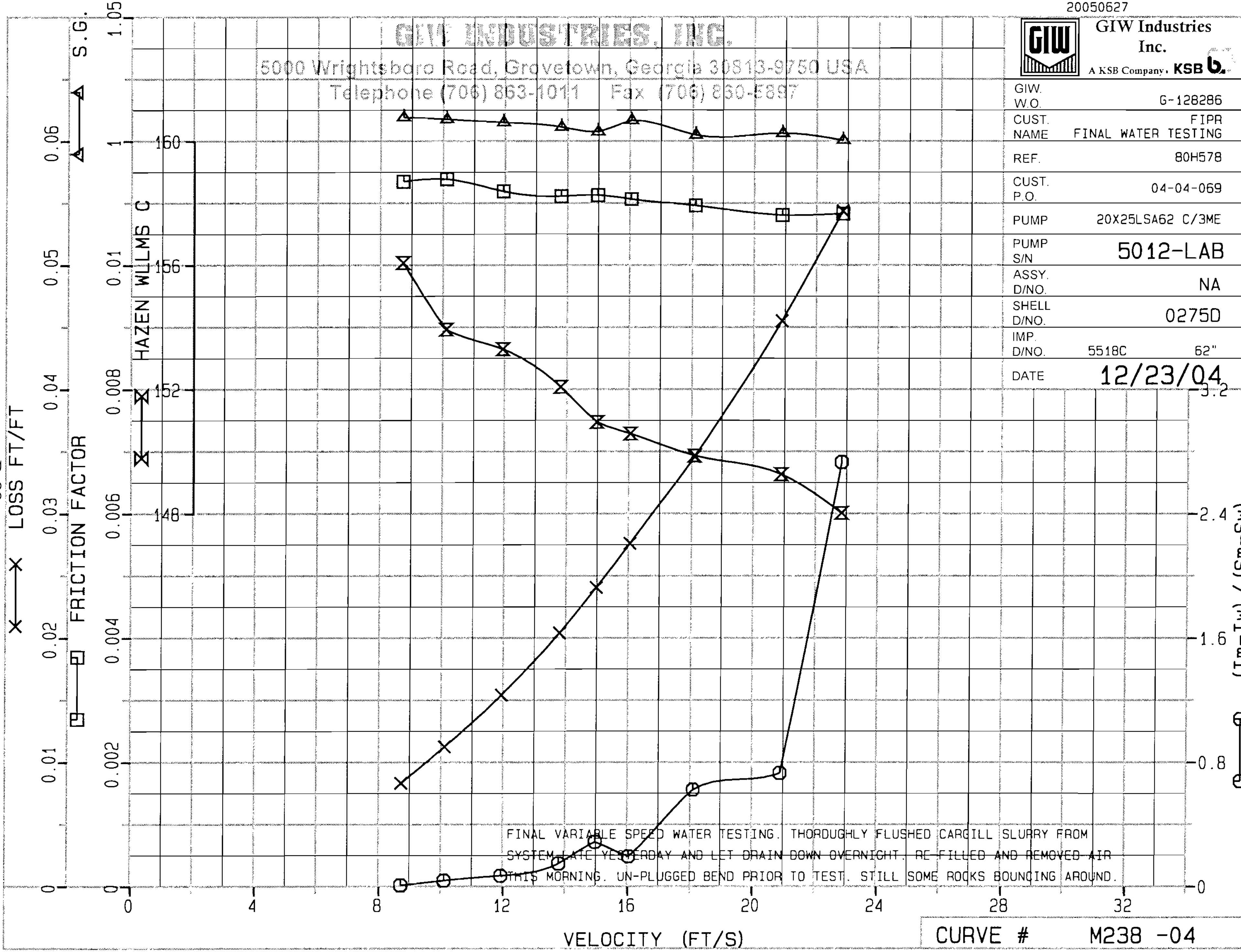
NO:	FLOW MEASUREMENT: FLOW Q: GPM	VELOCITY: FT/S	HEAD MEASUREMENT: DISCH: PSI	SUCTN: " HG	TOT HD: H FT	S.G.	DRIVER POWER: INPUT: KW	OUTPUT: BHP	SPEED: N: RPM	PUMP OUTPUT: WHP	EFF: n %	TEMP: Tm: F	SCALED PERFORMANCE: FLOW: GPM	HEAD: FT	POWER: BHP	EFF: %	TIME: t: H.MM	MAG18": C 25: *1.000	BEND12: S 10: *1.000
1	14879.7	16.20	42.52	-1.24	65.17	1.57	0.0	531.6	224.9	384.7	72.4	78.7	14888.	65.2	532.5	72.4	13.33	14880.	0.000
2	12831.1	13.97	45.20	-0.34	67.92	1.57	0.0	491.8	225.1	345.0	70.1	78.3	12826.	67.9	491.3	70.1	13.38	12831.	0.000
3	11975.4	13.04	46.11	0.00	68.73	1.57	0.0	469.7	225.3	325.9	69.4	77.6	11959.	68.5	467.8	69.4	13.41	11975.	0.000
4	11119.8	12.11	47.01	0.36	69.55	1.57	0.0	450.8	225.2	306.2	67.9	77.1	11112.	69.5	449.9	67.9	13.44	11120.	0.000
5	10252.1	11.16	48.00	0.68	70.62	1.57	0.0	431.8	225.1	286.4	66.3	76.7	10248.	70.6	431.3	66.3	13.47	10252.	0.000
6	9099.3	9.91	49.28	0.74	72.11	1.57	0.0	408.6	225.4	259.8	63.6	76.6	9081.	71.8	406.2	63.6	13.49	9099.3	0.000

TESTED BY LEE WHITLOCK DATE 12/22/04 COMMENTS: MOSAIC (CARGILL) PHOSPHATE MATRIX FIXED SPEED SLURRY TEST WITH TANK FULL. LOSSES AND BEND METER NOT READING CORRECTLY FOR THIS TEST. PUMP INFORMATION READING VERY WELL. WILL FLUSH NOW.

WITNESSED BY GRAEME ADDIE FOR FIPR

Version: 20050627

T237 -04 12/22/04



20050627
GIW Industries Inc.
A KSB Company, KSB
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW. W.O. G-128286
CUST. NAME FIPR FINAL WATER TESTING
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/23/04
S.G.
FRICTION FACTOR
LOSS FT/FT
HAZEN WLLMS C
(Im-Iw) / (Sm-Sw)
VELOCITY (FT/S)
FINAL VARIABLE SPEED WATER TESTING. THOROUGHLY FLUSHED CARGILL SLURRY FROM SYSTEM LATE YESTERDAY AND LET DRAIN DOWN OVERNIGHT. RE-FILLED AND REMOVED AIR THIS MORNING. UN-PLUGGED BEND PRIOR TO TEST. STILL SOME ROCKS BOUNCING AROUND.
CURVE # M238 -04

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF	0.GPM, 0.RPM
EFFICIENCY	0.0% BY 1.000

CH	USE	RDG	SOURCE INSTRUMENT
1	NULL	SUCTION	#1 YOKOGAWA-30-30 H20-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2 YOKOGAWA -4-8' H20-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3 ROSEMOUNT 4 12'H20 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4 ROSEMONT4 -4-8'H20-1E2 07134B 0.500
5.		DISCHARGE	#5 ROSEMONT 6 239'H20 1E1 07093B 1.000
6P		DIFHEAD	#6 ROSEMONT 6 236'H20 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7 ROSEMONT 5 60'H20 1E2 07093B 0.000
8.		FLOWBEND	#8 ROSEMONT 5 24'H20 1E2 07093B 1.000
9P		LOSS 20	#9 ROSEMONT 5 24'H20 1E2 07093B 1.000
10S		FLOWBEND	#10ROSEMOUNT 4 12'H20 1E2 07134B 1.000
11.		FLOWBEND	#11ROSEMOUNT 4 12'H20 1E2 07134B 1.000
12S	NULL	LOSS 20"	#12ROSEMOUNT 4 12'H20 1E2 07134B 0.000
13S		LOSS 20"	#13ROSEMONT4 -4-8'H20-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14ROSEMOUNT 5 24'H20 1E2 07134B 0.000
15S		DIFHEAD	#15ROSEMOUNT 5 60'H20 1E2 01164E 1.000
16S	NULL	DISCHARGE	#16ROSEMONT 7 692'H20 1E1 07093B 0.000
17		SUCTION	#17ROSE. 5 -30-30'H20-1E2 07093B 1.000
18P		TEMPTANK	#18 RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19 RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20 BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21 DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22 BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23 RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24 LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25 18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26 LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27 LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO# 6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29 6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30 LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31 LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32 LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO M238 -04 DATE 12/23/04

PUMP TEST DATA FOR FIPR
FINAL WATER TESTING

PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H20 = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.45"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 50.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

NO	VELOCITY Vm FT/S	FLOW Qm GPM	TEMP Tm F	S.G. Sw	S.G. Sm	VOLUME CONC. Cv %	WEIGHT CONC. Cw %	MASS Ms TON/HR	REYNOLDS NUMBER Re	PIPELINE LOSSES Im FT/FT	PIPELINE LOSSES Iw FT/FT	FRICTION FACTRS Fm	FRICTION FACTRS Fw :SAME Re	HAZEN WLLMS C	Im-Iw ----- Sm-Sw	TIME t HH.MM
1	22.82	20957.4	70.8	0.999	1.000	0.1	0.3	13.7	0.354E+07	0.0544	0.0500	0.0108	0.0100	148.	2.7339	9.57
2	20.87	19169.9	71.1	0.999	1.003	0.3	0.7	35.0	0.325E+07	0.0456	0.0422	0.0108	0.0101	149.	0.7332	10.00
3	18.07	16599.0	71.2	0.999	1.003	0.2	0.6	25.5	0.282E+07	0.0346	0.0322	0.0110	0.0102	150.	0.6263	10.01
4	16.03	14719.0	71.4	0.999	1.009	0.6	1.6	57.6	0.250E+07	0.0276	0.0257	0.0111	0.0104	151.	0.1967	10.04
5	14.95	13734.9	71.4	0.999	1.004	0.3	0.8	28.6	0.234E+07	0.0241	0.0226	0.0111	0.0105	151.	0.2893	10.06
6	13.77	12650.3	71.5	0.999	1.006	0.4	1.1	36.2	0.215E+07	0.0204	0.0194	0.0111	0.0106	152.	0.1504	10.09
7	11.92	10947.1	71.6	0.999	1.008	0.5	1.4	39.4	0.187E+07	0.0154	0.0148	0.0112	0.0108	153.	0.0723	10.10
8	10.09	9268.0	71.6	0.999	1.009	0.6	1.6	38.1	0.158E+07	0.0113	0.0109	0.0114	0.0111	154.	0.0411	10.12
9	8.70	7990.6	71.6	0.999	1.010	0.7	1.8	35.5	0.136E+07	0.0084	0.0082	0.0114	0.0113	156.	0.0104	10.15

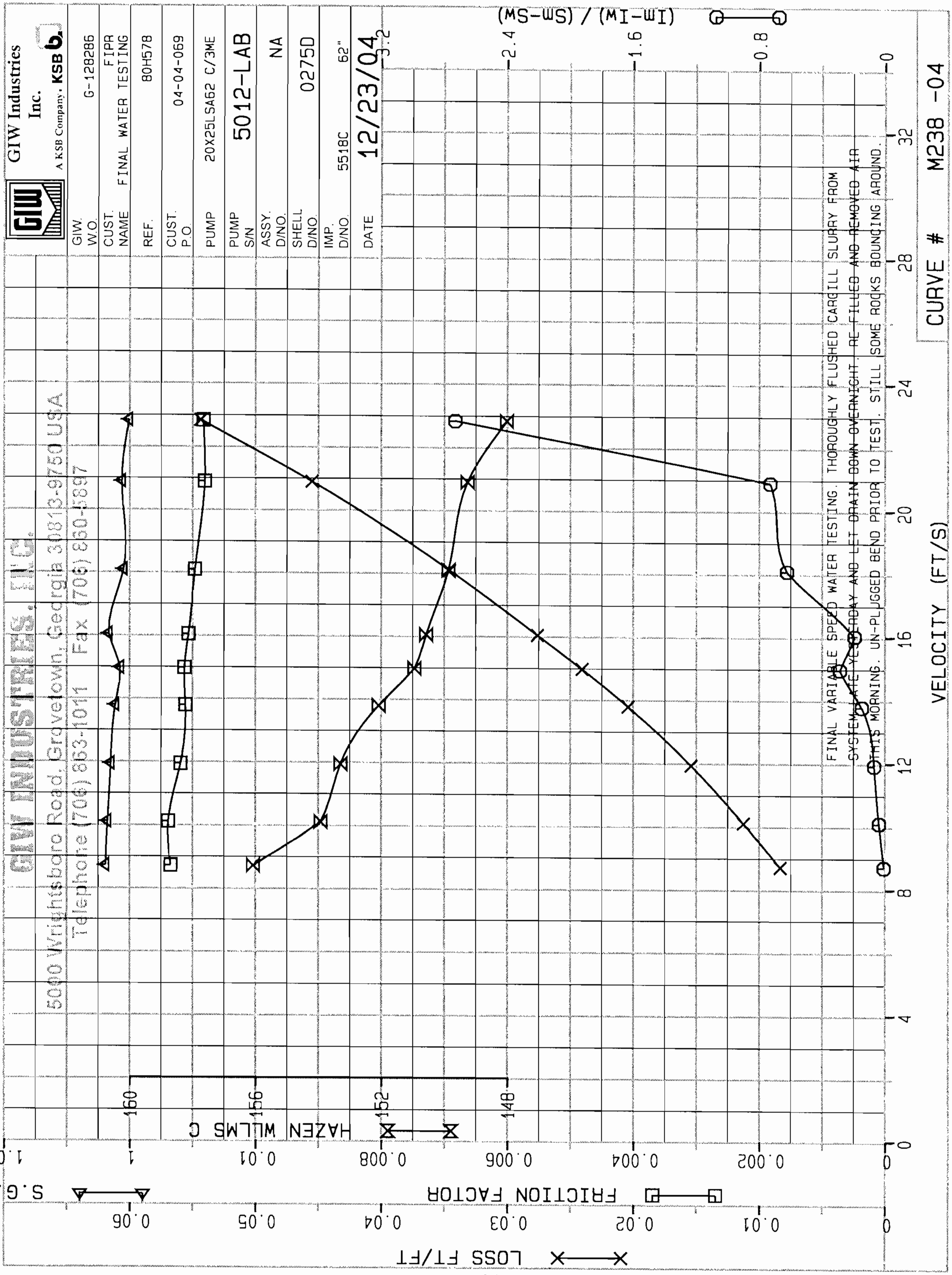
TESTED BY LEE WHITLOCK DATE 12/23/04

WITNESSED BY GRAEME ADDIE FOR FIPR

COMMENTS: FINAL VARIABLE SPEED WATER TESTING. THOROUGHLY FLUSHED CARGILL SLURRY FROM SYSTEM LATE YESTERDAY AND LET DRAIN DOWN OVERNIGHT. RE-FILLED AND REMOVED AIR THIS MORNING. UN-PLUGGED BEND PRIOR TO TEST. STILL SOME ROCKS BOUNCING AROUND.

Version: 20050627

M238 -04 12/23/04



2005062?
GIW Industries Inc.
A KSB Company. KSB
GIW W.O. G-128286
CUST. NAME FIPR FINAL WATER TESTING
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/23/04
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
(Im-Iw) / (Sm-Sw)
HAZEN WLLMS C
S.G.
FRICTION FACTOR
LOSS FT/FT
VELOCITY (FT/S)
FINAL VARIABLE SPEED WATER TESTING. THOROUGHLY FLUSHED CARGILL SLURRY FROM SYSTEM LATE YESTERDAY AND LET DRAIN DOWN OVERNIGHT. RE-FILLED AND REMOVED AIR THIS MORNING. UN-PLUGGED BEND PRIOR TO TEST. STILL SOME ROCKS BOUNCING AROUND.
CURVE # M238 -04

PUMP DETAIL	
PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL	
TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE 60 CPS	

SCALED PERFORMANCE FACTORS	
SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF 0.GPM,	0.RPM
EFFICIENCY 0.0%	BY 1.000

CH	USE RDG	SOURCE INSTRUMENT
1	NULLSUCTION	#1 YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULLLOSS 20"	#2 YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE S.G.U-SECUP	#3 ROSEMOUNT 4 12'H2O 1E2 07093B 0.500
4	AVE S.G.U-SECDN	#4 ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5.	DISCHARGE	#5 ROSEMONT 6 239'H2O 1E1 07093B 1.000
6P	DIFHEAD	#6 ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.	NULLFLOWORIFICE	#7 ROSEMOUNT 5 60'H2O 1E2 07093B 0.000
8.	FLOWBEND	#8 ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
9P	LOSS 20	#9 ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
10S	FLOWBEND	#10ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
11.	FLOWBEND	#11ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
12S	NULLLOSS 20"	#12ROSEMOUNT 4 12'H2O 1E2 07134B 0.000
13S	LOSS 20"	#13ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULLDISCHARGE	#14ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15S	DIFHEAD	#15ROSEMOUNT 5 60'H2O 1E2 01164E 1.000
16S	NULLDISCHARGE	#16ROSEMONT 7 692'H2O 1E1 07093B 0.000
17	SUCTION	#17ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P	TEMPTANK	#18 RTD TANK F 1E1 10204D 1.000
19S	TEMPAMBIENT	#19 RTD AMBIENT F 1E1 10204B 1.000
20P	BHP TRQ*RPM	#20 BENSFELD 30K FTLB1E-102122B 1.000
21	RPM TRQ BAR	#21 DAYTRONIC 300 RPM 1E1 02122D 1.000
22S	BHP TRQ BAR	#22 BENSFELD 3000HP 1E1 02122F 1.000
23S	NULLTEMPAMBIENT	#23 RTD7 100OHM F 1E1 04088B 0.000
24P	NULLBHP TRQ*RPM	#24 LEBOW DAY 166 FTLB1E1 12211B 0.000
25P	FLOW18" MAG	#25 18" F&P 32000 GPM 1E-111164B 1.000
26S	NULLBHP TRQ BAR	#26 LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULLFLOW3"MAG	#27 LOAD CELL 100LB 1E2 01101B 0.000
28S	NULLFLOWORIFICE	TECO# 6158 21.80 FPS 1E2 09256C 0.000
29.	NULLFLOW6"MAG	#29 6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULLBHP TRQ*RPM	#30 LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULLRPM TRQ BAR	#31 LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULLBHP TRQ BAR	#32 LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO T238 -04 DATE 12/23/04

PUMP TEST DATA FOR	FIPR
	FINAL WATER TESTING
PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.45"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 50.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

NO	FLOW MEASUREMENT: FLOW Q: GPM	VELOCITY: FT/S	HEAD MEASUREMENT: DISCH: PSI	SUCTN: " HG	TOT HD: H FT	S.G.	DRIVER POWER: INPUT: KW	OUTPUT: BHP	SPEED: N: RPM	PUMP: OUTPUT: WHP	EFF: n %	TEMP: Tm: F	SCALED PERFORMANCE: FLOW: GPM	HEAD: FT	POWER: BHP	EFF: %	TIME: t: H.MM	MAG18": C 25: *1.000	BEND12: S 10: *1.000
1	20957.4	22.82	16.37	-2.14	45.56	1.00	0.0	297.1	203.1	241.2	81.2	70.8	23221.	55.9	404.2	81.2	9.57	20957.	21080.
2	19169.9	20.87	13.75	-1.90	38.27	1.00	0.0	230.2	186.0	185.9	80.8	71.1	23195.	56.0	407.7	80.8	10.00	19170.	19213.
3	16599.0	18.07	10.37	-1.88	29.37	1.00	0.0	151.7	162.2	123.4	81.4	71.2	23025.	56.5	404.8	81.4	10.01	16599.	16524.
4	14719.0	16.03	8.22	-1.67	23.32	1.01	0.0	109.4	145.0	87.4	79.9	71.4	22847.	56.2	409.2	79.9	10.04	14719.	14623.
5	13734.9	14.95	7.15	-1.61	20.55	1.00	0.0	89.5	135.6	71.6	80.0	71.4	22795.	56.6	409.0	80.0	10.06	13735.	13697.
6	12650.3	13.77	6.07	-1.50	17.56	1.01	0.0	70.2	125.4	56.4	80.4	71.5	22699.	56.5	405.4	80.4	10.09	12650.	12582.
7	10947.1	11.92	4.53	-1.41	13.40	1.01	0.0	46.2	109.2	37.3	80.8	71.6	22566.	57.0	404.8	80.8	10.10	10947.	10882.
8	9268.0	10.09	3.18	-1.30	9.77	1.01	0.0	29.5	93.4	23.1	78.1	71.6	22323.	56.7	412.6	78.1	10.12	9268.0	9211.4
9	7990.6	8.70	2.30	-1.23	7.40	1.01	0.0	20.0	81.4	15.1	75.3	71.6	22097.	56.6	423.2	75.3	10.15	7990.6	7916.9

TESTED BY LEE WHITLOCK DATE 12/23/04

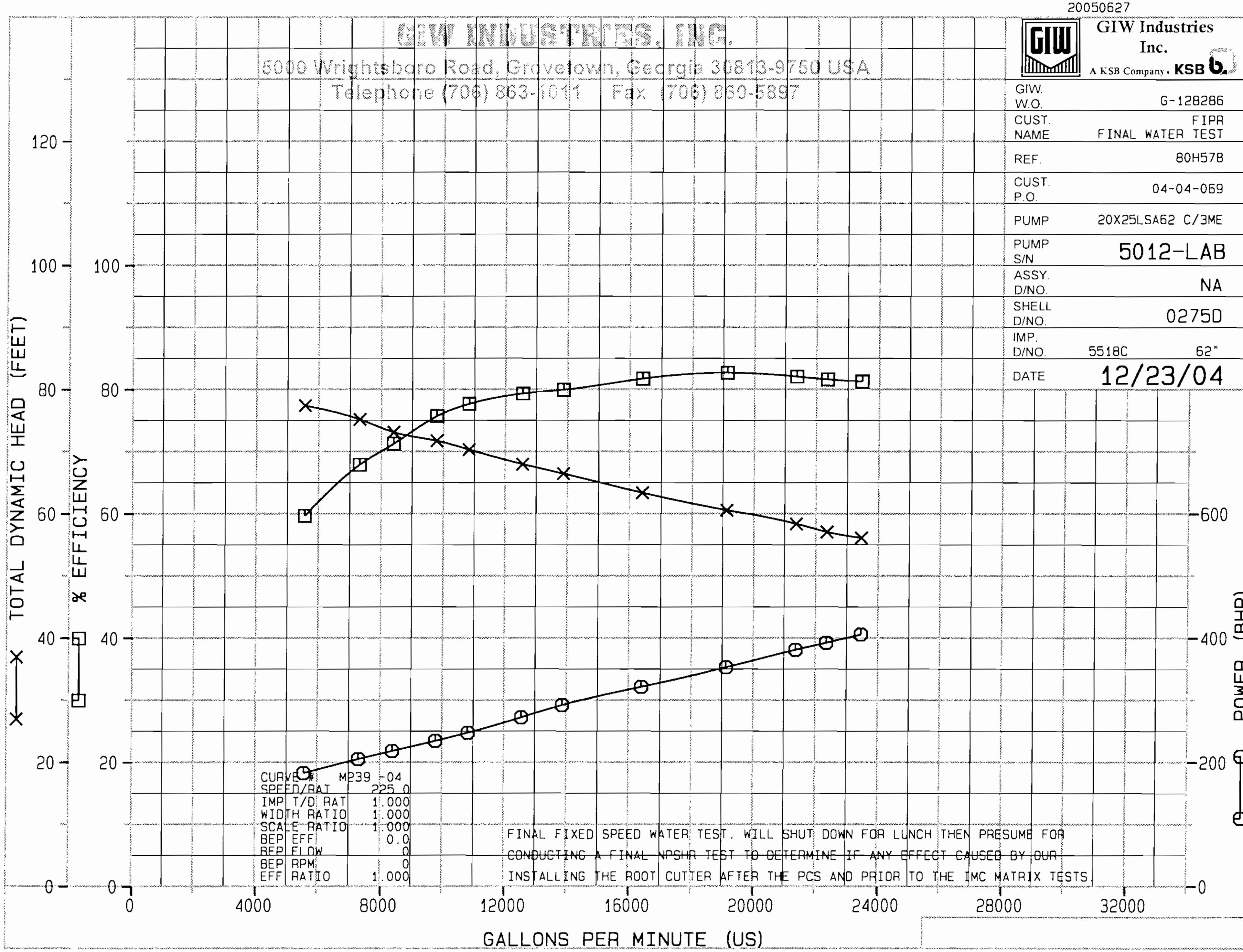
WITNESSED BY GRAEME ADDIE FOR FIPR

COMMENTS: FINAL VARIABLE SPEED WATER TESTING. THOROUGHLY FLUSHED CARGILL SLURRY FROM SYSTEM LATE YESTERDAY AND LET DRAIN DOWN OVERNIGHT. RE-FILLED AND REMOVED AIR THIS MORNING. UN-PLUGGED BEND PRIOR TO TEST. STILL SOME ROCKS BOUNCING AROUND.

Version: 20050627

T238 -04 12/23/04

20050627



GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
GIW Industries Inc.
A KSB Company. KSB
GIW. W.O. G-128286
CUST. NAME FIPR FINAL WATER TEST
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/23/04
TOTAL DYNAMIC HEAD (FEET)
% EFFICIENCY
POWER (BHP)
GALLONS PER MINUTE (US)
CURVE # M239 -04
SPEED/RAT 225.0
IMP T/D RAT 1.000
WIDTH RATIO 1.000
SCALE RATIO 1.000
BEP EFF 0.0
BEP FLOW 0
BEP RPM 0
EFF RATIO 1.000
FINAL FIXED SPEED WATER TEST. WILL SHUT DOWN FOR LUNCH THEN PRESUME FOR
CONDUCTING A FINAL NPSHR TEST TO DETERMINE IF ANY EFFECT CAUSED BY OUR
INSTALLING THE ROOT CUTTER AFTER THE PCS AND PRIOR TO THE IMC MATRIX TESTS.
0 4000 8000 12000 16000 20000 24000 28000 32000
0 20 40 60 80 100 120
0 200 400 600

PUMP DETAIL

PUMP	20X25LSA62 C/3ME
SERIAL NUMBER	5012-LAB
ASSEMBLY DRAWING NO	NA
SHELL DRAWING NO	0275D
IMPELLER DRAWING NO	5518C
IMPELLER DIAMETER	62"
OUTLET ANGLE	
OUTLET WIDTH	
ROTATION	CLOCKWISE
HYDROSTATIC PRESS.	STD

DRIVER DETAIL

TYPE	VARIABLE SPEED DRIVE
MAKE	GENERAL ELECTRIC
SERIAL NO	5511957
FRAME SIZE	5368480
RPM = 450	BHP = 2450.
4160 VOLTS 3 PHASE	60 CPS

SCALED PERFORMANCE FACTORS

SPEED OR RATIO	225.000
IMP TURN DOWN RATIO	1.000
MERIDINAL WIDTH RATIO	1.000
SCALE RATIO	1.000
BEP REF	0.GPM, 0.RPM
EFFICIENCY	0.0% BY 1.000

CH	USE	RDG	SOURCE INSTRUMENT
1	NULL	SUCTION	#1 YOKOGAWA-30-30 H20-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2 YOKOGAWA -4-8' H20-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3 ROSEMOUNT 4 12'H20 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4 ROSEMONT4 -4-8'H20-1E2 07134B 0.500
5.		DISCHARGE	#5 ROSEMONT 6 239'H20 1E1 07093B 1.000
6P		DIFHEAD	#6 ROSEMONT 6 236'H20 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7 ROSEMOUNT 5 60'H20 1E2 07093B 0.000
8.		FLOWBEND	#8 ROSEMOUNT 5 24'H20 1E2 07093B 1.000
9S		LOSS 20	#9 ROSEMOUNT 5 24'H20 1E2 07093B 1.000
10S		FLOWBEND	#10ROSEMOUNT 4 12'H20 1E2 07134B 1.000
11.		FLOWBEND	#11ROSEMOUNT 4 12'H20 1E2 07134B 1.000
12S	NULL	LOSS 20"	#12ROSEMOUNT 4 12'H20 1E2 07134B 0.000
13P		LOSS 20"	#13ROSEMONT4 -4-8'H20-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14ROSEMOUNT 5 24'H20 1E2 07134B 0.000
15S		DIFHEAD	#15ROSEMOUNT 5 60'H20 1E2 01164E 1.000
16S	NULL	DISCHARGE	#16ROSEMONT 7 692'H20 1E1 07093B 0.000
17		SUCTION	#17ROSE. 5 -30-30'H20-1E2 07093B 1.000
18P		TEMPTANK	#18 RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19 RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20 BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21 DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22 BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23 RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24 LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25 18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26 LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27 LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO# 6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29 6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30 LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31 LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32 LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO T239 -04 DATE 12/23/04

PUMP TEST DATA FOR FIPR FINAL WATER TEST

PROJECT	80H578
GIW WORK ORDER NO	G-128286
CUSTOMER ORDER NO	04-04-069

TEST CONSTANTS

1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.45"
HEAD LOSS = 35.00 FT OF 19.37 INCH DIAM
S.G. TAPS 8.00' APART G= 32.14 FT/S/S
SOLIDS SG 2.65 OF 50.MICRONS S.D.=0.0
PIPE ROUGHNESS REF M216 -04 E/D=.000010
SAMPLER AREA = 0.00 SQUARE FEET

TEST RESULTS

NO	FLOW MEASUREMENT: FLOW Q GPM	VELOCITY FT/S	HEAD MEASUREMENT: DISCH PSI	SUCTN " HG	TOT HD H FT	S.G.	DRIVER POWER: INPUT KW	OUTPUT BHP	SPEED: N RPM	PUMP: OUTPUT WHP	EFF n %	TEMP: Tm F	SCALED PERFORMANCE: FLOW GPM	HEAD FT	POWER BHP	EFF %	TIME: t H.MM	MAG18": C 25 *1.000	BEND12: S 10 *1.000
1	23460.0	25.54	20.40	-1.90	56.28	.994	0.0	407.6	225.2	331.5	81.3	72.8	23436.	56.2	406.4	81.3	10.26	23460.	21711.
2	22371.4	24.36	21.61	-1.05	57.37	.997	0.0	395.6	225.4	323.1	81.7	73.9	22327.	57.1	393.3	81.7	10.33	22371.	21683.
3	21314.9	23.21	22.23	-1.01	58.26	.995	0.0	380.0	224.7	312.1	82.1	74.2	21348.	58.4	381.8	82.1	10.35	21315.	21398.
4	19089.5	20.78	23.69	-1.25	60.56	1.00	0.0	352.8	224.9	291.9	82.7	74.9	19101.	60.6	353.5	82.7	10.40	19090.	19003.
5	16358.0	17.81	25.71	-0.79	63.24	1.00	0.0	320.7	224.7	262.3	81.8	75.5	16383.	63.4	322.2	81.8	10.45	16358.	16223.
6	13811.2	15.04	27.49	-0.73	66.17	1.01	0.0	290.4	224.4	232.3	80.0	75.8	13846.	66.5	292.6	80.0	10.48	13811.	13734.
7	12570.0	13.69	28.65	-0.69	68.39	1.01	0.0	275.2	225.6	218.5	79.4	76.0	12537.	68.0	273.0	79.4	10.50	12570.	12462.
8	10818.5	11.78	29.73	-0.73	70.55	1.00	0.0	249.1	225.3	193.6	77.7	76.2	10804.	70.4	248.1	77.7	10.51	10819.	10649.
9	9742.0	10.61	30.36	-0.68	71.52	1.01	0.0	233.8	224.6	177.1	75.8	76.3	9760.	71.8	235.1	75.8	10.53	9742.0	9637.5
10	8368.2	9.11	31.27	-0.71	73.12	1.01	0.0	218.7	224.9	156.0	71.3	76.4	8370.	73.2	218.9	71.3	10.54	8368.2	8338.8
11	7295.6	7.94	32.42	-0.67	75.42	1.01	0.0	206.7	225.3	140.4	68.0	76.5	7286.	75.2	205.8	68.0	10.56	7295.6	7336.7
12	5520.1	6.01	33.19	-0.63	76.91	1.01	0.0	181.3	224.2	108.3	59.7	76.7	5539.	77.4	183.2	59.7	10.58	5520.1	5609.0

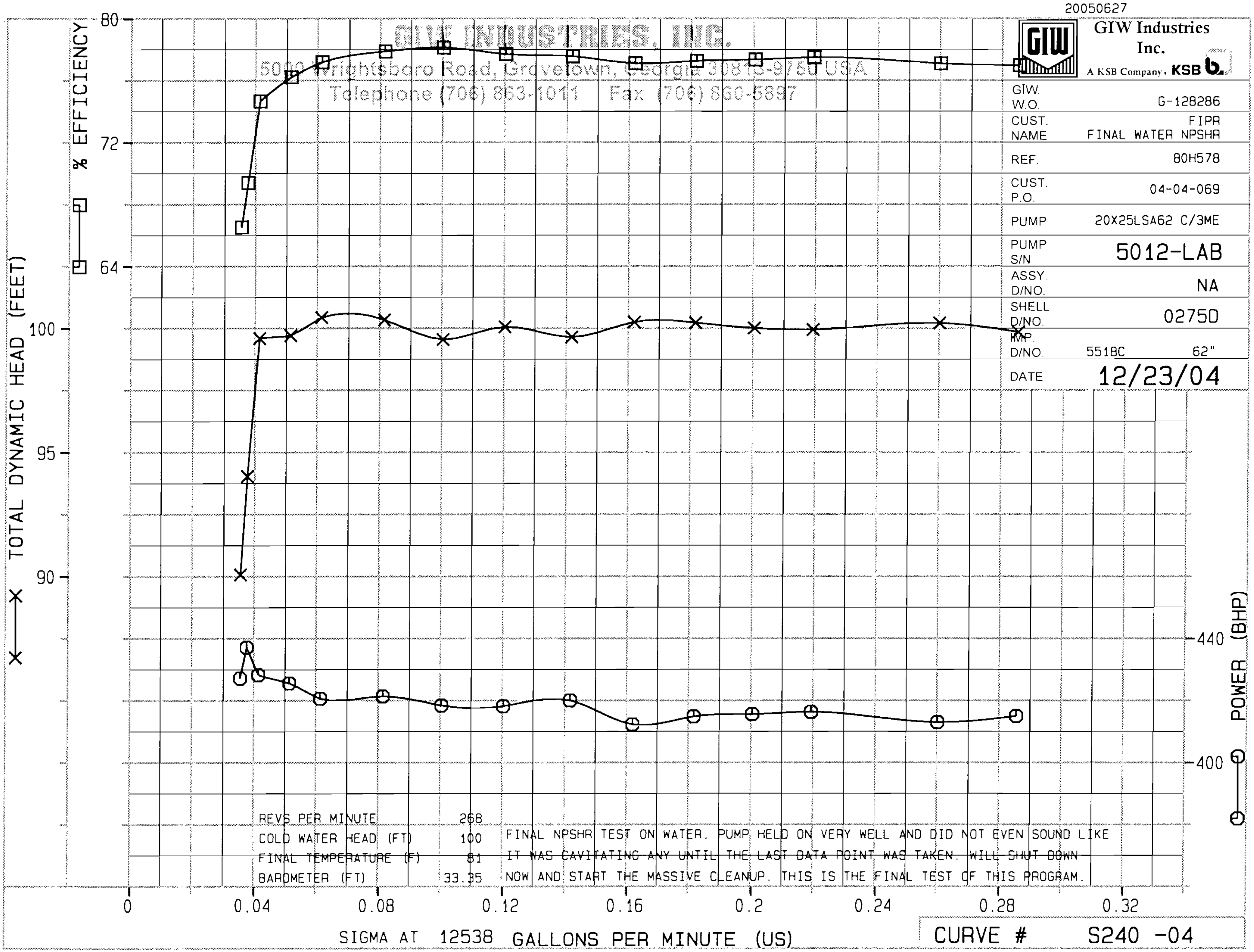
TESTED BY LEE WHITLOCK DATE 12/23/04

WITNESSED BY GRAEME ADDIE FOR FIPR

COMMENTS: FINAL FIXED SPEED WATER TEST. WILL SHUT DOWN FOR LUNCH THEN PRESUME FOR CONDUCTING A FINAL NPSHR TEST TO DETERMINE IF ANY EFFECT CAUSED BY OUR INSTALLING THE ROOT CUTTER AFTER THE PCS AND PRIOR TO THE IMC MATRIX TESTS.

Version: 20050627

T239 -04 12/23/04


20050627
GIW Industries Inc.
A KSB Company. KSB
GIW W.O. G-128286
CUST. NAME FIPR FINAL WATER NPSHR
REF. 80H578
CUST. P.O. 04-04-069
PUMP 20X25LSA62 C/3ME
PUMP S/N 5012-LAB
ASSY. D/NO. NA
SHELL D/NO. 0275D
IMP. D/NO. 5518C 62"
DATE 12/23/04
GIW INDUSTRIES, INC.
5000 Wrightsboro Road, Grovetown, Georgia 30813-9750 USA
Telephone (706) 863-1011 Fax (706) 860-5897
% EFFICIENCY
TOTAL DYNAMIC HEAD (FEET)
POWER (BHP)
80
72
64
100
95
90
440
400
REVS PER MINUTE 268
COLD WATER HEAD (FT) 100
FINAL TEMPERATURE (F) 81
BAROMETER (FT) 33.35
FINAL NPSHR TEST ON WATER. PUMP HELD ON VERY WELL AND DID NOT EVEN SOUND LIKE IT WAS CAVITATING ANY UNTIL THE LAST DATA POINT WAS TAKEN. WILL SHUT DOWN NOW AND START THE MASSIVE CLEANUP. THIS IS THE FINAL TEST OF THIS PROGRAM.
0
0.04
0.08
0.12
0.16
0.2
0.24
0.28
0.32
SIGMA AT 12538 GALLONS PER MINUTE (US)
CURVE # S240 -04

UMP DETAIL

UMP 20X25LSA62 C/3ME
ERIAL NUMBER 5012-LAB
SSEMBLY DRAWING NO NA
HELL DRAWING NO 0275D
MPELLER DRAWING NO 5518C
MPELLER DIAMETER 62"
UTLET ANGLE
UTLET WIDTH
OTATION CLOCKWISE
YDROSTATIC PRESS. STD

RIVER DETAIL

YPE VARIABLE SPEED DRIVE
AKE GENERAL ELECTRIC
ERIAL NO 5511957
RAME SIZE 5368480
PM = 450 BHP = 2450.
160 VOLTS 3 PHASE 60 CPS

CALED PERFORMANCE FACTORS

PEED OR RATIO 268.000

MP TURN DOWN RATIO 1.000
IERIDINAL WIDTH RATIO 1.000
CALE RATIO 1.000
EP REF 0.GPM, 0.RPM
FFICIENCY 0.0% BY 1.000

CH	USE	RDG	SOURCE	INSTRUMENT
1	NULL	SUCTION	#1	YOKOGAWA-30-30 H2O-1E2 06011B 0.000
2S	NULL	LOSS 20"	#2	YOKOGAWA -4-8' H2O-1E2 12040B 0.000
3	AVE	S.G.U-SECUP	#3	ROSEMOUNT 4 12'H2O 1E2 07093B 0.500
4	AVE	S.G.U-SECDN	#4	ROSEMONT4 -4-8'H2O-1E2 07134B 0.500
5.		DISCHARGE	#5	ROSEMONT 6 239'H2O 1E1 07093B 1.000
6P		DIFHEAD	#6	ROSEMONT 6 236'H2O 1E1 07093B 1.000
7.	NULL	FLOWORIFICE	#7	ROSEMOUNT 5 60'H2O 1E2 07093B 0.000
8.		FLOWBEND	#8	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
9S		LOSS 20	#9	ROSEMOUNT 5 24'H2O 1E2 07093B 1.000
10S		FLOWBEND	#10	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
11.		FLOWBEND	#11	ROSEMOUNT 4 12'H2O 1E2 07134B 1.000
12S	NULL	LOSS 20"	#12	ROSEMOUNT 4 12'H2O 1E2 07134B 0.000
13P		LOSS 20"	#13	ROSEMONT4 -4-8'H2O-1E2 01164E 1.000
14.	NULL	DISCHARGE	#14	ROSEMOUNT 5 24'H2O 1E2 07134B 0.000
15S		DIFHEAD	#15	ROSEMOUNT 5 60'H2O 1E2 01164E 1.000
16S	NULL	DISCHARGE	#16	ROSEMONT 7 692'H2O 1E1 07093B 0.000
17		SUCTION	#17	ROSE. 5 -30-30'H2O-1E2 07093B 1.000
18P		TEMPTANK	#18	RTD TANK F 1E1 10204D 1.000
19S		TEMPAMBIENT	#19	RTD AMBIENT F 1E1 10204B 1.000
20P		BHP TRQ*RPM	#20	BENSFELD 30K FTLB1E-102122B 1.000
21		RPM TRQ BAR	#21	DAYTRONIC 300 RPM 1E1 02122D 1.000
22S		BHP TRQ BAR	#22	BENSFELD 3000HP 1E1 02122F 1.000
23S	NULL	TEMPAMBIENT	#23	RTD7 100OHM F 1E1 04088B 0.000
24P	NULL	BHP TRQ*RPM	#24	LEBOW DAY 166 FTLB1E1 12211B 0.000
25P		FLOW18" MAG	#25	18" F&P 32000 GPM 1E-111164B 1.000
26S	NULL	BHP TRQ BAR	#26	LEBOW, DAY 75HP 1E2 12211D 0.000
27P	NULL	FLOW3"MAG	#27	LOAD CELL 100LB 1E2 01101B 0.000
28S	NULL	FLOWORIFICE	TECO#	6158 21.80 FPS 1E2 09256C 0.000
29.	NULL	FLOW6"MAG	#29	6" YOKO 2800 GPM 1E1 12281A 0.000
30P	NULL	BHP TRQ*RPM	#30	LEBOW,DAY 833 FTLB1E1 05098C 0.000
31	NULL	RPM TRQ BAR	#31	LEBOW,DAY1500 RPM 1E0 05024C 0.000
32S	NULL	BHP TRQ BAR	#32	LEBOW,DAY 300 HP 1E1 07287C 0.000

^ PRIMARY INSTRUMENTATION USED

GIW INDUSTRIES INC.
5000 WRIGHTSBORO ROAD
GROVETOWN, GEORGIA 30813-9750
TELEPHONE (706) 863-1011
FAX (Engr) (706) 868-8025
FAX (Sales) (706) 860-5897

TEST CURVE NO S240 -04 DATE 12/23/04

PUMP TEST DATA FOR FIPR
------------------- FINAL WATER NPSHR
PROJECT 80H578
GIW WORK ORDER NO G-128286
CUSTOMER ORDER NO 04-04-069

TEST CONSTANTS
1 FT H2O = 0.0 US GPM USING
BEND HT CORR = 0.0 FT CONST = 6201.05
DISCHARGE PIPE DIAMETER = 19.25 INS.
METER 0.00' ABOVE PUMP DATUM, TAP-2.48'
SUCTION PIPE DIAMETER = 25.00 INS.
METER 0.00' ABOVE PUMP DATUM, TAP 0.00'
PREROTATION LIM 0.0' BAROMETER 29.45"
G = 32.14 FT/S/S

EST RESULTS

	FLOW MEASUREMENT		HEAD MEASUREMENT			S.G.	DRIVER POWER		SPEED	PUMP		TEMP	CAVITATION		SCALED PERFORMANCE				TIME	MAG18"
	FLOW Q	VELOCITY	DISCH	SUCTN	TOT HD		INPUT	OUTPUT	N	OUTPUT	EFF	Tm	NPSH	SIGMA	FLOW	HEAD	POWER	EFF	t	C 25
IO	GPM	FT/S	PSI	" HG	H FT		KW	BHP	RPM	WHP	n %	F	FT		GPM	FT	BHP	%	H.MM	*1.000
1	12537.8	13.65	40.83	-4.25	99.86	1.01	0.0	415.1	268.3	319.6	77.0	78.1	28.5	0.285	12522.	99.6	413.6	77.0	12.46	12538.
2	12461.5	13.57	39.87	-6.50	100.22	1.01	0.0	413.2	268.5	318.6	77.1	78.4	26.0	0.260	12439.	99.9	410.9	77.1	12.48	12461.
3	12654.3	13.78	37.94	-10.16	99.96	1.01	0.0	416.5	268.5	322.8	77.5	78.6	21.9	0.219	12632.	99.6	414.2	77.5	12.49	12654.
4	12610.1	13.73	37.13	-11.83	100.02	1.01	0.0	415.7	268.5	321.7	77.4	78.8	20.0	0.200	12588.	99.7	413.5	77.4	12.50	12610.
5	12549.9	13.66	36.41	-13.48	100.24	1.01	0.0	415.0	268.5	320.8	77.3	78.9	18.1	0.181	12527.	99.9	412.8	77.3	12.50	12550.
6	12437.4	13.54	35.60	-15.23	100.26	1.01	0.0	412.4	268.5	318.1	77.1	79.1	16.1	0.162	12415.	99.9	410.2	77.1	12.51	12437.
7	12802.9	13.94	34.43	-17.11	99.66	1.01	0.0	420.2	268.5	326.0	77.6	79.3	14.1	0.141	12780.	99.3	417.9	77.6	12.53	12803.
8	12750.7	13.88	33.60	-18.96	100.07	1.01	0.0	418.3	268.5	325.2	77.7	79.4	12.0	0.120	12728.	99.7	416.1	77.7	12.54	12751.
9	12670.4	13.80	33.12	-21.09	99.56	1.03	0.0	418.6	268.4	327.1	78.2	79.6	10.0	0.100	12651.	99.3	416.7	78.2	12.54	12670.
10	12594.1	13.71	32.72	-22.82	100.36	1.03	0.0	421.5	268.4	328.4	77.9	79.8	8.1	0.081	12575.	100.1	419.6	77.9	12.55	12594.
11	12473.5	13.58	31.84	-24.56	100.45	1.03	0.0	420.8	268.4	324.9	77.2	80.2	6.1	0.061	12455.	100.1	418.9	77.2	12.58	12474.
12	12421.3	13.52	31.42	-25.72	99.73	1.04	0.0	425.7	268.3	324.6	76.2	80.5	5.1	0.051	12409.	99.5	424.5	76.2	12.59	12421.
13	12276.7	13.37	30.92	-26.57	99.61	1.04	0.0	428.5	268.1	320.0	74.7	80.9	4.1	0.041	12271.	99.5	427.9	74.7	13.01	12277.
14	12393.2	13.49	28.09	-26.80	94.05	1.03	0.0	437.3	268.1	303.6	69.4	81.0	3.7	0.037	12388.	94.0	436.7	69.4	13.02	12393.
15	12124.1	13.20	26.28	-26.95	90.09	1.03	0.0	427.3	268.1	284.5	66.6	81.0	3.5	0.035	12119.	90.0	426.8	66.6	13.02	12124.

TESTED BY LEE WHITLOCK DATE 12/23/04 COMMENTS: FINAL NPSHR TEST ON WATER. PUMP HELD ON VERY WELL AND DID NOT EVEN SOUND LIKE IT WAS CAVITATING ANY UNTIL THE LAST DATA POINT WAS TAKEN. WILL SHUT DOWN NOW AND START THE MASSIVE CLEANUP. THIS IS THE FINAL TEST OF THIS PROGRAM.

WITNESSED BY GRAEME ADDIE FOR FIPR

Version: 20050627

S240 -04 12/23/04

Appendix C

PARTICLE SIZE DISTRIBUTIONS OF PHOSPHATE MATRIX SAMPLES

A KSB America Company

PARTICLE SIZE ANALYSIS

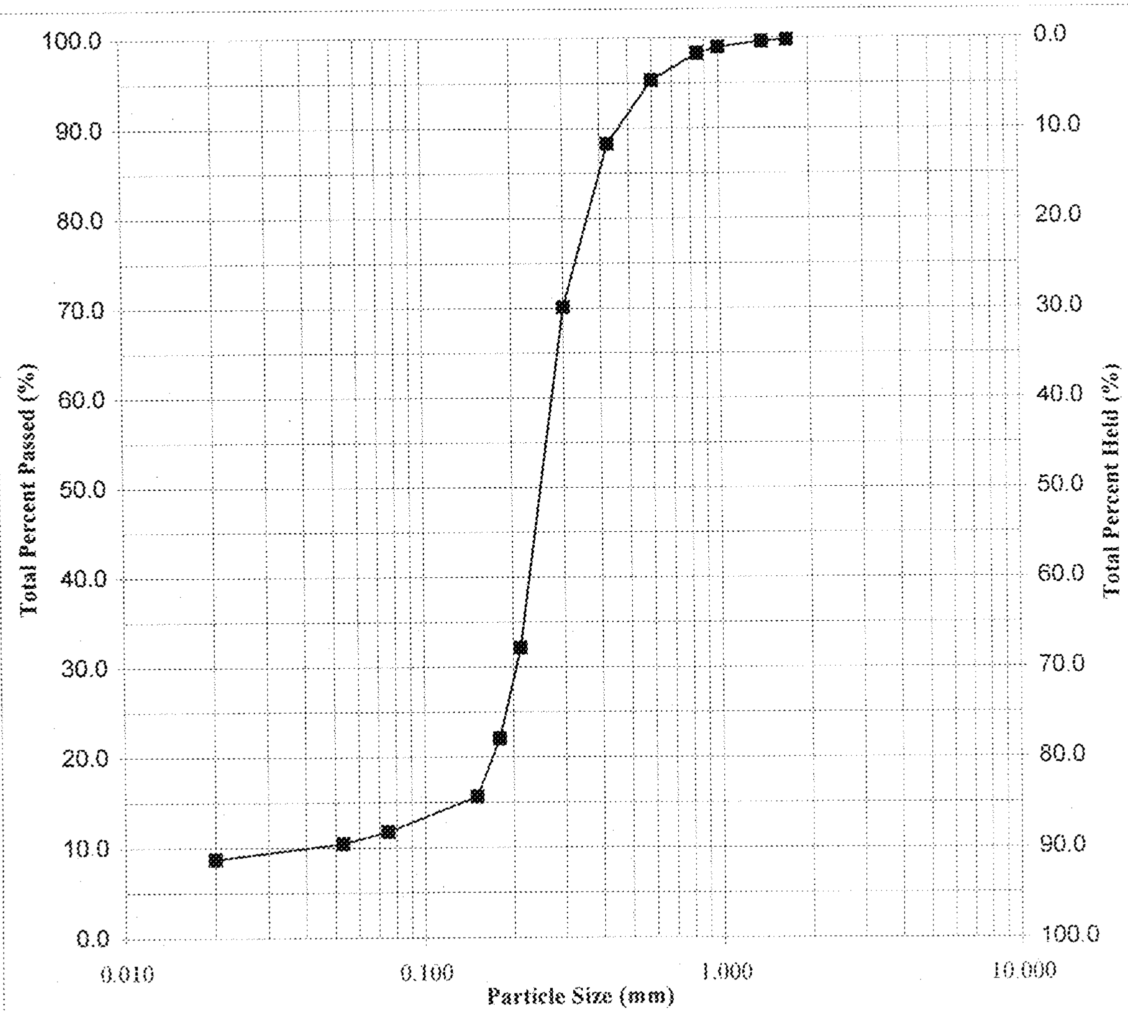
Date: 12/28/2004
Test Method: Wet Sieve
Initial Sample Weight (g): 233.22

Tested For: PCS
Test #: M221 -04
Work Order #: G-128286

Sample: Phosphate Matrix
D50 Value (micron): 253
D85 Value (micron): 402

Sieve Size (mm)	Mass Held (g)	Total Mass Held (g)	Total % Held (%)	Total % Passed (%)
1.700	0.58	0.58	0.2	99.8
1.400	0.38	0.96	0.4	99.6
1.000	1.53	2.49	1.1	98.9
0.850	1.55	4.04	1.7	98.3
0.600	6.92	10.96	4.7	95.3
0.425	16.38	27.34	11.7	88.3
0.300	42.36	69.70	29.9	70.1
0.212	88.57	158.27	67.9	32.1
0.180	23.57	181.84	78.0	22.0
0.150	14.91	196.75	84.4	15.6
0.075	9.08	205.83	88.3	11.7
0.053	3.05	208.88	89.6	10.4
0.020	4.04	212.92	91.3	8.7
fines	20.30	233.22	100.0	0.0

TEST TECHNICIAN : L. Encarnacion



COMMENTS: Original sample used on test M221 -04 before releasing into the water in the pipeline system.

PCSOriginal SampleWetSieve

A KSB America Company

PARTICLE SIZE ANALYSIS

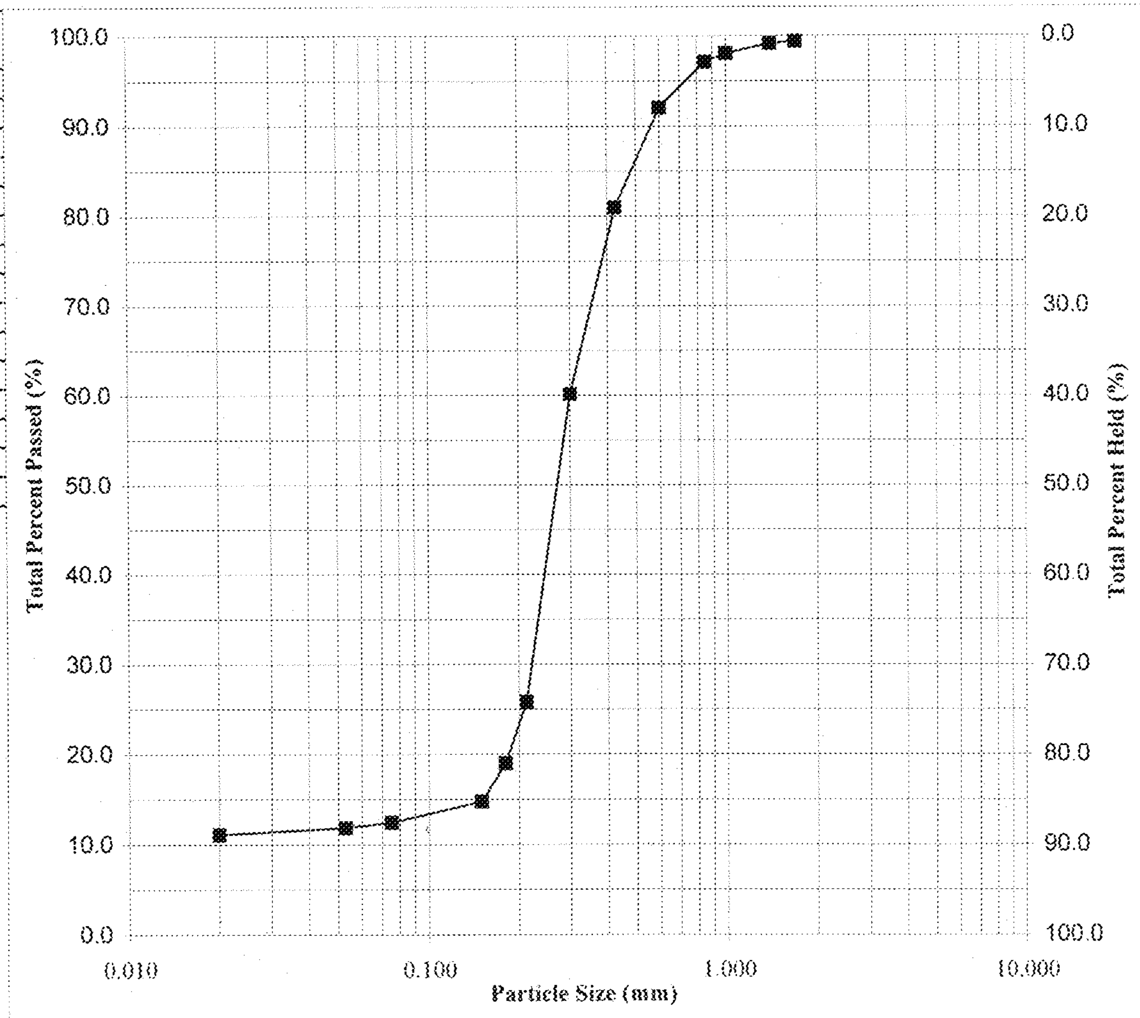
Date: 12/28/2004
Test Method: Wet Sieve
Initial Sample Weight (g): 272.15

Tested For: PCS
Test #: M221 -04
Work Order #: G-128286

Sample: Phosphate Matrix
D50 Value (micron): 274
D85 Value (micron): 489

Sieve Size	Mass Held	Total Mass Held	Total % Held	Total % Passed
(mm)	(g)	(g)	(%)	(%)
1.700	1.59	1.59	0.6	99.4
1.400	0.72	2.31	0.8	99.2
1.000	2.99	5.30	1.9	98.1
0.850	2.54	7.84	2.9	97.1
0.600	13.82	21.66	8.0	92.0
0.425	30.14	51.80	19.0	81.0
0.300	56.64	108.44	39.8	60.2
0.212	93.55	201.99	74.2	25.8
0.180	18.48	220.47	81.0	19.0
0.150	11.60	232.07	85.3	14.7
0.075	6.19	238.26	87.5	12.5
0.053	1.65	239.91	88.2	11.8
0.020	2.12	242.03	88.9	11.1
fines	30.12	272.15	100.0	0.0

TEST TECHNICIAN : L. Encarnacion



COMMENTS: Sample was taken after test M221 -04 from sample valve located on discharge pipe.

M221_04AfterWetSieve

A KSB America Company

PARTICLE SIZE ANALYSIS

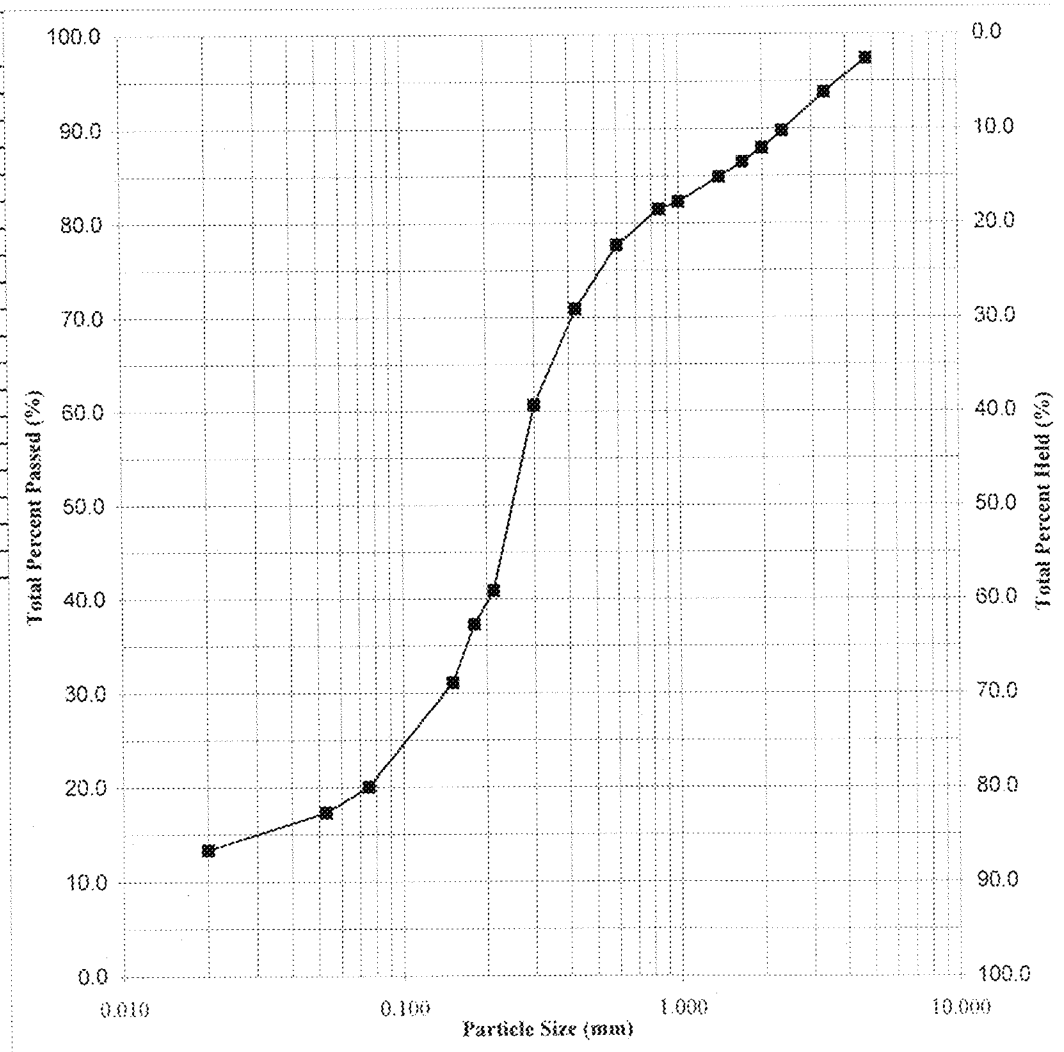
Date: 12/28/2004
Test Method: Wet Sieve
Initial Sample Weight (g): 232.90

Tested For: Mosaic(IMC)
Test #: M221 -04
Work Order #: G-128286

Sample: Phosphate Matrix
D50 Value (micron): 253
D85 Value (micron): 1420

Sieve Size	Mass Held	Total Mass Held	Total % Held	Total % Passed
(mm)	(g)	(g)	(%)	(%)
4.750	6.14	6.14	2.6	97.4
3.350	8.20	14.34	6.2	93.8
2.360	9.54	23.88	10.3	89.7
2.000	4.15	28.03	12.0	88.0
1.700	3.48	31.51	13.5	86.5
1.400	3.67	35.18	15.1	84.9
1.000	6.05	41.23	17.7	82.3
0.850	1.90	43.13	18.5	81.5
0.600	8.86	51.99	22.3	77.7
0.425	15.83	67.82	29.1	70.9
0.300	23.75	91.57	39.3	60.7
0.212	46.14	137.71	59.1	40.9
0.180	8.36	146.07	62.7	37.3
0.150	14.45	160.52	68.9	31.1
0.075	25.73	186.25	80.0	20.0
0.053	6.35	192.60	82.7	17.3
0.020	9.18	201.78	86.6	13.4
fines	31.12	232.90	100.0	0.0

TEST TECHNICIAN : L. Encarnacion



COMMENTS: Original sample used on test M221 -04 before releasing into the water in the pipeline system.

IMCOriginal SampleWetSieve

PARTICLE SIZE ANALYSIS

A KSB America Company

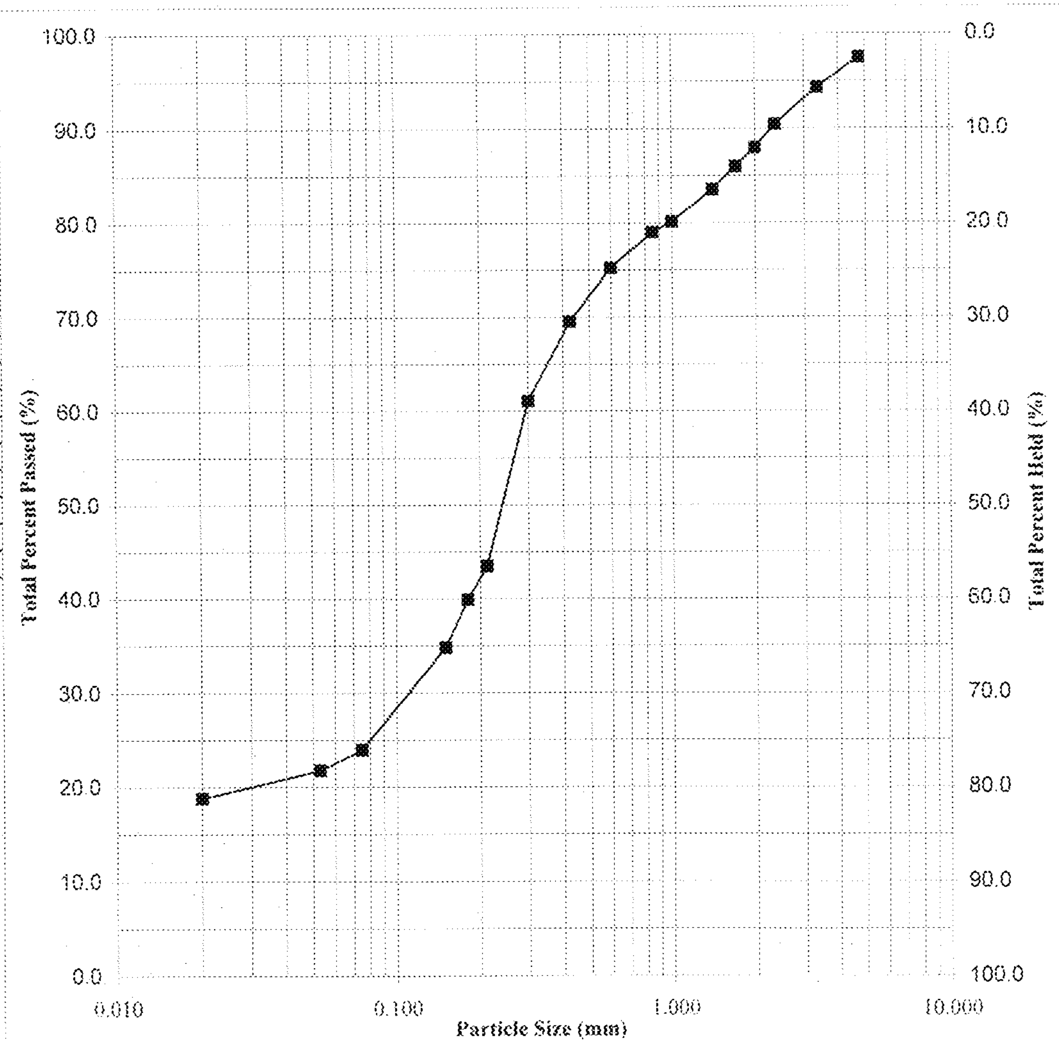
Date: 12/28/2004
Test Method: Wet Sieve
Initial Sample Weight (g): 419.39

Tested For: Mosaic(IMC)
Test #: M225 -04
Work Order #: G-128286

Sample: Phosphate Matrix
D50 Value (micron): 245
D85 Value (micron): 1579

Sieve Size (mm)	Mass Held (g)	Total Mass Held (g)	Total % Held (%)	Total % Passed (%)
4.750	10.56	10.56	2.5	97.5
3.350	13.22	23.78	5.7	94.3
2.360	16.39	40.17	9.6	90.4
2.000	10.36	50.53	12.0	88.0
1.700	8.29	58.82	14.0	86.0
1.400	10.14	68.96	16.4	83.6
1.000	14.41	83.37	19.9	80.1
0.850	4.64	88.01	21.0	79.0
0.600	15.85	103.86	24.8	75.2
0.425	23.91	127.77	30.5	69.5
0.300	35.49	163.26	38.9	61.1
0.212	73.84	237.10	56.5	43.5
0.180	14.99	252.09	60.1	39.9
0.150	21.29	273.38	65.2	34.8
0.075	45.56	318.94	76.0	24.0
0.053	9.17	328.11	78.2	21.8
0.020	12.44	340.55	81.2	18.8
fines	78.84	419.39	100.0	0.0

TEST TECHNICIAN : L. Encarnacion



COMMENTS: Sample was collected after test M225 -04 .

M225_04AfterWetSieve

A KSB America Company

PARTICLE SIZE ANALYSIS

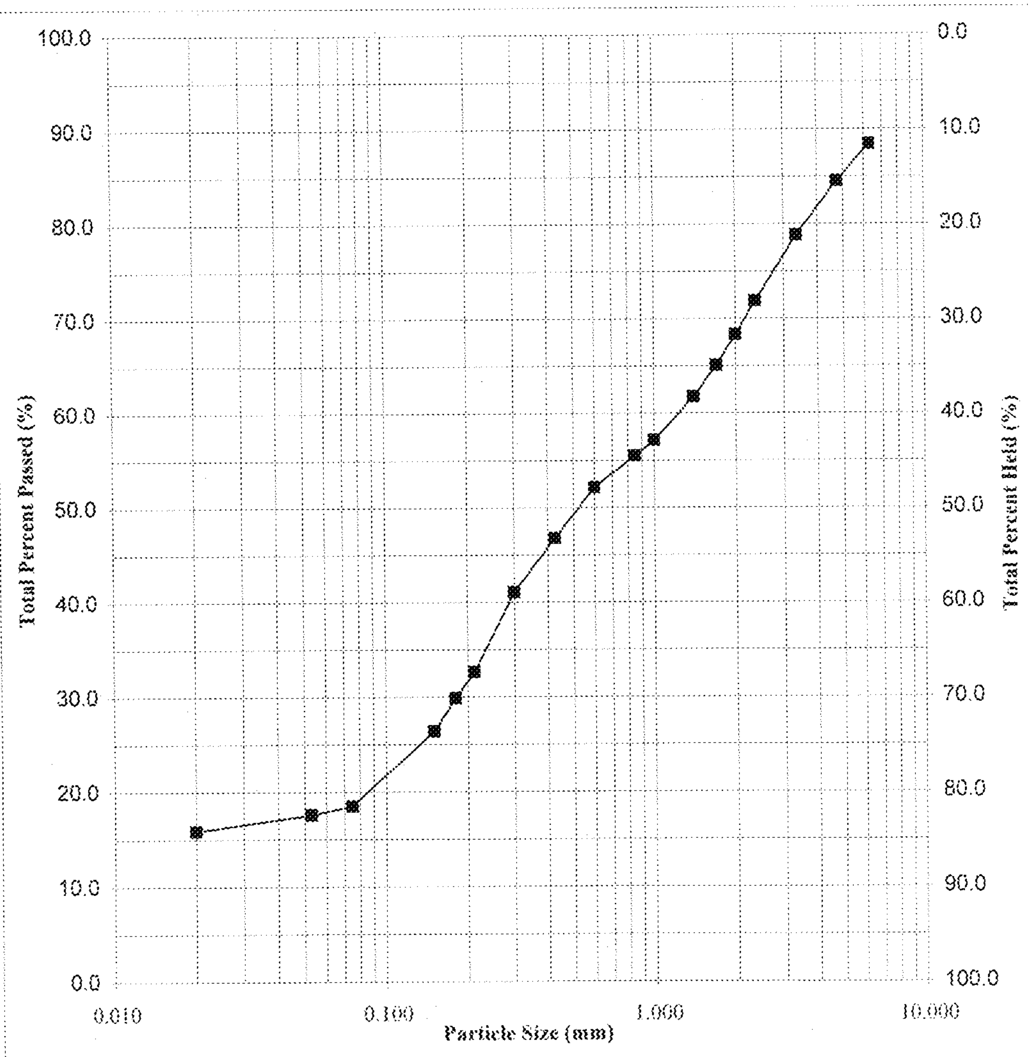
Date: 12/28/2004
Test Method: Wet Sieve
Initial Sample Weight (g): 660.04

Tested For: Cargill
Test #: M233 -04
Work Order #: G-128286

Sample: Phosphate Matrix
D50 Value (micron): 530
D85 Value (micron): 4936

Sieve Size	Mass Held	Total Mass Held	Total % Held	Total % Passed
(mm)	(g)	(g)	(%)	(%)
6.300	76.48	76.48	11.6	88.4
4.750	25.59	102.07	15.5	84.5
3.350	37.78	139.85	21.2	78.8
2.360	45.86	185.71	28.1	71.9
2.000	23.41	209.12	31.7	68.3
1.700	21.53	230.65	34.9	65.1
1.400	21.91	252.56	38.3	61.7
1.000	30.25	282.81	42.8	57.2
0.850	10.87	293.68	44.5	55.5
0.600	22.08	315.76	47.8	52.2
0.425	35.56	351.32	53.2	46.8
0.300	37.53	388.85	58.9	41.1
0.212	56.00	444.85	67.4	32.6
0.180	18.00	462.85	70.1	29.9
0.150	23.17	486.02	73.6	26.4
0.075	51.90	537.92	81.5	18.5
0.053	6.04	543.96	82.4	17.6
0.020	11.29	555.25	84.1	15.9
fines	104.79	660.04	100.0	0.0

TEST TECHNICIAN : L. Encarnacion



COMMENTS: Original sample used on test M233 -04 before releasing into the water in the pipeline system.

CargillOriginal SampleWetSieve

A KSB America Company

PARTICLE SIZE ANALYSIS

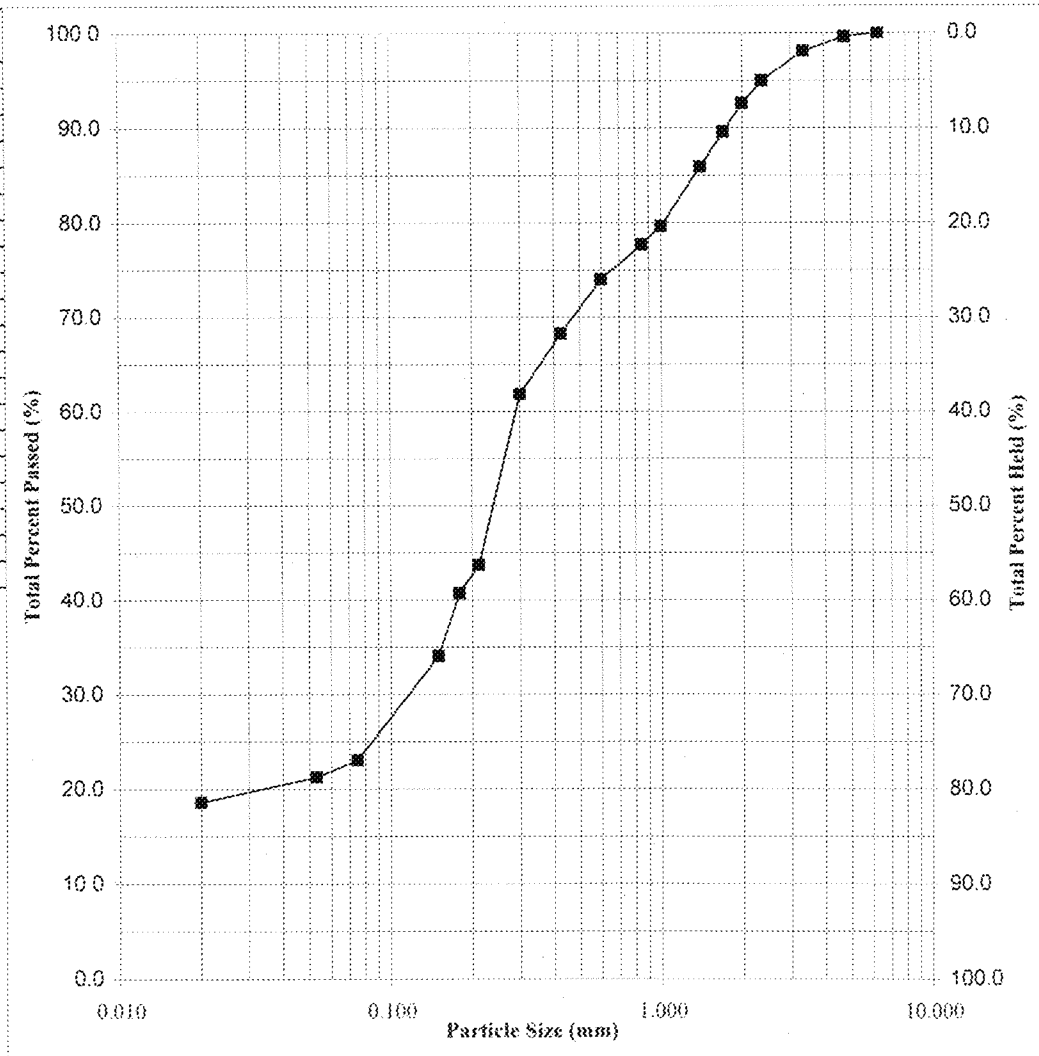
Date: 12/28/2004
Test Method: Wet Sieve
Initial Sample Weight (g): 861.29

Tested For: Cargill
Test #: M233 -04
Work Order #: G-128286

Sample: Phosphate Matrix
D50 Value (micron): 243
D85 Value (micron): 1342

Sieve Size	Mass Held	Total Mass Held	Total % Held	Total % Passed
(mm)	(g)	(g)	(%)	(%)
6.300	0.00	0.00	0.0	100.0
4.750	3.36	3.36	0.4	99.6
3.350	12.97	16.33	1.9	98.1
2.360	27.14	43.47	5.0	95.0
2.000	20.12	63.59	7.4	92.6
1.700	25.96	89.55	10.4	89.6
1.400	31.82	121.37	14.1	85.9
1.000	54.14	175.51	20.4	79.6
0.850	16.62	192.13	22.3	77.7
0.600	31.52	223.65	26.0	74.0
0.425	49.73	273.38	31.7	68.3
0.300	55.11	328.49	38.1	61.9
0.212	156.59	485.08	56.3	43.7
0.180	25.59	510.67	59.3	40.7
0.150	57.12	567.79	65.9	34.1
0.075	94.90	662.69	76.9	23.1
0.053	15.60	678.29	78.8	21.2
0.020	22.89	701.18	81.4	18.6
fines	160.11	861.29	100.0	0.0

TEST TECHNICIAN : L. Encarnacion



COMMENTS: Sample was taken after test M233 -04.

M233_04AfterWetSieve

Appendix D

VARIOUS PICTURES

Figure D-1. 20x25LSA62 Pump and Drivetrain.

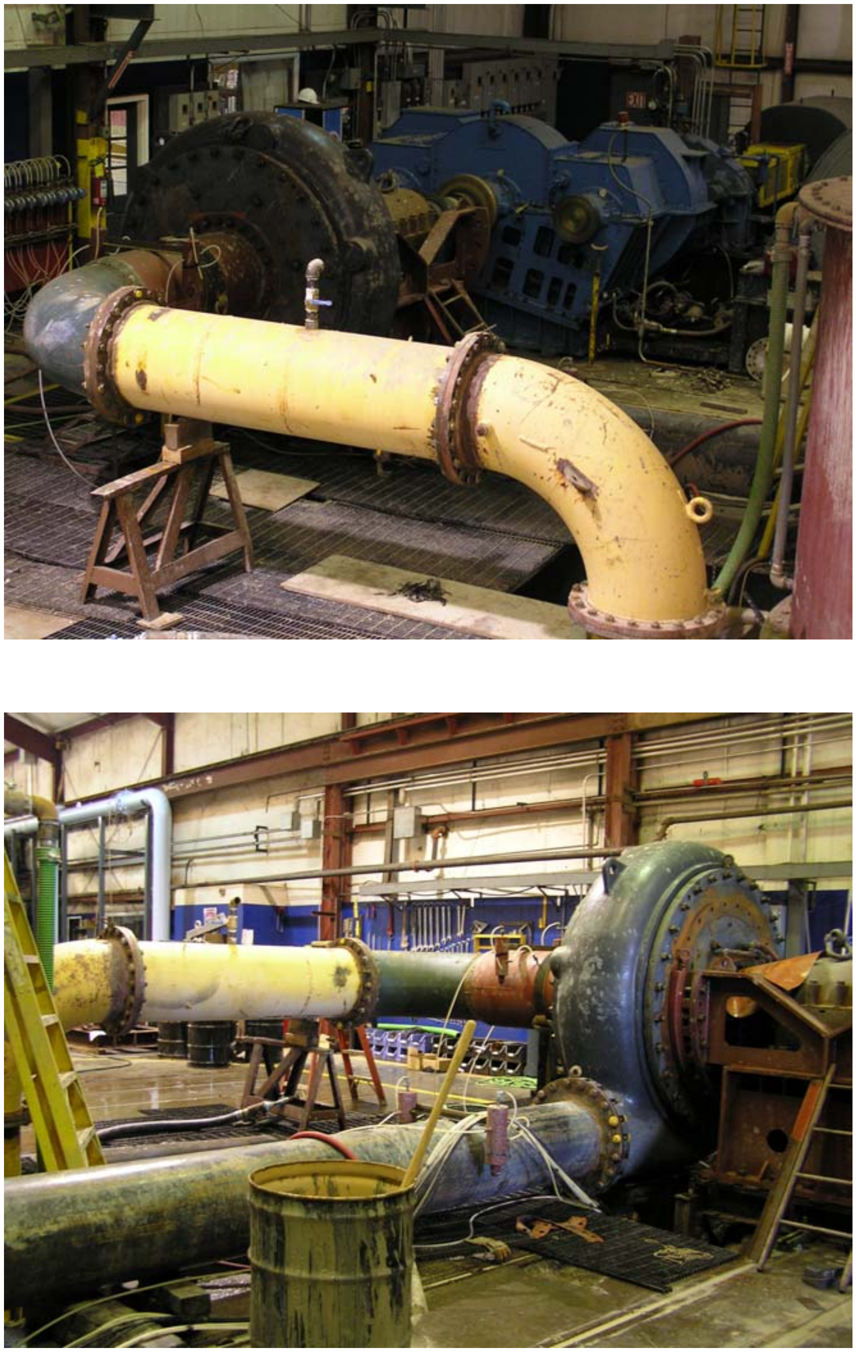


Figure D-2. Pump Suction and Discharge Pipe.

Figure D-3. 25” Pipe Suction Taps and 20” Pipe Discharge Taps.

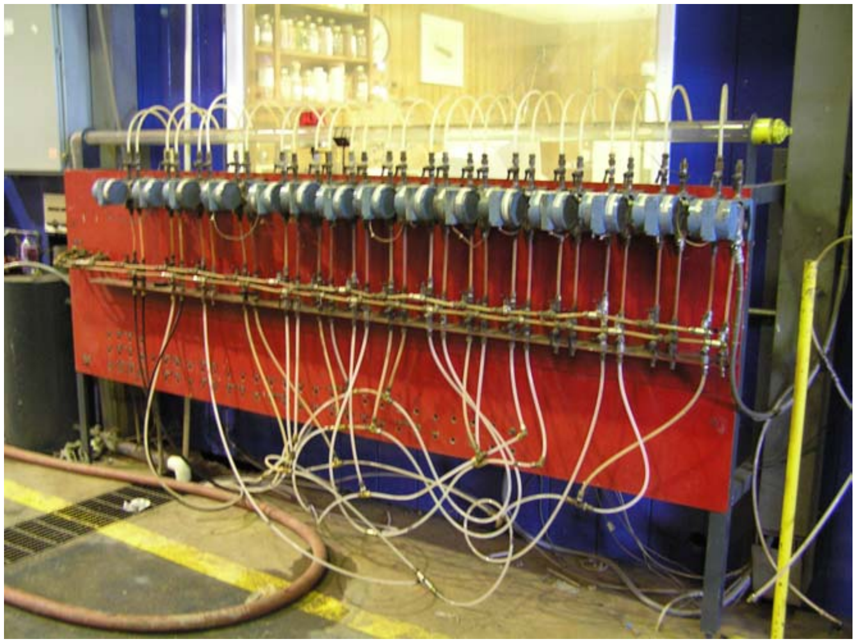


Figure D-4. Pressure Transducers and Magnetic Flowmeter.

Figure D-5. Bend Flowmeter and SG Loop.

Figure D-6. Orifice Plate and 35 Ft. Horizontal Loss Section.

Figure D-7. Vacuum Pump and Sealable Slurry Tank.

Figure D-8. 8” Flush Valves and 8” Flush HDPE Pipeline.

Figure D-9. Slurry Disposal Collection Pond.

Appendix E

CHARACTERIZATION OF PHOSPHATE SLURRIES FOR PUMP EFFECTS AND PIPE EFFECTS

FINAL REPORT

by

Abbas A. Zaman

CHARACTERIZATION OF PHOSPHATE SLURRIES FOR PUMP EFFECTS AND PIPE EFFECTS

FINAL REPORT

by

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1855 West Main Street
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Contract Manager: Dr. Patrick Zhang
FIPR Contract # 04-04-070

May 2005

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ABSTRACT

The overall goal of this project was to characterize and study the rheological behavior of three different phosphate matrix slurries that were tested by GIW Industries Inc. to determine pump and pipeline performance. The data will be used by GIW to determine feasibility, and optimization of pumping at higher solids content for Florida phosphatic slurries. Pumping phosphate matrix slurries at high solids content is desirable from technological as well as economical point of view. In this study, the coarse and fines of each phosphate matrix were separated using a sieve of 150 mesh and the fine portions were analyzed for particle size distribution. The rheological behavior of the fine portions including shear viscosity and yield stress were determined as a function of solids content of the fine slurries. The power required for mixing the unit volume of the three phosphate matrix slurries at different solids contents as a function of rotational speed is also measured. These results are presented and discussed in terms of the observed behavior by GIW industries Inc.

ACKNOWLEDGEMENTS

We would like to thank GIW industries Inc., for providing us three matrix slurries from PCS Phosphate and Mosaic (formerly Cargill and IMC). We would like to thank Dr. Graeme R. Addie, Vice President, Engineering and R&D; and Mr. Lee Whitlock, Hydraulic Test Lab Manager, at GIW Industries, Inc. We would especially like to also thank Dr. Hassan El-Shall from the University of Florida and Dr. David V. Boger from the Department of Chemical Engineering, University of Melbourne, Australia, for the very useful discussions on the project.

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(Note: The first page number shown is the number as given in the original report; the second number refers to pagination of this Appendix E.)

EXECUTIVE SUMMARY

Prior to this work, a project, entitled "Centrifugal Slurry Pump Concentration Limit Testing and Evaluation" was funded by FIPR for GIW industries Inc., to obtain pump and pipeline test data to quantify the feasibility and effect of high concentration pumping. The pumping characteristics of three Florida phosphate matrix products were investigated at the GIW Hydraulic Testing Laboratory in a 19.37 inches diameter nearly 300 ft long pipeline loop with a newly designed 62 inches diameter pit pump. The three products showed different behaviour and represent high, medium and low pipeline friction loss characteristic slurries. Past research indicates that up to a certain level, it is more energy efficient to transport slurries in a pipeline at higher solids content, after which there will be an increase in pipeline friction, due to solids. At the same time, the centrifugal pump internal losses increase with higher pumping concentrations reducing the pumping efficiency and increasing the head loss.

Preliminary tests conducted by GIW using three different matrix slurries indicate that performance of the pump and pipeline varies from matrix to matrix. Detailed characterization of the matrix is needed to correlate the pumping performance to the physical characteristics of the matrix. This was discussed in FIPR board of directors meeting and detailed characterization of three different phosphate matrix used by GIW industries Inc. was suggested.

Based on the suggestions made by FIPR board of directors, a complementary proposal was submitted by the University of Florida to determine the rheological behavior and pumpability of three matrix slurries used by GIW Industries Inc. The results of this complementary proposal will be applied by GIW Industries Inc. to correlate pump and pipeline performance to the physical characteristics of the materials.

INTRODUCTION

The phosphate industry in Florida is a vital segment of the nation's economy and provides about 85 percent of the nations and 30 percent of the worlds phosphate requirements. About 82 percent of the Florida phosphate is converted into phosphoric acid, which is used to make fertilizer.

Pumping phosphatic clay slurries at higher solids loading is desirable from technological and economical point of view. Preparation of highly concentrated suspensions, and efficient transportation and handling of these materials requires a basic understanding of the role of different variables that govern the dispersion properties. These include particle size, particle size distribution, particle shape, volume fraction of the particles, shear rate and colloidal forces.

The power required for pumping slurries through pipelines is directly related to the apparent viscosity of the mixture. Pumping at high solids loading is a key to pumping efficiency and is desirable from a technological as well as an economic point of view. Increasing the solids loading will increase the viscosity of the system and can give rise to technological problems such as plugging and yield stress among others. In order to overcome these problems and to increase the efficiency of the transportation of phosphatic clay slurries, methods for control and increase of fluidity should be developed. These methods will enable one to increase the solids loading while maintaining sufficient fluidity in the system for pumping and processing of these materials. The pressure drop and energy consumed during pumping of these slurries is directly related to the fluidity of the material and may vary significantly from matrix to matrix as shown in a study by GIW Industries Inc. (Addie and Whitlock 1998).

Tests carried out by GIW on three different matrix slurries under a FIPR grant categorized the pipeline performance of so called difficult, average and easy matrix slurries. The tests were limited to the moderate concentrations then in use. In the study by GIW, it was shown that operation with a normal matrix, significant increases in concentration and throughput were possible but with difficult matrix problems occurred. It was also seen that insufficient information was available on the pipeline, pump and cavitations performance at high concentrations and when and how to take advantage of the higher concentrations. What is needed is pipeline head loss data, pump solids affect data and cavitation limit data for different Florida phosphate matrix slurries at high concentrations, and for guidelines on how to operate the pumps and the pipeline in the most cost effective way.

While the slurries used by GIW were regarded as being primarily settling slurries, it was brought up at the FIPR board meeting in Bartow on July 16-20, 2004, that clays (or fines) present can modify the viscosity of the water carrier and the resulting slurry performance.

In a subsequent meeting held August 17th, it was agreed that the University of Florida would be given a separate contract to test and analyze the fines in each of the three matrix samples, and that GIW were to include this in their findings.

A main aim of this study therefore is to investigate the flow behavior of different phosphate matrix slurries that were tested by GIW Industries Inc. to determine pump and pipeline performance. The data will be used by GIW to determine feasibility, and optimization of pumping at higher solids content for Florida phosphatic slurries.

The GIW test work was completed by the end of 2004 and the University work was expected to be completed by May 2005. The work was split into two phases. The first covering the main tests at GIW and the second covering the University of Florida work and its incorporation into the main study. Phase 1 report was submitted by GIW in 2004 and the current report is about the second phase of the work.

GOALS

The overall objective of the proposed work was to investigate the flow behavior of different phosphate matrix slurries that were tested by GIW Industries Inc. to determine pump and pipeline performance. The data will be used by GIW to determine feasibility, and optimization of pumping at higher solids content for Florida phosphatic slurries. It was our aim to:

(1) Characterize the size distribution of the matrix samples

(2) Study the rheological behavior and pumpability of the received matrix samples as a function of solid content

(3) Separate coarse and fines of a phosphate matrix using a sieve of 150 mesh.

(4) Study the rheological behavior of the fine (-150 mesh) as a function of solids content.

(5) Rheological behavior and pumpability of coarse particles added to the dispersion of fine particles as a carrier fluid. These experiments will be conducted on at least two sets of samples, each prepared by adding different amount of coarse particles to a dispersion of fines of fixed weight fraction of fine particles.

CHARACTERIZATION

MOISTURE ANALYSIS

The solids content of the samples was determined using an MB45 moisture analyzer. Using this instrument, a sample, which its weight is normally larger than 0.5 grams, is placed on an aluminum pan inside the instrument. The weight of the wet sample is recorded before the run is started and then again after all water has been evaporated and the run has been completed. The run is complete when there is no change in the weight of the sample with time. Also, some samples were analyzed for solids content using conventional method. Phosphatic clays were dried at 120°C by leaving several of the batches of samples in aluminum pans in a convection oven for at least 24 hours. Pans were weighed several times during this period to make sure that all the water has been evaporated. Comparison of the results indicate that the two methods give similar results and the differences are not significant.

PARTICLE SIZE DISTRIBUTION

The particle size distribution of the fine portion of the phosphatic clays (-150 mesh) was measured using a Beckman Coulter, LS13320 Laser Diffraction Particle Size Analyzer. The instrument contains a fluid module, a sonicator that helps to disperse the particles, and a variable speed circulation pump that circulates the particles through sample cells. A 750 nm diode laser is used for analysis in the size range from 40 nm to 2 mm. The calculations assume a scattering pattern due to spherical particles.

For sieving, a Retsch type AS200 sieve shaker was used. The apparatus runs at a frequency of 60 hertz. The sieving was conducted via five different mesh sieves. The sieves were placed in order starting from top to bottom with the largest mesh size on the top and decreasing to the smallest mesh size on the bottom with the fines going into an empty bucket. The sieve openings are listed as follows going from largest size to smallest size: opening 9.51 mm (0.375 inches), No. 18 (1 mm), No. 35 (500 µm), No.40 (420 µm), and No.150 (105 µm).

SAMPLE PREPARATIONS

All samples used in this study were prepared by adding a known amount of a phosphatic clay matrix to the tab water and the mixture was agitated for at least four hours at 400 rpm using the Lightnin L1U08F mixer. For fluidity measurements, the samples were prepared in a stainless steel cylinder of 16 cm diameter, and 18.5 cm height. For sieving, very dilute samples were prepared in five gallon buckets and were agitated for at least four hours to obtain a well dispersed slurry. After a well-mixed slurry was achieved, sieving was conducted using the procedure as explained above. The initial weight of the sieves was taken before sieving. After sieving each sieve was placed into an oven and left over night to remove the reaming water from the samples. The dry weight of sieves plus samples was then taken and recorded. The fines (-150 mesh), which were collected in a bucket during sieving, were analyzed for solids content and also for particle sizing via the MB45 moisture analyzer and Beckman Coulter LS 13 320 Laser Diffraction Particle Size Analyzer, respectively. Experiments were conducted on three samples of each matrix and the results reported here are the averages of the three runs used for each matrix.

PUMPABILITY MEASUREMENTS

The power required to mix a known volume of the slurry was measured using a Lightnin model L1U08F mixer. The mixing power required is measured based on the energy consumption of the mixer at a certain pumping capacity and can be interpreted as the degree of the fluidity of the slurry and energy consumption for pumping. The pumping power for mixing was measured at different rotational speeds on samples of different solids loading. The characteristics of the mixer, impeller, and cylinder used are as follows:

Mixer model: Lightnin L1U08F

Impeller diameter: 94 mm (3.7 in)

Cylinder diameter: 160 mm (6.3 in)

Cylinder height: 185 mm (7.28 in)

Rotational speed: 200, 250, 300, 350, 400, 450, 500, 550, 600, and 650 RPM

Pumping capacity: 92, 114, 138, 160, 184, 207, 230, 254, 277, and 299 L/min at above rotational speeds respectively

Power (W): is recorded at different rotational speeds

RESULTS

MOISTURE ANALYSIS, SIEVE ANALYSIS, AND PARTICLE SIZE DISTRIBUTION OF FINES (-150 MESH)

The as-delivered matrix phosphatic clay samples were analyzed for solids content using the above mentioned procedure. Resulting solids content of the as received samples are shown in Table 1. Data were collected for three different samples of each matrix and the results reported here are the averages of three runs.

Table 1. Solids Content of As-Delivered Samples.

Product	PCS	IMC	Cargill
%wt Solids	87.60 ± 1.3	77.60 ± 1.4	75.30 ± 1.1

The resulting particle size distributions of as-delivered samples via sieve analysis are presented in Table 2. Matrix products are often roughly characterized with respect to the content of particles less than 100 µm and the portion larger than 1,000 µm. The coarser fraction may contain particles with sizes of up to 20,000 µm. The portion less than 100 µm is a mixture of, in addition to quartz, different finely divided minerals; for example apatite, dolomite and montmorillonite, forming phosphatic clay (El-Shall and Zhang 2004; Brackebusch and Shillabeer 1998). Particle size distribution of the as delivered samples via sieve analysis as measured by GIW Industries at 60 %wt before and after pumping are given in Table 3. Comparison of the data obtained at PERC and GIW Industries Inc. indicate that the results are very closed together and agree within experimental error.

Table 2. Measured Particle Size Distributions by PERC.

Product	PCS	IMC	Cargill
% > 10,000 µm	0	0	1.72
% > 1,000 µm (16 mesh)	1.83	27.61	36.07
% > 500 µm (32 mesh)	12.34	35.8	39.08
% > 420 µm (35 mesh)	21.45	40.33	39.58
% > 106 µm (150 mesh)	89.55	77.29	80.15
% < 106 µm (150 mesh)	10.48	22.71	19.85

Table 3. Measured Particle Size Distributions by GIW Industries Inc.

Product	PCS		IMC		Cargill	
Sample Description	Original	Final	Original	Final	Original	Final
d_{max} µm	1,800	1,800	6,000	6,000	20,000	6,000
d_{85} µm	400	490	1.420	1,580	4,940	1,340
d_{50} µm	250	275	250	245	530	245
% < 100 µm	13	13	25	28	22	28
% < 40 µm	10	12	16	21	17	21

The particle size distribution of the fine portion of the samples (-150 mesh) was measured using a Beckman Coulter LS13320 Laser Diffraction Particle Size Analyzer and the results are presented in Figures 1 through 8 for PCS, IMC, and Cargill matrices respectively. Figures 1-3 represent the volume average particle size distribution of the samples. The number average particle size distribution of the matrices are shown in Figures 5 through 7. Figures 4 and 8 are composite plots for the volume average based and number average based particle size distribution of the samples.

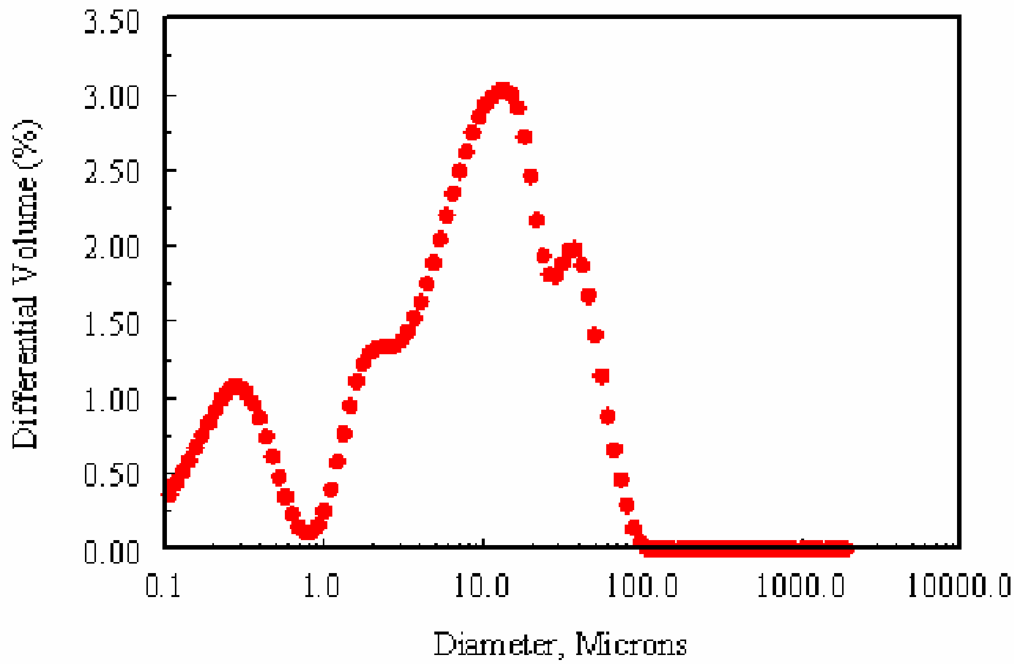

Figure 1. Volume-Based Particle Size Distribution of Fine Portion (-150 Mesh) of PCS Phosphatic Clay Matrix.

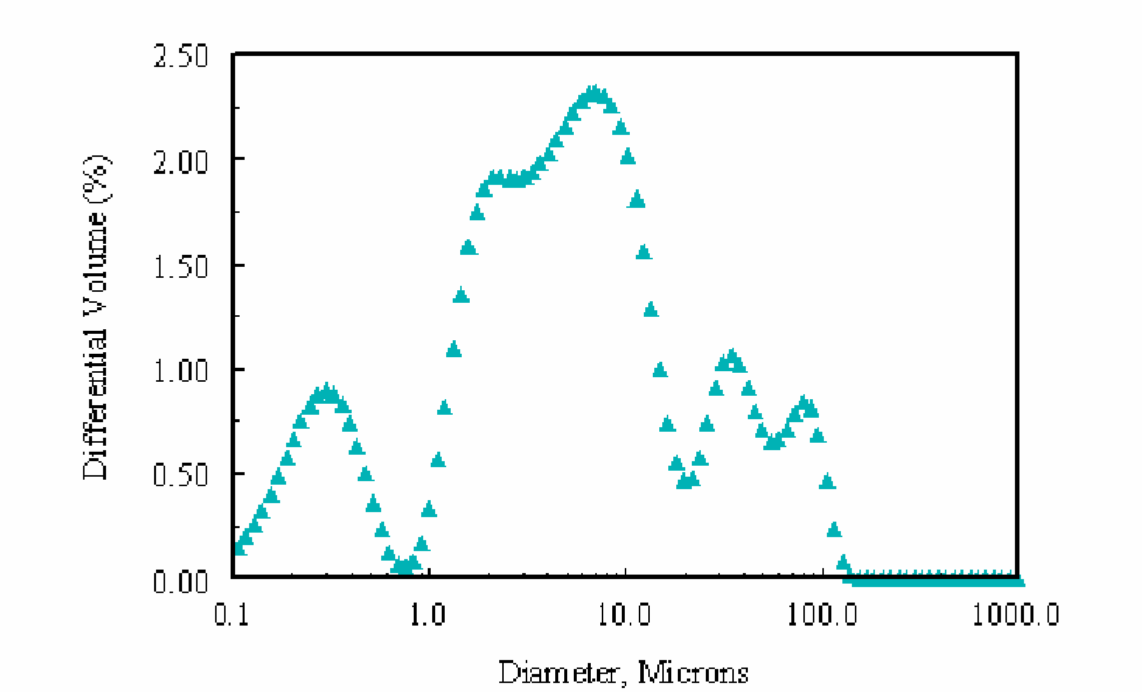

Figure 2. Volume-Based Particle Size Distribution of Fine Portion (-150 Mesh) of Cargill Phosphatic Clay Matrix.

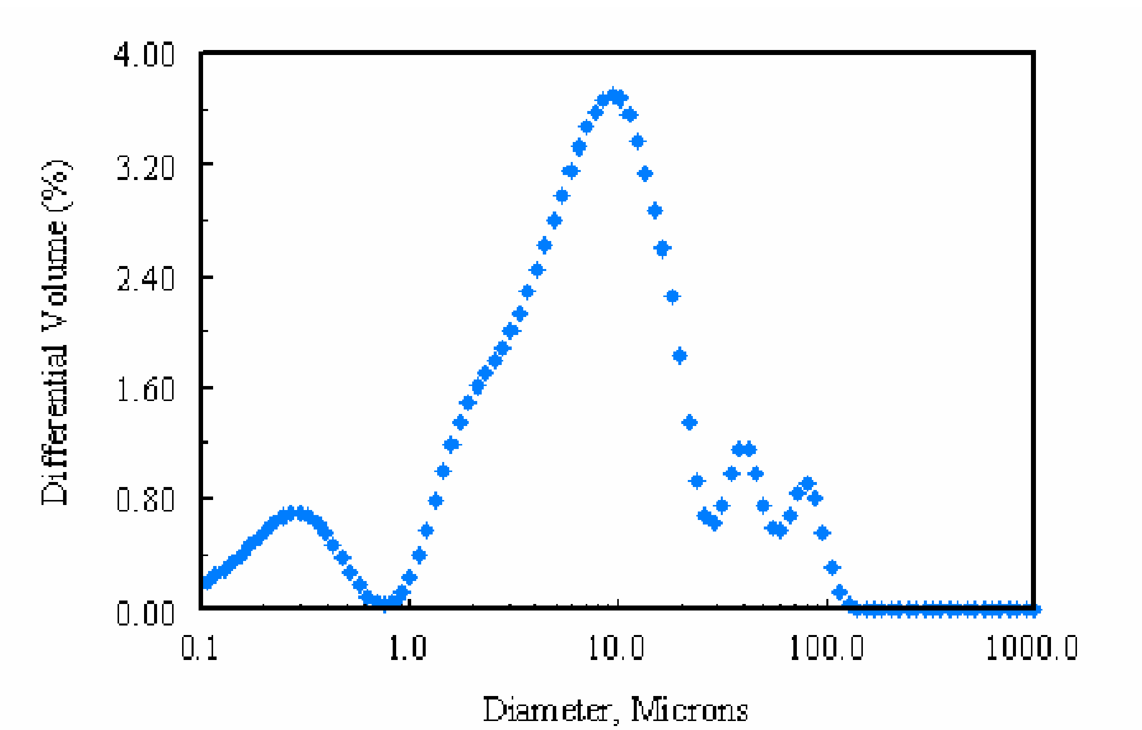

Figure 3. Volume-Based Particle Size Distribution of Fine Portion (-150 Mesh) of IMC Phosphatic Clay Matrix.

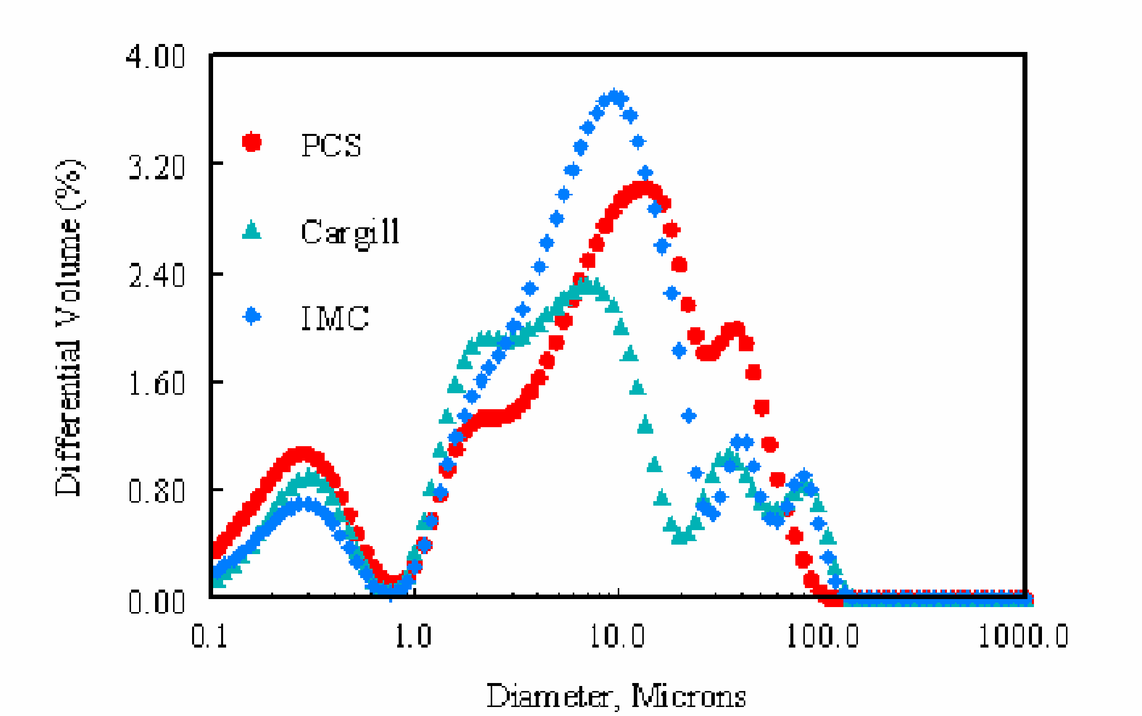

Figure 4. Comparison Between Volume-Based Particle Size Distribution of Fine Portion (-150 Mesh) of Florida Phosphatic Clays.

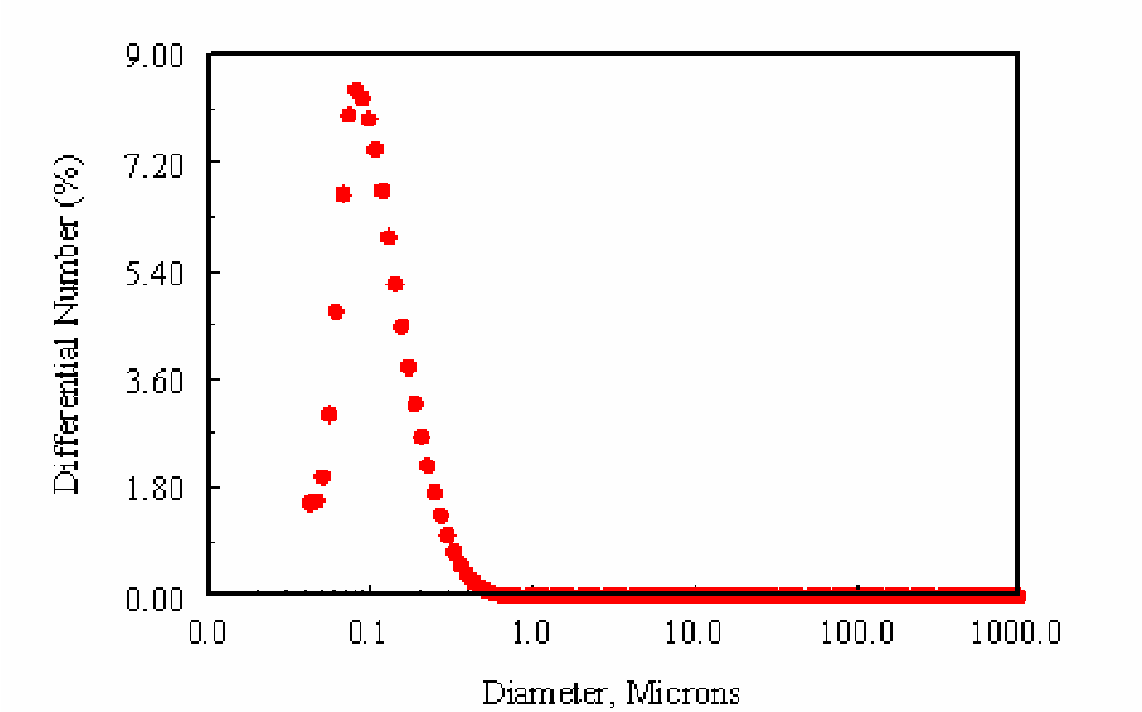

Figure 5. Number-Based Particle Size Distribution of Fine Portion (-150 Mesh) of PCS Phosphatic Clay Matrix.

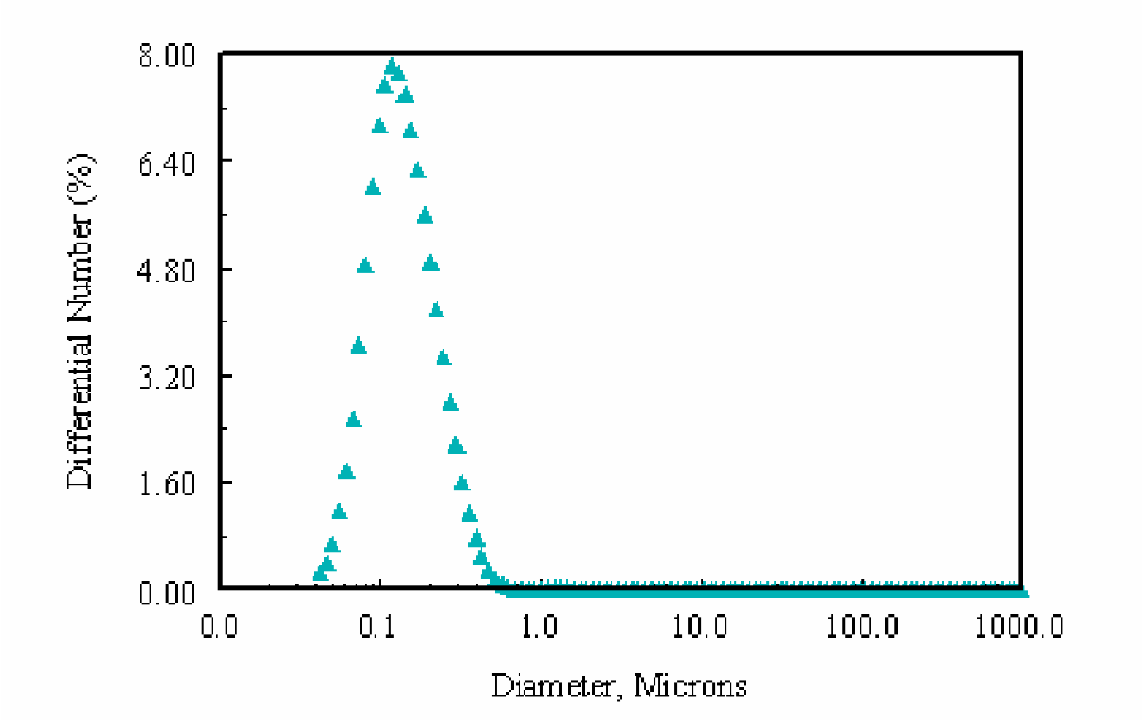

Figure 6. Number-Based Particle Size Distribution of Fine Portion (-150 Mesh) of Cargill Phosphatic Clay Matrix.

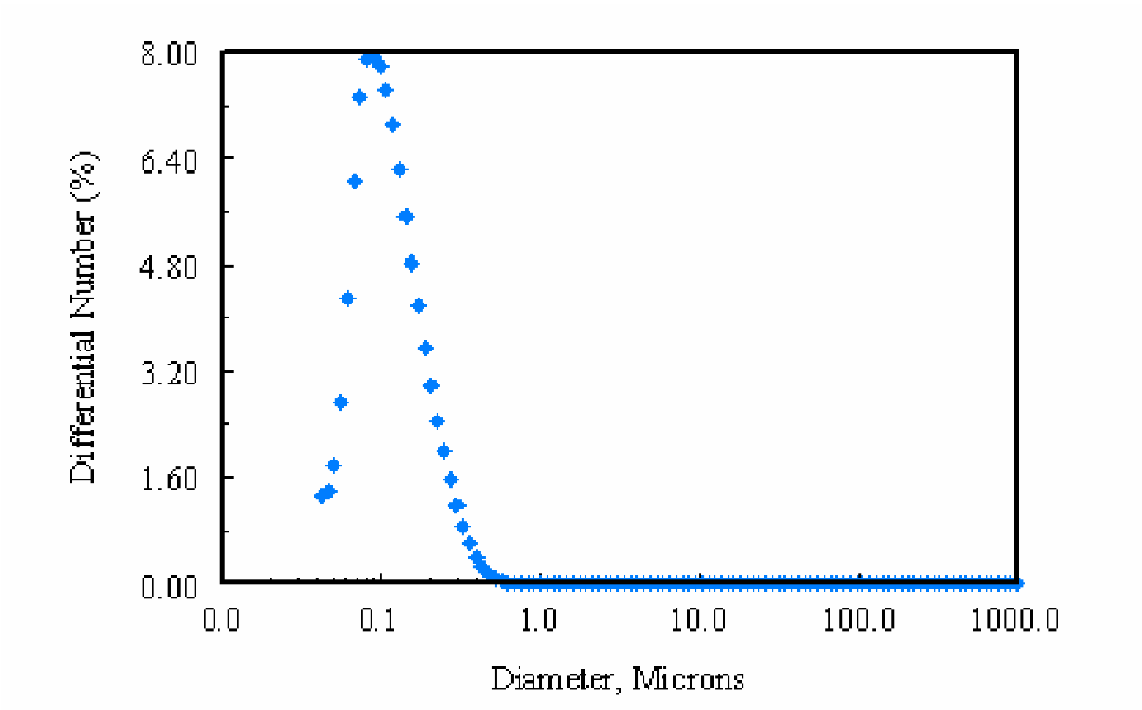

Figure 7. Number-Based Particle Size Distribution of Fine Portion (-150 Mesh) of IMC Phosphatic Clay Matrix.

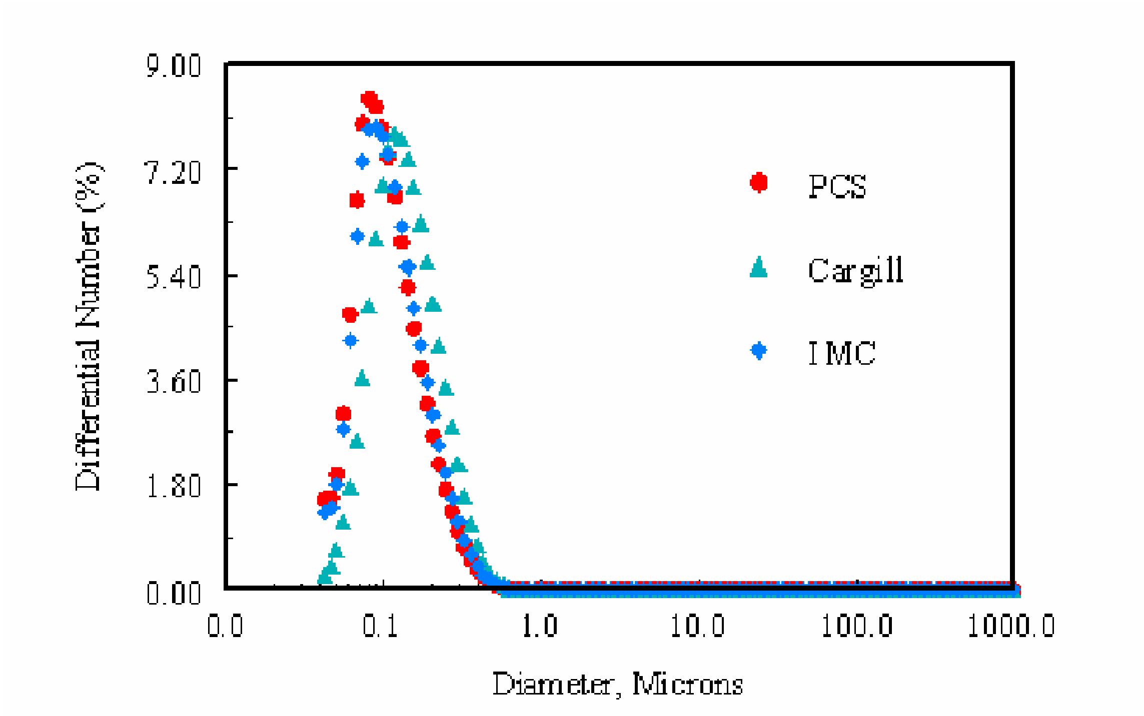

Figure 8. Comparison Between Number-Based Particle Size Distribution of Fine Portion (-150 Mesh) of Florida Phosphatic Clays.

As given in Table 2, IMC matrix contains larger amounts of (-)150 mesh particles than Cargill and PCS matrices, respectively. Figure 4 shows similar trend and indicates that the majority of the volume of the (-)150 mesh particles have diameters smaller than 6 µm.

FLUIDITY (POWER REQUIRED FOR MIXING) OF THE AS-DELIVEREED SAMPLES

The data for the as-delivered phosphatic clay matrices at various solids loading of 40 %wt, 45 %wt, 50 %wt, and 60 %wt samples are presented in Figures 9 through 11, which are plots of mixing power as a function of the rotational speed at different solids content for PCS, Cargill, and IMC matrices, respectively. Figure 12 is comparison of the results for three matrices at 60 %wt. It appears from the data that the (log-log) plots of mixing power versus rotational speed are linear over the solids content range studied. The power readings are plotted as a function of rotational speed for three different phosphatic clay matrices at 60 %wt solids in Figure 12 and, as can be observed, the amount of energy required to mix (pump) IMC matrix slurry is larger than Cargill and PCS matrices, respectively.

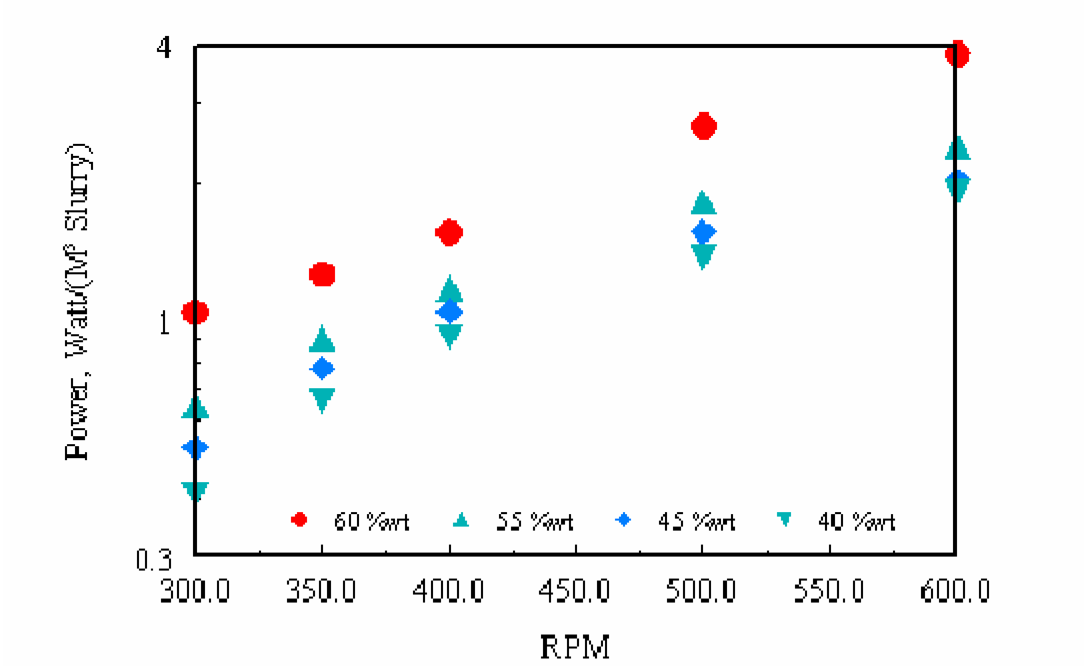

Figure 9. Power Readings as a Function of Rotational Speed for PCS Phosphatic Clay Matrix Slurries at Various Solids Loadings.

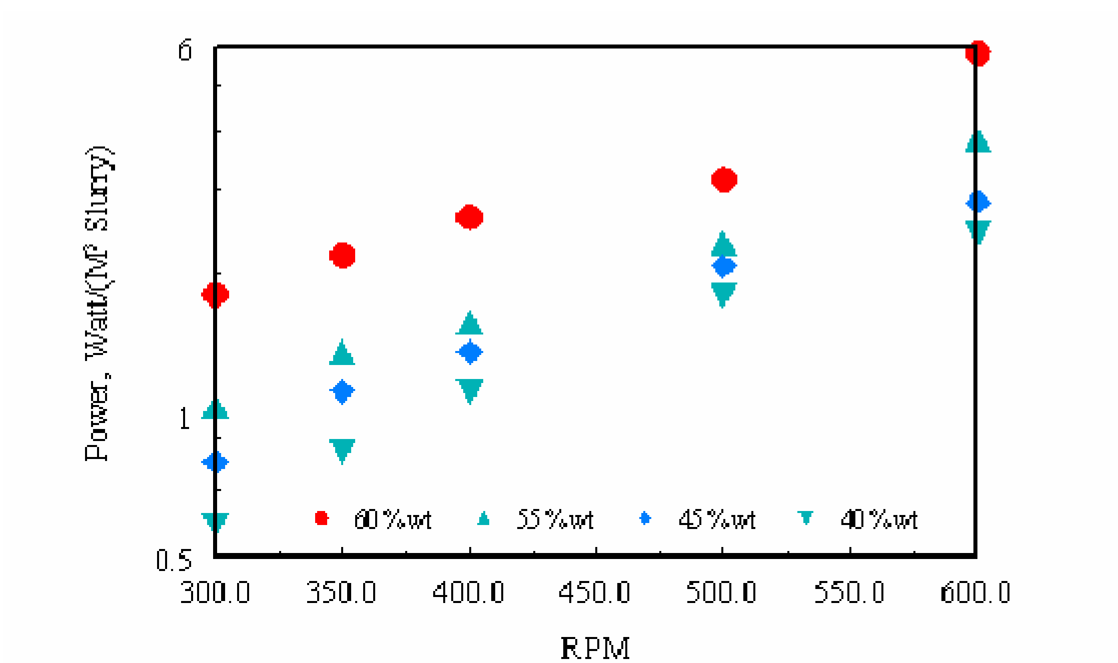

Figure 10. Power Readings as a Function of Rotational Speed for Cargill Phosphatic Clay Matrix Slurries at Various Solids Loadings.

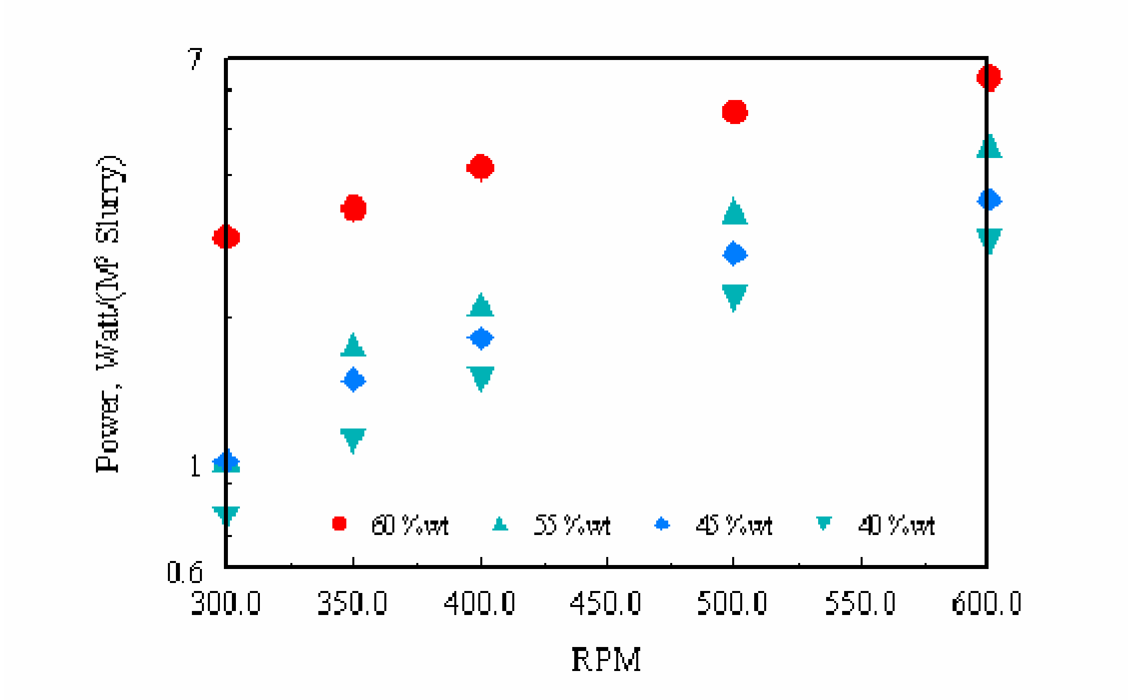

Figure 11. Power Readings as a Function of Rotational Speed for IMC Phosphatic Clay Matrix Slurries at Various Solids Loadings.

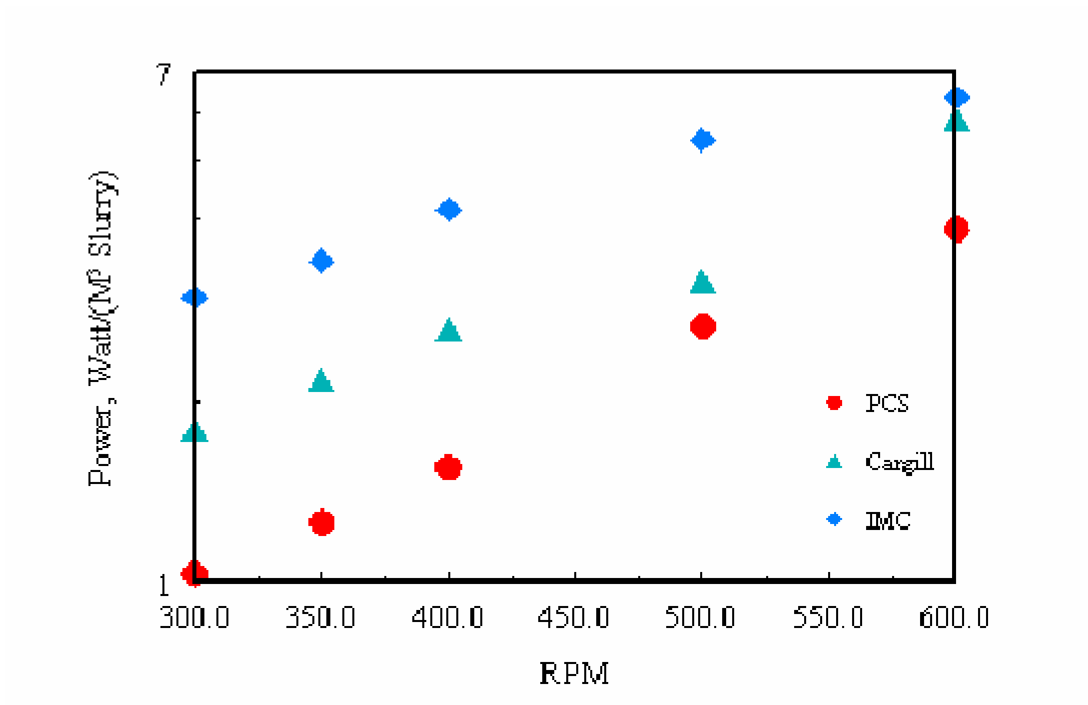

Figure 12. Power Readings as a Function of Rotational Speed for Florida Phosphatic Clay Matrix Slurries at 60 %wt.

The IMC material in Figure 11 with a large content of clay and also coarser particles needs a much larger mixing energy than the partly sand-like PCS slurry in Figure 9. The mixing power for IMC slurry at 60 %wt is nearly 3 times larger than PCS matrix, and 2 times larger than Cargill matrix as shown in Figure 12.

The Cargill matrix slurries in Figure 10 show partly a similar behavior as the IMC matrix. The effect of exposure time was also studied while conducting these experiments. The effects of exposure time seem to be similar for IMC and Cargill matrices. Also, it was experimentally observed that clay balls (with large particles embedded in clay lumps) might form during mixing period, which may affect pipeline performance while pumping phosphatic clay slurries.

VISCOSITY BEHAVIOR OF FINE PORTION (-150 MESH) OF THE SLURRIES

After separating the coarse and fine portions of the three different phosphatic clay matrices using a sieve of 150 mesh, the fine portion of the slurries (-150 mesh) were used to study their rheological behavior as a function of solids content. The shear viscosity of the samples of different weight fraction solids was measured using a Paar Physica UDS 200 Rheometer with a parallel plate geometry (plate radius, 2.5 cm). Steady shear flow experiments were conducted over shear rates ranging from 1-5000 s^{-1}.

For rheological studies as a function of solids content, several batches of -150 mesh phosphatic clay samples were left in a convection oven at 25 °C. These batches consist of samples of different weights in HDPE bottles. Bottles were weighed before being placed in the oven and were left in the oven for several hours, after which the samples were weighed again to estimate the approximate solids content of the samples in the bottles. The final solids content of the samples was measured using the moisture analyzer as was explained earlier.

In general, viscosity behavior of colloidal dispersions is affected by physical characteristics of the particles such as particle size, particle size distribution, particle shape, solids content, solubility of the particles, type of the stabilizing method (electrostatic, steric), range of electrostatic repulsion, adsorption density of the polymer, conformation, molecular weight, and chemistry of functional groups, hydrodynamic forces, and Brownian motion of the particles.[*] Developing methods that can be applied to control the viscosity and stability of dispersions is of significant importance to a wide variety of industries utilizing particulate suspensions such as slurry transport of tailings in the mining industry. By engineering the dispersions, it should be possible to maximize the solids loadings and improve process efficiency. As solids loading increases, however, understanding of the rheological behavior of the suspensions becomes crucial to developing engineered dispersions. Characterization of the shear rheology allows

[*] Zaman and others, 1996; Zaman and others 1998; Zaman and Moudgil 1999; Zaman and others 2000a; Zaman 2000; Zaman and others 2000b; Zaman and Delorme 2002; Qin and Zaman 2003; Jones and others 1991; van der Werff and DeKruif 1989; Marshall and Zukoski 1990; Bossis and Brady 1989; Russel 1980; Russel and others 1991; Barnes 1989; Hoffman 1972; Boersma and others 1990; Chow and Zukoski 1995; Rodd and others 2002; Zhou and others 2001; Want and others 1982; Nguyen and Boger 1983; Loeng 1988; Nguyen 1983.

determination of the spreading characteristics, the requirements for pipeline start-up and the conditions for minimal energy expenditure during pipeline transport.

The rheological characterization of concentrated mineral suspensions requires specialized equipment and techniques. Mineral suspensions are generally non-Newtonian fluids at high solids loadings, exhibiting a yield stress, which is the minimum stress required for material deformation and flow to occur. Furthermore, the rheology of many suspensions is time-dependent (thixotropic) and shear rate sensitive (shear thinning or pseudo-plastic). The shear thinning often evident in mineral suspensions is attributed to the alignment of particles or flocs. An increase in the shear rate from rest results in the alignment of particles in the direction of shear, therefore, providing a lower resistance to flow.

Measurement of the viscosity behavior may be undertaken using different geometries including parallel-plate, cone-and-plate (for particles less than 5 microns), concentric cylinder, and capillary viscometers (Charles and Charles 1977; Condolios and Chapus 1963; Petrellis and Flumerfelt 1973). Particular care must be taken to minimize the possibility of wall and end effects, and slip at the wall of the geometries (Vocadlo and Charles 1971).

The shear viscosity of the samples are presented in Figures 13 through 15 which are plots of shear viscosity as a function of shear rate and solids content of the slurries for PCS, Cargill, and IMC matrices respectively. Results shown in these Figures represent a highly non-Newtonian behavior with a yield stress, which can be approximately estimated by extrapolating the data to very low shear rates. Yield stress of the samples was measured directly using a Vane shear method as will be presented later.

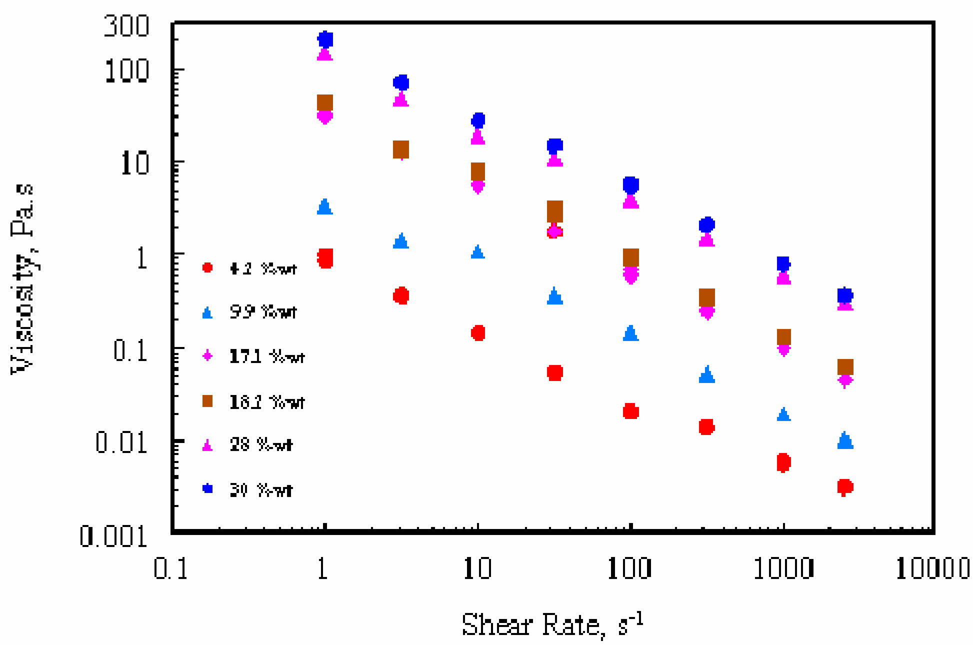

Figure 13. Viscosity as a Function of Shear Rate for the Fine (-150 Mesh) Portion of PCS Phosphatic Clay Matrix Slurries at Various Solids Loadings.

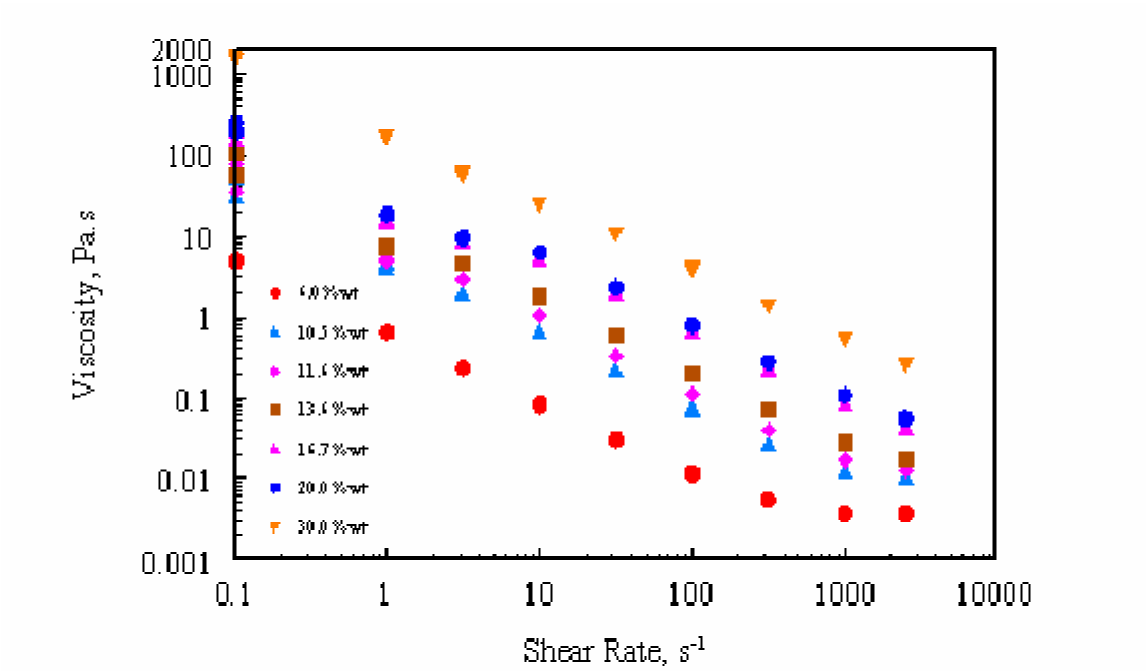

Figure 14. Viscosity as a Function of Shear Rate for the Fine (-150 Mesh) Portion of Cargill Phosphatic Clay Matrix Slurries at Various Solids Loadings.

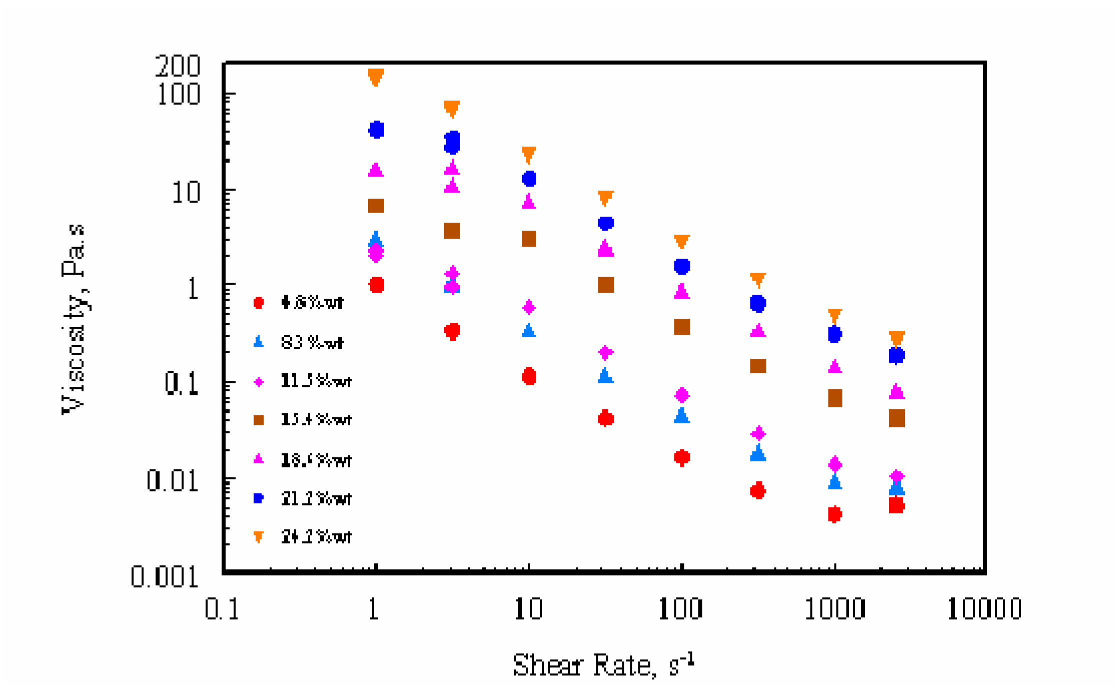

Figure 15. Viscosity as a Function of Shear Rate for the Fine (-150 Mesh) Portion of IMC Phosphatic Clay Matrix Slurries at Various Solids Loadings.

The steady shear viscosity (η) as a function of shear rate ($\dot{\gamma}$) was measured for dispersions of the fine portion of phosphatic clays at various solids loadings. It can be observed that all samples exhibit non-Newtonian behavior over the entire range of shear rate and solids content studied. There is at least three orders of magnitude decrease in the viscosity as the shear rate is increased from 0.1^{s-1} to $5,000^{s-1}$. From processing point of view it is easier to pump the material at higher flow rates due to the significant decrease in viscosity at higher shear rates.

The viscosity data as a function of the solids content of the slurries at a shear rate of 10 s-1 are presented in Figure 16. All samples show nearly the same viscosity for solids contents up to 20 %wt. However, difference between the viscosity of the three (-150 mesh) phosphatic clay samples is more significant at higher solids loadings.

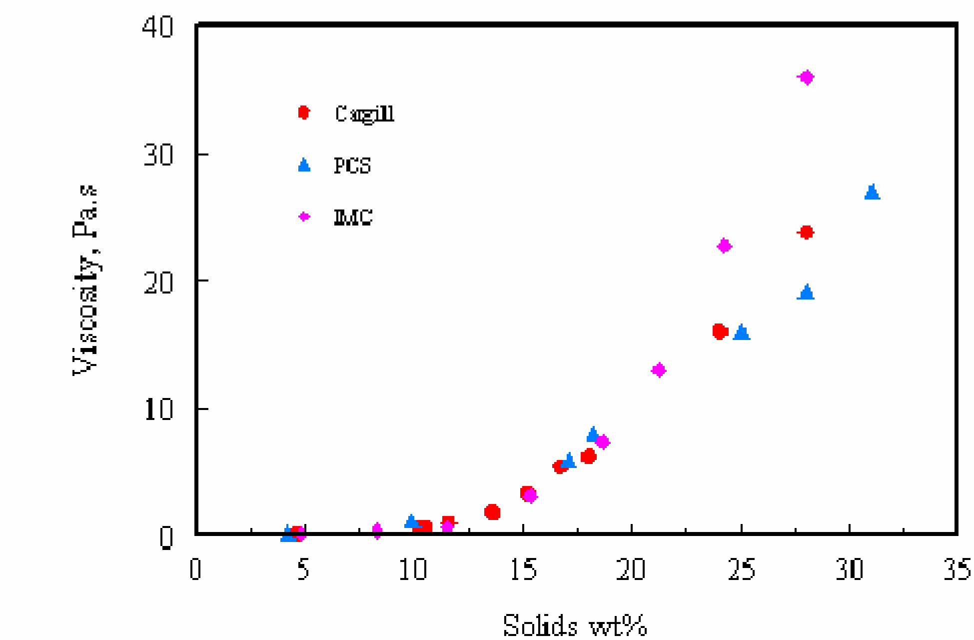

Figure 16. Viscosity as a Function of Solids Loadings for the Fine (-150 Mesh) Portion of Florida Phosphatic Clay Slurries at a Shear Rate of 10^{s-1}.

It follows from Figure 16 that at concentrations above 20 %wt, the PCS, Cargill, and IMC fines exhibit the lowest viscosity, intermediate viscosity, and the highest viscosity respectively. With the assumption that energy required for pumping is directly proportional to the viscosity of slurries, the data presented in this figure show that PCS matrix, Cargill matrix, and IMC matrix correspond to low, intermediate, and high energy consumptions respectively. It can be concluded from the data that fine (-150 mesh) phosphate slurries show different energy consumption characteristics at solids concentrations larger than 25 %wt.

EFFECTS OF SOLIDS CONTENT ON SHEAR YIELD STRESS OF (-)150 MESH FLORIDA PHOSPHATIC CLAY SLURRIES

Colloidal dispersions may exhibit a yield stress which is the critical shear stress that must be applied before the material shows a fluid-like behavior. This important rheological behavior is the onset of transition from solid-like to liquid-like behavior and determines the limit of pumpability of the slurry. Under the application of small stress, these systems deform elastically with finite rigidity, but when the applied stress exceeds the yield value, continuous deformation occurs with the material flowing like a viscous fluid. This minimum value of stress required to produce a shearing flow is defined as the yield stress. The yield stress can thus be regarded as a material property denoting a transition from solid-like to liquid-like behavior. The yield stress is the minimum shear stress corresponding to the first evidence of flow, i.e., the value of the shear stress at zero velocity gradient. These systems represent a broad spectrum of real materials including paints, clays, foodstuffs, and mineral slurries, etc.

A precise quantitative knowledge of the yield stress is very important in handling, storage, processing, and transport of concentrated suspensions in industry. For example, in slurry pipeline transport, knowledge of the yield stress is essential for pump and pipeline design, as it is known that the yield stress provides an additional drag force on the particle. Furthermore, it has been found economically viable to transport coarse solids by using a suspension of fine particles as an effective suspending medium (Charles and Charles 1977). Too high yield stress may result in unnecessarily high power consumption and hence high operating costs (Condolios and Chapus 1963). In addition, in the disposal of mineral waste slurries through a pipeline, a selection of the yield stress must be made to balance both the stability of the flowing slurry and the spreadability of the slurry discharged into the disposal area.

YIELD STRESS MEASUREMENT

Because of the importance of the yield stress in processing particulate suspensions, it is essential that the yield stress be determined or measured as accurately as possible. The yield stress of concentrated suspensions can be determined or measured by a large number of techniques. Unfortunately, many of the existing methods are either tedious to perform or limited in their applicability. Also, it is not uncommon to find that, even for a given material, the yield stress values obtained may vary with the experimental conditions employed.

Yield stress has been determined by both indirect and direct methods. Indirect methods are based on interpretation of fundamental shear-stress shear-rate data and attempt to obtain the shear stress in the limit of very low shear rates. In practice, with conventional viscometric instruments, this straightforward technique (indirect) is difficult due to the lack of data at sufficiently low shear rates and the inaccuracy of the data at low shear rates. It is therefore necessary to measure the yield stress directly by independent and more direct techniques whenever possible.

Yield stress can be measured accurately with techniques such as the shear stress relaxation method, the vane method, etc. One of the direct methods for yield stress measurement relies on measurement of the shear stress at which flow first begins. This experiments can be carried out under shear stress-controlled or shear rate-controlled conditions. In the constant shear stress technique, a constant shear stress is applied and the deformation of the material is observed as function of time (Petrellis and Flumerfelt 1973; Vocadlo and Charles 1971), while the constant shear rate experiment involves shearing the material at a low and constant shear rate to measure the stress-time response of the system (Roller and Stoddard 1944; Colic and others 1997). From either of these tests, the shear stress corresponding to the first evidence of plastic flow can be interpreted as a yield stress.

In another direct measurement technique sometimes referred to as the stress relaxation method, the suspension is first sheared at constant shear rate in an instrument with a rotating body. The speed of rotation is then reduced either gradually or suddenly to zero and the value of shear stress exerted by the suspension on the stationary suspended body is called the yield value.

The yield stress of highly concentrated suspensions (or pastes) can be measured by using several specially designed techniques and apparatus. One of the most important techniques to measure yield stress of mineral suspensions, which was completed at the University of Melbourne is the Vane-shear instrument. This technique allows direct and accurate determination of the yield stress from a single point measurement of incipient yielding (Want and others 1982; Loeng 1988; Nguyen 1983) and avoids the need to extrapolate flow data. Furthermore, the particle shape effects that can contribute to slip are eliminated by the use of the Vane, where the material yields on itself rather than a solid surface. Many workers world-wide have adopted the Vane-shear method and confirmed its applicability for all types of yield stress materials (Nguyen and Boger 1985; Yoshimura and others 1987; James and others 1987; Avramidis and Turian 1991; Liddell and Boger 1996; Buscall and White 1997).

Figure 17 represents the composite plot for the yield stress as a function of solids content for the fine (-150 mesh) portion of phosphatic clay samples used in this work. A Paar Physica UDS 200 Rheometer with a Vane geometry was employed to conduct yield stress measurements.

The results shown in the above mentioned figure represent yield values of 187 Pa, 223 Pa, and 298 Pa for PCS fines, Cargill fines, and IMC fines at a solids content of 28 %wt. However, at solids contents lower than 15 %wt, differences between the yield stress values are not significant.

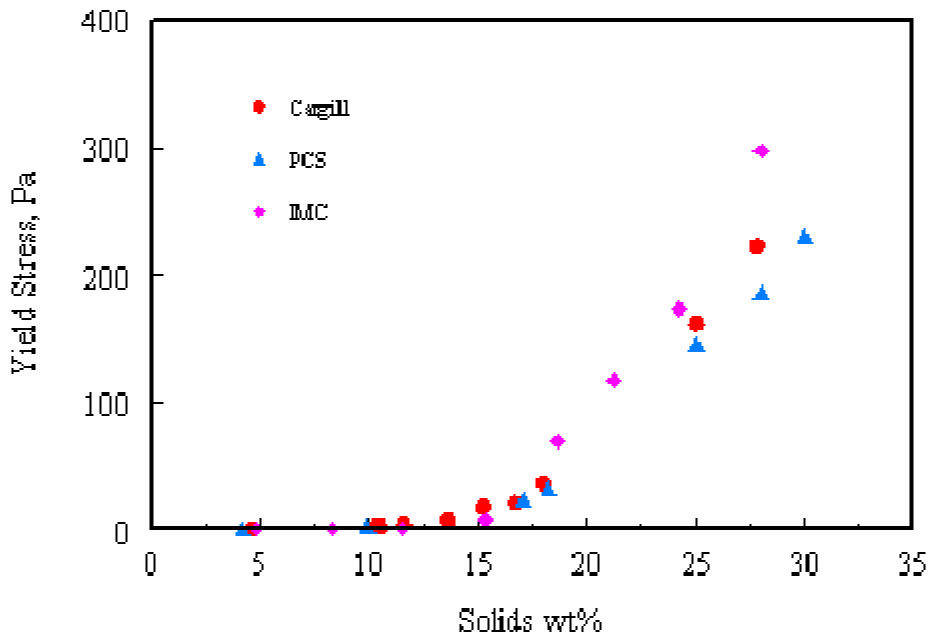

Figure 17. Yield Stress as a Function of Solids Loadings for the Fine (-150 Mesh) Portion of Florida Phosphatic Clay Slurries.

To check the accuracy and consistency of the results, vanes of two different geometries were employed in this work to conduct experimental measurements. The two geometries used had vane diameters of 22 mm and 9.92 mm and vane heights of 16 mm and 8.78 mm respectively. The differing geometries were meant to bring about consistency and accuracy to measure yield stress properties. Comparison of the results obtained from the two geometries show a variation of ±5% indicating the good accuracy of the method. Also, in some cases the yield stress values were estimated using the shear stress, shear rate data generated with parallel plate geometry. Some of the results for IMC fines are given in Table 4, and as can be observed there is a very good agreement between the estimated values obtained from extrapolation of the parallel-plate geometry data and the yield stress values obtained with a Vane geometry.

Table 4. Comparison Between the Yield Stress Values for IMC Fines Using Parallel-Plate Geometry and Vane Methods.

% Solids (wt)	18.65	21.20	24.20
Yield Stress, pa Vane	70.2	117.3	173.5
Yield Stress, pa Parallel-Plate	72.6	119.8	177.8

EFFECT OF THE WEIGHT RATIO OF FINES (-150 MESH) AND COARSE (+150 MESH) PARTICLES ON THE FLUIDITY AND PUMPABILITY OF PHOSPHATIC CLAY SLURRIES

Energy consumption and pumpability of coarse particles (+150 mesh) added to the dispersion of fine particles (-150 mesh) as a carrier fluid was also studied in this work. These experiments were conducted on several sets of IMC matrix slurries. For convenience, the total solids content was fixed at 13.5 %wt and the weight of the two portions was varied to cover a wide range of weight ratios. The power required for mixing for the samples at different rotational speeds was measured and recorded.

Figure 18 represents the results for IMC matrix slurries which are plots of mixing power as a function of wt% of coarse particles (weight ratio of coarse to fine portions). In order to study the mixtures of the two portions, the slurries were prepared by varying the weight of coarse particles at fixed total solids content. The compositions of the mixtures are given in terms of the weight percent of the large particles. Energy consumption for the mixture of the two portions was always lower than the energy consumption of the slurry just containing the fine portion of the matrix. Data indicate that at a given solids loading, the energy consumption is highly affected by the weight ratio of the two portions. At different rotational speeds, a minimum in the mixing power is observed as the weight ratio of large particles in the slurry is increased indicating that the resistance to flow and energy consumption for pumping of these slurries can be controlled by changing the weight ratio of the two portions. Similar behavior has been reported for the viscosity of the bimodal mixtures of monosized particles, which is the result of more efficient packing of polydisperse spheres as indicated by earlier investigators (e.g., Farris 1968; Chang and Powell 1994; Hoffman 1992; Rodriguez and others 1992; D'Haene and Mewis 1994; Berend and Richtering 1995; Greenwood and others 1998; Lionberger 2002; Dames and others 2001). In these systems, small particles can fit into the spaces between the larger particles and if they are small enough, along with the suspending fluid act like a larger sea for the big particles (Hoffman 1992). From the data given in Figure 18, it is evident that the lowest level of mixing power is obtained when the coarse portion makes about 50% of the solids in the slurry. In the case of bimodal systems, the volume ratio at which the lowest level of viscosities are obtained may vary with total volume fraction of solids and also, absolute size of the particles.

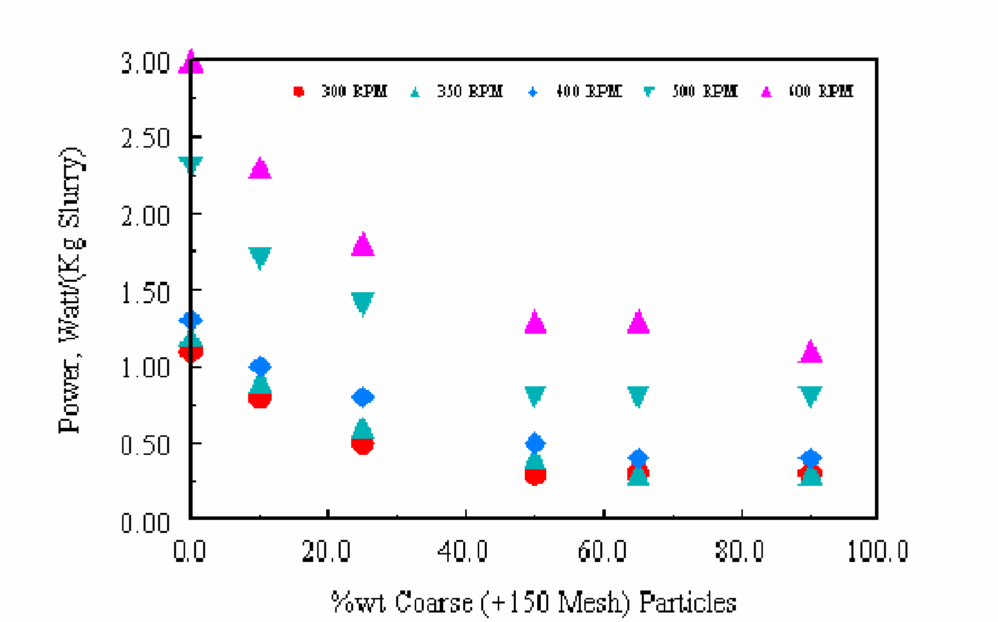

Figure 18. Power Readings as a Function of %wt of Coarse Portion (+150 Mesh) for IMC Phosphatic Clay Slurries of 13.5 %wt Total Solids at Various Rotational Speeds.

Figure 19 represents power required for mixing as a function of rotational speed for the three phosphatic clay slurries for a condition at which the coarse (+150 mesh) particles make 50 %wt of solids in the slurry. As can be observed, the mixing power for PCS slurry is nearly 3 times smaller than IMC matrix. For Cargill matrix, the mixing power is approximately 50 percent lower than IMC matrix.

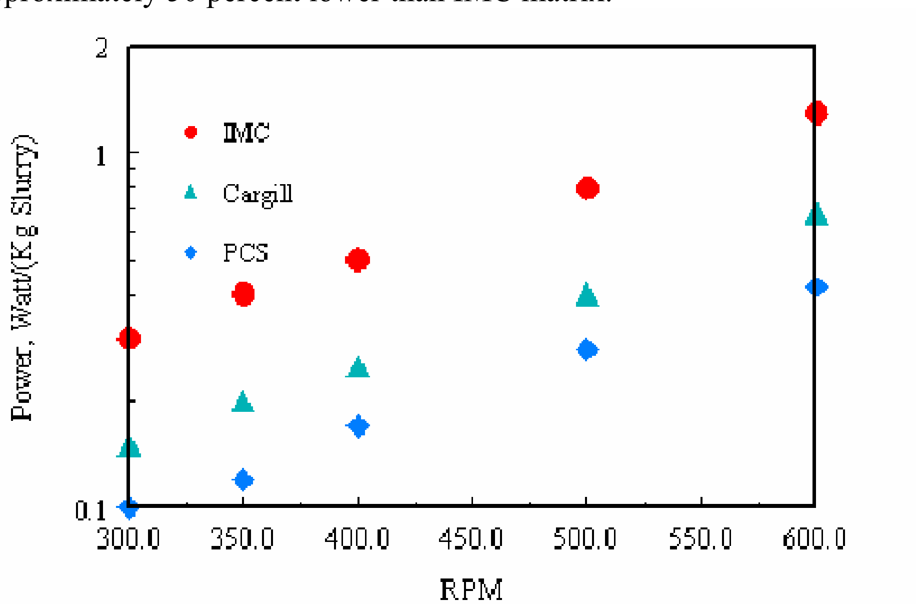

Figure 19. Power Readings as a Function of Rotational Speed for the Mixture of 50/50 Coarse (+150 Mesh) to Fine Portion (-150 Mesh) for Florida Phosphatic Clay Slurries of 13.5 %wt Total Solids.

SUMMARY AND CONCLUSIONS

The work conducted by GIW Industries Inc. on frictional loss, pump head efficiency, and pump cavitations using three phosphatic clay matrices has shown that pumping efficiency, pipe line performance, and specific energy consumptions to overcome friction losses in a horizontal pipeline for phosphatic clays varies from matrix to matrix and based on the energy consumption, these matrices were categorized as the low friction loss (PCS matrix), intermediate friction loss (Cargill matrix), and high friction loss (IMC matrix) products. The friction loss evaluations by GIW were focused on operating data obtained at comparatively short exposure times during the loading of solids.

Detailed characterization of the phosphatic clay matrices was conducted in this work to correlate the pumping performance and pipeline efficiency to the physical characteristics of the matrix. The three different phosphatic clay matrices used by GIW industries Inc. are characterized in details in this work including particle size analysis, pumpability, and rheological behavior at different conditions. The results of this work will be applied by GIW Industries Inc. to correlate pump and pipeline performance to the physical characteristics of the materials. Pumpability of the as received samples was studied by measuring the power required for mixing the unit volume of the three phosphate matrix slurries at different solids contents as a function of rotational speed. To study the effect of fine particles, in this work, the coarse and fines of each phosphate matrix were separated using a sieve of 150 mesh and the fine portions were analyzed for particle size distribution. The rheological behavior of the fine portions including shear viscosity and yield stress were determined as a function of solids content of the fine slurries. These results are presented and discussed in terms of the observed behavior by GIW industries Inc.

The IMC matrix contains larger amounts of (-)150 mesh particles than Cargill and PCS samples respectively. Results indicate that the majority of the volume of the (-)150 mesh particles have diameters smaller than 6 μm. The IMC material with a large content of clay and also coarser particles needs a much larger mixing energy than the partly sand-like PCS slurry. The mixing power for IMC slurry at 60 %wt is nearly 3 times larger than PCS matrix, and 2 times larger than Cargill matrix.

The steady shear viscosity (η) as a function of shear rate ($\dot{\gamma}$) was measured for dispersions of the fine portion of phosphatic clays at various solids loadings. It was observed that all samples exhibit highly non-Newtonian behavior over the entire range of shear rate and solids content studied. It follows from the data that at concentrations above 20 %wt, the PCS, Cargill, and IMC fines exhibit the lowest viscosity, intermediate viscosity, and the highest viscosity respectively. With the assumption that energy required for pumping is directly proportional to the viscosity of slurries, the data presented in this figure show that PCS matrix, Cargill matrix, and IMC matrix correspond to low, intermediate, and high energy consumptions respectively. It can be concluded from the data that fine (-150 mesh) phosphate slurries show different energy consumption characteristics at solids concentrations larger than 25 %wt.

The results on the yield stress indicate that at solids contents lower than 15% wt, differences between the yield stress values are not significant. PCS fines, Cargill fines, and IMC fines show yield values of 187 Pa, 223 Pa, and 298 Pa respectively at a solids content of 28% wt.

Energy consumption and pumpability of coarse particles (+150 mesh) added to the dispersion of fine particles (-150 mesh) as a carrier fluid was also studied in this work. These experiments were conducted on several sets of IMC matrix slurries containing a total solids content of 13.5% wt of varying weight ratio of the two portions. The power required for mixing and pumpability varies with the weight ratio of the two portions and for the sample used in this work is minimum when coarse particles make nearly 50% wt of the total solids in the slurry.

Future work should look to broadening the knowledge of phosphate matrix carriers and their effect integrated into a model that considers different proportions of solids and carrier, and the time in the pipeline and pumps.

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Appendix F

CARGILL 2005

Specific Energy and Gun Water Calculations

I_M model by Ken Wilson 03-March-2005
Spreadsheet by R. Visintainer, GIW, revised: 13-June-2005
Least Squares VB Solver by Andy Hatfield, revised: 09-June-2005

Cells key:
- = taken direct from user input
- = fixed calculation, do not change
- = copied from columns A-G, do not change
- = user defined calculation
- blue = user input
- green = user input from "Calibration" sheet
- black = calculated or fixed

INPUT in BLUE:

Project FIPR TEST Winter 2004-2005
Date: 13Jun-05 by RV
Reference Cargill, from Anders Selgren 13-June-05

Solids SG	SG_S	2.65	(-)					
Fluid SG	SG_S	1.00	(-)					
Pipe Diameter	D	19.37	(in)	1.614	(ft)			
Lines of constant C_W	C_W	35%	40%	45%	50%	55%	60%	(% wt.)
	C_V	16.9%	20.1%	23.6%	27.4%	31.6%	36.1%	(% vol.)
Lines of constant V_M	V_M	13.0	14.0	15.0	16.0	17.0	18.0	(ft/s)
Lines of constant gun water	W_G	6000	7000	8000	9000	10000	11000	(gpm)
Matrix moisture (% by weight)	M_W	20.0%	(% wt.)	39.8%	(% vol)	1.663	Rel. vol.- wet solids:dry solids	

Model constants	A	1.400	< calibration parameter
Model constants	B	0.500	< calibration parameter
Model constants	f	1.77E-02	< friction factor
Model constants	X	0.95	< A' from equiv. fluid model, 0 < X < 1, related to fraction coarse solids
Model constants	m	4.80	< based on earlier tests, circa Dr. Carstens
Model constants	n	0.95	< based on earlier tests, circa Dr. Carstens
Model constants	p	0.70	< based on Newitt sliding bed model
Model constants	q	0.60	< based on Newitt sliding bed model

$$i_m = \mathrm{MAX}[\ A(C_v)^m(V_m)^n\ ,\ (f/2gD)(V_m^{\ 2})\{1+X(SG_s-1)C_v\}\ ] + \ B(C_v)^p/(V_m)^q$$

$$SEC = (5.33/SG_s)(\ i_m/C_v)$$

Calculations for constant Vm plot:

Cw %	Cv %	V_M (ft/s)	i_M (ft/ft)	prod (ton/hr)	SEC (hp-hr/t-mi)	gun water (gpm)	Max term used
35%	17%	13.0	0.043	1337	0.517	8586	green
40%	20%	13.0	0.050	1591	0.498	7949	green
45%	24%	13.0	0.056	1868	0.481	7256	green
50%	27%	13.0	0.075	2169	0.553	6500	red
55%	32%	13.0	0.111	2499	0.708	5673	red
60%	36%	13.0	0.174	2861	0.966	4764	red
35%	17%	14.0	0.044	1440	0.524	9247	green
40%	20%	14.0	0.051	1714	0.506	8560	green
45%	24%	14.0	0.058	2011	0.491	7814	green
50%	27%	14.0	0.076	2336	0.557	7000	red
55%	32%	14.0	0.114	2691	0.724	6110	red
60%	36%	14.0	0.180	3082	1.003	5131	red
35%	17%	15.0	0.045	1543	0.536	9907	green
40%	20%	15.0	0.052	1836	0.518	9171	green
45%	24%	15.0	0.059	2155	0.503	8372	green
50%	27%	15.0	0.076	2503	0.561	7500	red
55%	32%	15.0	0.116	2883	0.741	6546	red
60%	36%	15.0	0.187	3302	1.040	5497	red
35%	17%	16.0	0.046	1645	0.550	10568	green
40%	20%	16.0	0.053	1959	0.533	9783	green
45%	24%	16.0	0.061	2299	0.519	8930	green
50%	27%	16.0	0.077	2669	0.567	8000	red
55%	32%	16.0	0.119	3075	0.760	6983	red
60%	36%	16.0	0.194	3522	1.079	5864	red
35%	17%	17.0	0.048	1748	0.567	11228	green
40%	20%	17.0	0.055	2081	0.551	10394	green
45%	24%	17.0	0.063	2442	0.538	9488	green
50%	27%	17.0	0.078	2836	0.574	8500	red
55%	32%	17.0	0.122	3268	0.779	7419	red
60%	36%	17.0	0.201	3742	1.118	6230	red
35%	17%	18.0	0.049	1851	0.588	11888	green
40%	20%	18.0	0.057	2203	0.572	11006	green
45%	24%	18.0	0.066	2586	0.559	10046	green
50%	27%	18.0	0.079	3003	0.582	9000	red
55%	32%	18.0	0.125	3460	0.799	7856	red
60%	36%	18.0	0.208	3962	1.159	6597	red

associated Cw lines:

Cw %	Cv %	V_M (ft/s)	i_M (ft/ft)	j_M (ft/ft)	prod (ton/hr)	SEC (hp-hr/t-mi)	gun water (gpm)
35%	17%	13.0	0.043	0.034	1337	0.517	8586
35%	17%	14.0	0.044	0.034	1440	0.524	9247
35%	17%	15.0	0.045	0.035	1543	0.536	9907
35%	17%	16.0	0.046	0.036	1645	0.550	10568
35%	17%	17.0	0.048	0.037	1748	0.567	11228
35%	17%	18.0	0.049	0.039	1851	0.588	11888
40%	20%	13.0	0.050	0.037	1591	0.498	7949
40%	20%	14.0	0.051	0.038	1714	0.506	8560
40%	20%	15.0	0.052	0.039	1836	0.518	9171
40%	20%	16.0	0.053	0.040	1959	0.533	9783
40%	20%	17.0	0.055	0.041	2081	0.551	10394
40%	20%	18.0	0.057	0.043	2203	0.572	11006
45%	24%	13.0	0.056	0.041	1868	0.481	7256
45%	24%	14.0	0.058	0.041	2011	0.491	7814
45%	24%	15.0	0.059	0.042	2155	0.503	8372
45%	24%	16.0	0.061	0.044	2299	0.519	8930
45%	24%	17.0	0.063	0.045	2442	0.538	9488
45%	24%	18.0	0.066	0.047	2586	0.559	10046
50%	27%	13.0	0.075	0.052	2169	0.553	6500
50%	27%	14.0	0.076	0.052	2336	0.557	7000
50%	27%	15.0	0.076	0.053	2503	0.561	7500
50%	27%	16.0	0.077	0.053	2669	0.567	8000
50%	27%	17.0	0.078	0.054	2836	0.574	8500
50%	27%	18.0	0.079	0.055	3003	0.582	9000
55%	32%	13.0	0.111	0.073	2499	0.708	5673
55%	32%	14.0	0.114	0.075	2691	0.724	6110
55%	32%	15.0	0.116	0.076	2883	0.741	6546
55%	32%	16.0	0.119	0.078	3075	0.760	6983
55%	32%	17.0	0.122	0.080	3268	0.779	7419
55%	32%	18.0	0.125	0.082	3460	0.799	7856
60%	36%	13.0	0.174	0.109	2861	0.966	4764
60%	36%	14.0	0.180	0.113	3082	1.003	5131
60%	36%	15.0	0.187	0.117	3302	1.040	5497
60%	36%	16.0	0.194	0.121	3522	1.079	5864
60%	36%	17.0	0.201	0.126	3742	1.118	6230
60%	36%	18.0	0.208	0.130	3962	1.159	6597

Calculations for constant gun water plot:

Cw %	Cv %	V_M (ft/s)	i_M (ft/ft)	prod (ton/hr)	SEC (hp-hr/t-mi)	gun water (gpm)	Max term used
35%	17%	9.1	0.044	934	0.529	6000	green
40%	20%	9.8	0.050	1201	0.498	6000	green
45%	24%	10.8	0.057	1544	0.484	6000	red
50%	27%	12.0	0.075	2002	0.552	6000	red
55%	32%	13.7	0.113	2643	0.719	6000	red
60%	36%	16.4	0.197	3604	1.094	6000	red
35%	17%	10.6	0.043	1090	0.515	7000	green
40%	20%	11.4	0.049	1401	0.492	7000	green
45%	24%	12.5	0.056	1802	0.478	7000	green
50%	27%	14.0	0.076	2336	0.557	7000	red
55%	32%	16.0	0.119	3083	0.760	7000	red
60%	36%	19.1	0.216	4204	1.203	7000	red
35%	17%	12.1	0.043	1246	0.513	8000	green
40%	20%	13.1	0.050	1602	0.498	8000	green
45%	24%	14.3	0.058	2059	0.495	8000	green
50%	27%	16.0	0.077	2669	0.567	8000	red
55%	32%	18.3	0.127	3524	0.806	8000	red
60%	36%	21.8	0.237	4805	1.317	8000	red
35%	17%	13.6	0.044	1401	0.521	9000	green
40%	20%	14.7	0.051	1802	0.515	9000	green
45%	24%	16.1	0.061	2317	0.521	9000	green
50%	27%	18.0	0.079	3003	0.582	9000	red
55%	32%	20.6	0.134	3964	0.855	9000	red
60%	36%	24.6	0.257	5405	1.433	9000	red
35%	17%	15.1	0.045	1557	0.537	10000	green
40%	20%	16.4	0.054	2002	0.540	10000	green
45%	24%	17.9	0.065	2574	0.557	10000	green
50%	27%	20.0	0.082	3337	0.600	10000	red
55%	32%	22.9	0.142	4404	0.907	10000	red
60%	36%	27.3	0.279	6006	1.550	10000	red
35%	17%	16.7	0.047	1713	0.561	11000	green
40%	20%	18.0	0.057	2202	0.572	11000	green
45%	24%	19.7	0.070	2831	0.601	11000	green
50%	27%	22.0	0.090	3670	0.658	11000	green
55%	32%	25.2	0.151	4845	0.960	11000	red
60%	36%	30.0	0.300	6607	1.669	11000	red

associated Cw lines:

Cw %	Cv %	V_M (ft/s)	i_M (ft/ft)	prod (ton/hr)	SEC (hp-hr/t-mi)	gun water (gpm)
35%	17%	9.1	0.044	934	0.529	6000
35%	17%	10.6	0.043	1090	0.515	7000
35%	17%	12.1	0.043	1246	0.513	8000
35%	17%	13.6	0.044	1401	0.521	9000
35%	17%	15.1	0.045	1557	0.537	10000
35%	17%	16.7	0.047	1713	0.561	11000
40%	20%	9.8	0.050	1201	0.498	6000
40%	20%	11.4	0.049	1401	0.492	7000
40%	20%	13.1	0.050	1602	0.498	8000
40%	20%	14.7	0.051	1802	0.515	9000
40%	20%	16.4	0.054	2002	0.540	10000
40%	20%	18.0	0.057	2202	0.572	11000
45%	24%	10.8	0.057	1544	0.484	6000
45%	24%	12.5	0.056	1802	0.478	7000
45%	24%	14.3	0.058	2059	0.495	8000
45%	24%	16.1	0.061	2317	0.521	9000
45%	24%	17.9	0.065	2574	0.557	10000
45%	24%	19.7	0.070	2831	0.601	11000
50%	27%	12.0	0.075	2002	0.552	6000
50%	27%	14.0	0.076	2336	0.557	7000
50%	27%	16.0	0.077	2669	0.567	8000
50%	27%	18.0	0.079	3003	0.582	9000
50%	27%	20.0	0.082	3337	0.600	10000
50%	27%	22.0	0.090	3670	0.658	11000
55%	32%	13.7	0.113	2643	0.719	6000
55%	32%	16.0	0.119	3083	0.760	7000
55%	32%	18.3	0.127	3524	0.806	8000
55%	32%	20.6	0.134	3964	0.855	9000
55%	32%	22.9	0.142	4404	0.907	10000
55%	32%	25.2	0.151	4845	0.960	11000
60%	36%	16.4	0.197	3604	1.094	6000
60%	36%	19.1	0.216	4204	1.203	7000
60%	36%	21.8	0.237	4805	1.317	8000
60%	36%	24.6	0.257	5405	1.433	9000
60%	36%	27.3	0.279	6006	1.550	10000
60%	36%	30.0	0.300	6607	1.669	11000

Appendix G

IMC 2005

Specific Energy and Gun Water Calculations

I_M model by Ken Wilson 03-March-2005
Spreadsheet by R. Visintainer, GIW, revised: 13-June-2005
Least Squares VB Solver by Andy Hatfield, revised: 09-June-2005

Cells key:

(light blue)	= taken direct from user input
(light green)	= fixed calculation, do not change
(orange)	= copied from columns A-G, do not change
(yellow)	= user defined calculation
blue	= user input
green	= user input from "Calibration" sheet
black	= calculated or fixed

INPUT in BLUE:

Project	**FIPR TEST Winter 2004-2005**							
Date:	**13Jun-05 by RV**							
Reference	**High Friction Matrix Slurry (p28 prelim. report)**							
Solids SG	SG_S	**2.65**	(-)					
Fluid SG	SG_S	**1.00**	(-)					
Pipe Diameter	D	**19.37**	(in)	**1.614**	(ft)			
Lines of constant C_W	C_W	**35%**	**40%**	**45%**	**50%**	**55%**	**60%**	(% wt.)
	C_V	**16.9%**	**20.1%**	**23.6%**	**27.4%**	**31.6%**	**36.1%**	(% vol.)
Lines of constant V_M	V_M	**13.0**	**14.0**	**15.0**	**16.0**	**17.0**	**18.0**	(ft/s)
Lines of constant gun water	W_G	**6000**	**7000**	**8000**	**9000**	**10000**	**11000**	(gpm)
Matrix moisture (% by weight)	M_W	**20.0%**	(% wt.)	**39.8%**	(% vol)	**1.663**	Rel. vol.- wet solids:dry solids	

Model constants	A	**1.500**	**< calibration parameter**
Model constants	B	**1.300**	**< calibration parameter**
Model constants	f	**1.87E-02**	**< friction factor**
Model constants	X	**0.85**	**< A' from equiv. fluid model, 0 < X < 1, related to fraction coarse solids**
Model constants	m	**4.80**	**< based on earlier tests, circa Dr. Carstens**
Model constants	n	**0.95**	**< based on earlier tests, circa Dr. Carstens**
Model constants	p	**0.95**	**< based on Newitt sliding bed model**
Model constants	q	**0.95**	**< based on Newitt sliding bed model**

$$i_m = MAX[\ A(C_v)^m(V_m)^n\ ,\ (f/2gD)(V_m^{\ 2})\{1+X(SG_s-1)C_v\}\ ] +\ B(C_v)^p/(V_m)^q$$

$$SEC = (5.33/SG_s)(\ i_m/C_v)$$

Calculations for constant Vm plot:

Cw %	Cv %	V_M (ft/s)	i_M (ft/ft)	prod (ton/hr)	SEC (hp-hr/t-mi)	gun water (gpm)	Max term used
35%	17%	13.0	0.033	1337	0.397	8586	green
40%	20%	13.0	0.039	1591	0.395	7949	green
45%	24%	13.0	0.046	1868	0.393	7256	green
50%	27%	13.0	0.068	2169	0.496	6500	green
55%	32%	13.0	0.106	2499	0.673	5673	green
60%	36%	13.0	0.173	2861	0.962	4764	green
35%	17%	14.0	0.034	1440	0.403	9247	green
40%	20%	14.0	0.040	1714	0.401	8560	green
45%	24%	14.0	0.047	2011	0.400	7814	green
50%	27%	14.0	0.068	2336	0.498	7000	green
55%	32%	14.0	0.108	2691	0.688	6110	green
60%	36%	14.0	0.179	3082	0.999	5131	green
35%	17%	15.0	0.035	1543	0.414	9907	green
40%	20%	15.0	0.041	1836	0.412	9171	green
45%	24%	15.0	0.048	2155	0.410	8372	green
50%	27%	15.0	0.068	2503	0.501	7500	green
55%	32%	15.0	0.111	2883	0.705	6546	green
60%	36%	15.0	0.186	3302	1.037	5497	green
35%	17%	16.0	0.036	1645	0.428	10568	green
40%	20%	16.0	0.043	1959	0.426	9783	green
45%	24%	16.0	0.050	2299	0.424	8930	green
50%	27%	16.0	0.069	2669	0.507	8000	green
55%	32%	16.0	0.114	3075	0.724	6983	green
60%	36%	16.0	0.193	3522	1.077	5864	green
35%	17%	17.0	0.037	1748	0.445	11228	green
40%	20%	17.0	0.044	2081	0.443	10394	green
45%	24%	17.0	0.052	2442	0.442	9488	green
50%	27%	17.0	0.070	2836	0.514	8500	green
55%	32%	17.0	0.117	3268	0.744	7419	green
60%	36%	17.0	0.201	3742	1.118	6230	green
35%	17%	18.0	0.039	1851	0.465	11888	green
40%	20%	18.0	0.046	2203	0.464	11006	green
45%	24%	18.0	0.054	2586	0.462	10046	green
50%	27%	18.0	0.071	3003	0.522	9000	green
55%	32%	18.0	0.120	3460	0.765	7856	green
60%	36%	18.0	0.208	3962	1.160	6597	green

associated Cw lines:

Cw %	Cv %	V_M (ft/s)	i_M (ft/ft)	j_M (ft/ft)	prod (ton/hr)	SEC (hp-hr/t-mi)	gun water (gpm)
35%	17%	13.0	0.033	0.026	1337	0.397	8586
35%	17%	14.0	0.034	0.026	1440	0.403	9247
35%	17%	15.0	0.035	0.027	1543	0.414	9907
35%	17%	16.0	0.036	0.028	1645	0.428	10568
35%	17%	17.0	0.037	0.029	1748	0.445	11228
35%	17%	18.0	0.039	0.031	1851	0.465	11888
40%	20%	13.0	0.039	0.030	1591	0.395	7949
40%	20%	14.0	0.040	0.030	1714	0.401	8560
40%	20%	15.0	0.041	0.031	1836	0.412	9171
40%	20%	16.0	0.043	0.032	1959	0.426	9783
40%	20%	17.0	0.044	0.033	2081	0.443	10394
40%	20%	18.0	0.046	0.035	2203	0.464	11006
45%	24%	13.0	0.046	0.033	1868	0.393	7256
45%	24%	14.0	0.047	0.034	2011	0.400	7814
45%	24%	15.0	0.048	0.035	2155	0.410	8372
45%	24%	16.0	0.050	0.036	2299	0.424	8930
45%	24%	17.0	0.052	0.037	2442	0.442	9488
45%	24%	18.0	0.054	0.039	2586	0.462	10046
50%	27%	13.0	0.068	0.047	2169	0.496	6500
50%	27%	14.0	0.068	0.047	2336	0.498	7000
50%	27%	15.0	0.068	0.047	2503	0.501	7500
50%	27%	16.0	0.069	0.048	2669	0.507	8000
50%	27%	17.0	0.070	0.048	2836	0.514	8500
50%	27%	18.0	0.071	0.049	3003	0.522	9000
55%	32%	13.0	0.106	0.069	2499	0.673	5673
55%	32%	14.0	0.108	0.071	2691	0.688	6110
55%	32%	15.0	0.111	0.073	2883	0.705	6546
55%	32%	16.0	0.114	0.075	3075	0.724	6983
55%	32%	17.0	0.117	0.077	3268	0.744	7419
55%	32%	18.0	0.120	0.079	3460	0.765	7856
60%	36%	13.0	0.173	0.108	2861	0.962	4764
60%	36%	14.0	0.179	0.112	3082	0.999	5131
60%	36%	15.0	0.186	0.117	3302	1.037	5497
60%	36%	16.0	0.193	0.121	3522	1.077	5864
60%	36%	17.0	0.201	0.126	3742	1.118	6230
60%	36%	18.0	0.208	0.131	3962	1.160	6597

Calculations for constant gun water plot:

Cw %	Cv %	V_M (ft/s)	i_M (ft/ft)	prod (ton/hr)	SEC (hp-hr/t-mi)	gun water (gpm)	Max term used
35%	17%	9.1	0.036	934	0.423	6000	green
40%	20%	9.8	0.041	1201	0.407	6000	green
45%	24%	10.8	0.048	1544	0.413	6000	green
50%	27%	12.0	0.068	2002	0.497	6000	green
55%	32%	13.7	0.107	2643	0.684	6000	green
60%	36%	16.4	0.196	3604	1.092	6000	green
35%	17%	10.6	0.034	1090	0.401	7000	green
40%	20%	11.4	0.039	1401	0.394	7000	green
45%	24%	12.5	0.046	1802	0.392	7000	green
50%	27%	14.0	0.068	2336	0.498	7000	green
55%	32%	16.0	0.114	3083	0.725	7000	green
60%	36%	19.1	0.217	4204	1.207	7000	green
35%	17%	12.1	0.033	1246	0.395	8000	green
40%	20%	13.1	0.039	1602	0.395	8000	green
45%	24%	14.3	0.047	2059	0.403	8000	green
50%	27%	16.0	0.069	2669	0.507	8000	green
55%	32%	18.3	0.121	3524	0.773	8000	green
60%	36%	21.8	0.239	4805	1.328	8000	green
35%	17%	13.6	0.034	1401	0.400	9000	green
40%	20%	14.7	0.041	1802	0.409	9000	green
45%	24%	16.1	0.050	2317	0.426	9000	green
50%	27%	18.0	0.071	3003	0.522	9000	green
55%	32%	20.6	0.129	3964	0.825	9000	green
60%	36%	24.6	0.261	5405	1.452	9000	green
35%	17%	15.1	0.035	1557	0.416	10000	green
40%	20%	16.4	0.043	2002	0.432	10000	green
45%	24%	17.9	0.054	2574	0.460	10000	green
50%	27%	20.0	0.074	3337	0.541	10000	green
55%	32%	22.9	0.138	4404	0.880	10000	green
60%	36%	27.3	0.284	6006	1.579	10000	green
35%	17%	16.7	0.037	1713	0.439	11000	green
40%	20%	18.0	0.046	2202	0.463	11000	green
45%	24%	19.7	0.059	2831	0.503	11000	green
50%	27%	22.0	0.077	3670	0.569	11000	green
55%	32%	25.2	0.147	4845	0.938	11000	green
60%	36%	30.0	0.307	6607	1.707	11000	green

associated Cw lines:

Cw %	Cv %	V_M (ft/s)	i_M (ft/ft)		prod (ton/hr)	SEC (hp-hr/t-mi)	gun water (gpm)
35%	17%	9.1	0.036		934	0.423	6000
35%	17%	10.6	0.034		1090	0.401	7000
35%	17%	12.1	0.033		1246	0.395	8000
35%	17%	13.6	0.034		1401	0.400	9000
35%	17%	15.1	0.035		1557	0.416	10000
35%	17%	16.7	0.037		1713	0.439	11000
40%	20%	9.8	0.041		1201	0.407	6000
40%	20%	11.4	0.039		1401	0.394	7000
40%	20%	13.1	0.039		1602	0.395	8000
40%	20%	14.7	0.041		1802	0.409	9000
40%	20%	16.4	0.043		2002	0.432	10000
40%	20%	18.0	0.046		2202	0.463	11000
45%	24%	10.8	0.048		1544	0.413	6000
45%	24%	12.5	0.046		1802	0.392	7000
45%	24%	14.3	0.047		2059	0.403	8000
45%	24%	16.1	0.050		2317	0.426	9000
45%	24%	17.9	0.054		2574	0.460	10000
45%	24%	19.7	0.059		2831	0.503	11000
50%	27%	12.0	0.068		2002	0.497	6000
50%	27%	14.0	0.068		2336	0.498	7000
50%	27%	16.0	0.069		2669	0.507	8000
50%	27%	18.0	0.071		3003	0.522	9000
50%	27%	20.0	0.074		3337	0.541	10000
50%	27%	22.0	0.077		3670	0.569	11000
55%	32%	13.7	0.107		2643	0.684	6000
55%	32%	16.0	0.114		3083	0.725	7000
55%	32%	18.3	0.121		3524	0.773	8000
55%	32%	20.6	0.129		3964	0.825	9000
55%	32%	22.9	0.138		4404	0.880	10000
55%	32%	25.2	0.147		4845	0.938	11000
60%	36%	16.4	0.196		3604	1.092	6000
60%	36%	19.1	0.217		4204	1.207	7000
60%	36%	21.8	0.239		4805	1.328	8000
60%	36%	24.6	0.261		5405	1.452	9000
60%	36%	27.3	0.284		6006	1.579	10000
60%	36%	30.0	0.307		6607	1.707	11000

Appendix H

PCS 2005

Specific Energy and Gun Water Calculations

i_M model by Ken Wilson 03-March-2005
Spreadsheet by R. Visintainer, GIW, revised: 13-June-2005
Least Squares VB Solver by Andy Hatfield, revised: 09-June-2005

Cells key:
- = taken direct from user input
- = fixed calculation, do not change
- = copied from columns A-G, do not change
- = user defined calculation
- **blue** = user input
- **green** = user input from "Calibration" sheet
- **black** = calculated or fixed

INPUT in BLUE:

Project	**FIPR TEST Winter 2004-2005**							
Date:	**13Jun-05 by RV**							
Reference	**Low Friction Matrix Slurry (p28 prelim. report)**							
Solids SG	SG_S	**2.65**	(-)					
Fluid SG	SG_S	**1.00**	(-)					
Pipe Diameter	D	**19.37**	(in)	**1.614**	(ft)			
Lines of constant C_W	C_W	**35%**	**40%**	**45%**	**50%**	**55%**	**60%**	(% wt.)
	C_V	**16.9%**	**20.1%**	**23.6%**	**27.4%**	**31.6%**	**36.1%**	(% vol.)
Lines of constant V_M	V_M	**13.0**	**14.0**	**15.0**	**16.0**	**17.0**	**18.0**	(ft/s)
Lines of constant gun water	W_G	**6000**	**7000**	**8000**	**9000**	**10000**	**11000**	(gpm)
Matrix moisture (% by weight)	M_W	**20.0%**	(% wt.)	**39.8%**	(% vol)	**1.663**	Rel. vol.- wet solids:dry solids	

Model constants	A	**0.312**	**< calibration parameter**
Model constants	B	**0.119**	**< calibration parameter**
Model constants	f	**1.49E-02**	**< friction factor**
Model constants	X	**1.00**	**< A' from equiv. fluid model, 0 < X < 1, related to fraction coarse solids**
Model constants	m	**3.01**	**< based on earlier tests, circa Dr. Carstens**
Model constants	n	**0.17**	**< based on earlier tests, circa Dr. Carstens**
Model constants	p	**0.81**	**< based on Newitt sliding bed model**
Model constants	q	**0.25**	**< based on Newitt sliding bed model**

$$i_m = \mathrm{MAX}[\ A(C_v)^m(V_m)^n\ ,\ (f/2gD)(V_m^{\ 2})\{1+X(SG_s-1)C_v\}\ ] +\ B(C_v)^p/(V_m)^q$$

$$SEC = (5.33/SG_s)(\ i_m/C_v)$$

Calculations for constant Vm plot:

Cw %	Cv %	V_M (ft/s)	i_M (ft/ft)	prod (ton/hr)	SEC (hp-hr/t-mi)	gun water (gpm)	Max term used
35%	17%	13.0	0.026	1337	0.306	8586	green
40%	20%	13.0	0.030	1591	0.300	7949	green
45%	24%	13.0	0.035	1868	0.295	7256	green
50%	27%	13.0	0.040	2169	0.290	6500	green
55%	32%	13.0	0.045	2499	0.286	5673	green
60%	36%	13.0	0.051	2861	0.282	4764	green
35%	17%	14.0	0.027	1440	0.323	9247	green
40%	20%	14.0	0.032	1714	0.317	8560	green
45%	24%	14.0	0.037	2011	0.312	7814	green
50%	27%	14.0	0.042	2336	0.308	7000	green
55%	32%	14.0	0.048	2691	0.303	6110	green
60%	36%	14.0	0.054	3082	0.300	5131	green
35%	17%	15.0	0.029	1543	0.342	9907	green
40%	20%	15.0	0.034	1836	0.336	9171	green
45%	24%	15.0	0.039	2155	0.332	8372	green
50%	27%	15.0	0.045	2503	0.327	7500	green
55%	32%	15.0	0.051	2883	0.323	6546	green
60%	36%	15.0	0.057	3302	0.319	5497	green
35%	17%	16.0	0.030	1645	0.363	10568	green
40%	20%	16.0	0.036	1959	0.357	9783	green
45%	24%	16.0	0.041	2299	0.353	8930	green
50%	27%	16.0	0.047	2669	0.348	8000	green
55%	32%	16.0	0.054	3075	0.344	6983	green
60%	36%	16.0	0.061	3522	0.340	5864	green
35%	17%	17.0	0.032	1748	0.386	11228	green
40%	20%	17.0	0.038	2081	0.380	10394	green
45%	24%	17.0	0.044	2442	0.375	9488	green
50%	27%	17.0	0.051	2836	0.371	8500	green
55%	32%	17.0	0.058	3268	0.367	7419	green
60%	36%	17.0	0.065	3742	0.363	6230	green
35%	17%	18.0	0.034	1851	0.410	11888	green
40%	20%	18.0	0.040	2203	0.405	11006	green
45%	24%	18.0	0.047	2586	0.400	10046	green
50%	27%	18.0	0.054	3003	0.396	9000	green
55%	32%	18.0	0.061	3460	0.392	7856	green
60%	36%	18.0	0.070	3962	0.388	6597	green

associated Cw lines:

Cw %	Cv %	V_M (ft/s)	i_M (ft/ft)	j_M (ft/ft)	prod (ton/hr)	SEC (hp-hr/t-mi)	gun water (gpm)
35%	17%	13.0	0.026	0.020	1337	0.306	8586
35%	17%	14.0	0.027	0.021	1440	0.323	9247
35%	17%	15.0	0.029	0.022	1543	0.342	9907
35%	17%	16.0	0.030	0.024	1645	0.363	10568
35%	17%	17.0	0.032	0.025	1748	0.386	11228
35%	17%	18.0	0.034	0.027	1851	0.410	11888
40%	20%	13.0	0.030	0.022	1591	0.300	7949
40%	20%	14.0	0.032	0.024	1714	0.317	8560
40%	20%	15.0	0.034	0.025	1836	0.336	9171
40%	20%	16.0	0.036	0.027	1959	0.357	9783
40%	20%	17.0	0.038	0.029	2081	0.380	10394
40%	20%	18.0	0.040	0.030	2203	0.405	11006
45%	24%	13.0	0.035	0.025	1868	0.295	7256
45%	24%	14.0	0.037	0.026	2011	0.312	7814
45%	24%	15.0	0.039	0.028	2155	0.332	8372
45%	24%	16.0	0.041	0.030	2299	0.353	8930
45%	24%	17.0	0.044	0.032	2442	0.375	9488
45%	24%	18.0	0.047	0.034	2586	0.400	10046
50%	27%	13.0	0.040	0.027	2169	0.290	6500
50%	27%	14.0	0.042	0.029	2336	0.308	7000
50%	27%	15.0	0.045	0.031	2503	0.327	7500
50%	27%	16.0	0.047	0.033	2669	0.348	8000
50%	27%	17.0	0.051	0.035	2836	0.371	8500
50%	27%	18.0	0.054	0.037	3003	0.396	9000
55%	32%	13.0	0.045	0.029	2499	0.286	5673
55%	32%	14.0	0.048	0.031	2691	0.303	6110
55%	32%	15.0	0.051	0.033	2883	0.323	6546
55%	32%	16.0	0.054	0.036	3075	0.344	6983
55%	32%	17.0	0.058	0.038	3268	0.367	7419
55%	32%	18.0	0.061	0.040	3460	0.392	7856
60%	36%	13.0	0.051	0.032	2861	0.282	4764
60%	36%	14.0	0.054	0.034	3082	0.300	5131
60%	36%	15.0	0.057	0.036	3302	0.319	5497
60%	36%	16.0	0.061	0.038	3522	0.340	5864
60%	36%	17.0	0.065	0.041	3742	0.363	6230
60%	36%	18.0	0.070	0.044	3962	0.388	6597

Calculations for constant gun water plot:

Cw %	Cv %	V_M (ft/s)	i_M (ft/ft)	prod (ton/hr)	SEC (hp-hr/t-mi)	gun water (gpm)	Max term used
35%	17%	9.1	0.022	934	0.256	6000	green
40%	20%	9.8	0.026	1201	0.257	6000	green
45%	24%	10.8	0.031	1544	0.262	6000	green
50%	27%	12.0	0.037	2002	0.274	6000	green
55%	32%	13.7	0.047	2643	0.299	6000	green
60%	36%	16.4	0.063	3604	0.349	6000	green
35%	17%	10.6	0.023	1090	0.272	7000	green
40%	20%	11.4	0.028	1401	0.276	7000	green
45%	24%	12.5	0.034	1802	0.287	7000	green
50%	27%	14.0	0.042	2336	0.308	7000	green
55%	32%	16.0	0.054	3083	0.345	7000	green
60%	36%	19.1	0.075	4204	0.417	7000	green
35%	17%	12.1	0.024	1246	0.292	8000	green
40%	20%	13.1	0.030	1602	0.301	8000	green
45%	24%	14.3	0.037	2059	0.318	8000	green
50%	27%	16.0	0.047	2669	0.348	8000	green
55%	32%	18.3	0.063	3524	0.400	8000	green
60%	36%	21.8	0.089	4805	0.498	8000	green
35%	17%	13.6	0.027	1401	0.316	9000	green
40%	20%	14.7	0.033	1802	0.331	9000	green
45%	24%	16.1	0.042	2317	0.355	9000	green
50%	27%	18.0	0.054	3003	0.396	9000	green
55%	32%	20.6	0.073	3964	0.464	9000	green
60%	36%	24.6	0.106	5405	0.590	9000	green
35%	17%	15.1	0.029	1557	0.345	10000	green
40%	20%	16.4	0.037	2002	0.365	10000	green
45%	24%	17.9	0.047	2574	0.398	10000	green
50%	27%	20.0	0.061	3337	0.450	10000	green
55%	32%	22.9	0.084	4404	0.536	10000	green
60%	36%	27.3	0.125	6006	0.695	10000	green
35%	17%	16.7	0.032	1713	0.378	11000	green
40%	20%	18.0	0.040	2202	0.404	11000	green
45%	24%	19.7	0.052	2831	0.446	11000	green
50%	27%	22.0	0.069	3670	0.510	11000	green
55%	32%	25.2	0.097	4845	0.617	11000	green
60%	36%	30.0	0.146	6607	0.811	11000	green

associated Cw lines:

Cw %	Cv %	V_M (ft/s)	i_M (ft/ft)		prod (ton/hr)	SEC (hp-hr/t-mi)	gun water (gpm)
35%	17%	9.1	0.022		934	0.256	6000
35%	17%	10.6	0.023		1090	0.272	7000
35%	17%	12.1	0.024		1246	0.292	8000
35%	17%	13.6	0.027		1401	0.316	9000
35%	17%	15.1	0.029		1557	0.345	10000
35%	17%	16.7	0.032		1713	0.378	11000
40%	20%	9.8	0.026		1201	0.257	6000
40%	20%	11.4	0.028		1401	0.276	7000
40%	20%	13.1	0.030		1602	0.301	8000
40%	20%	14.7	0.033		1802	0.331	9000
40%	20%	16.4	0.037		2002	0.365	10000
40%	20%	18.0	0.040		2202	0.404	11000
45%	24%	10.8	0.031		1544	0.262	6000
45%	24%	12.5	0.034		1802	0.287	7000
45%	24%	14.3	0.037		2059	0.318	8000
45%	24%	16.1	0.042		2317	0.355	9000
45%	24%	17.9	0.047		2574	0.398	10000
45%	24%	19.7	0.052		2831	0.446	11000
50%	27%	12.0	0.037		2002	0.274	6000
50%	27%	14.0	0.042		2336	0.308	7000
50%	27%	16.0	0.047		2669	0.348	8000
50%	27%	18.0	0.054		3003	0.396	9000
50%	27%	20.0	0.061		3337	0.450	10000
50%	27%	22.0	0.069		3670	0.510	11000
55%	32%	13.7	0.047		2643	0.299	6000
55%	32%	16.0	0.054		3083	0.345	7000
55%	32%	18.3	0.063		3524	0.400	8000
55%	32%	20.6	0.073		3964	0.464	9000
55%	32%	22.9	0.084		4404	0.536	10000
55%	32%	25.2	0.097		4845	0.617	11000
60%	36%	16.4	0.063		3604	0.349	6000
60%	36%	19.1	0.075		4204	0.417	7000
60%	36%	21.8	0.089		4805	0.498	8000
60%	36%	24.6	0.106		5405	0.590	9000
60%	36%	27.3	0.125		6006	0.695	10000
60%	36%	30.0	0.146		6607	0.811	11000

Appendix I

BASIS OF GIW EXCEL® MODEL FOR PIPELINE FLOW OF SETTLING NON-NEWTONIAN SLURRIES

by

K. C. Wilson

July 2005

INTRODUCTION

At high-solids concentration, many Florida phosphate slurries appear to flow as laminar non-Newtonian materials. However, some of the solid particles will settle under these conditions, forming a sliding contact-load layer near the bottom of the pipe (Thomas and others 2004). Some analysis of this flow configuration has already been done, as reported, for example, by Clarke and Charles (1993), Maciejewski and others (1993) and Wilson and others (1993). In these works, the tendency has been to use a two-layer force-balance model that requires considerable computer processing and thus is not 'transparent' to the user. For typical applications, it is preferable to have a simpler model that maintains the two basic components of 'fluid effect' and 'solids effect,' and a model of this sort is developed below.

THE MODEL

The hydraulic gradient i_m of the mixture (expressed in height of water per unit length of pipe) has a fluid-effect component written i_f and a solids-effect component written i_s. For given properties of fluid and solids, it is expected that both of these components may depend on volumetric solids concentration C_v, mixture velocity (discharge divided by area of pipe cross-section) V_m and internal pipe diameter D. Within the range of variables of commercial interest, it can be assumed that the effects of each of these variables can be approximated by a power law, as shown below.

The fluid-effect component is based on typical behaviour of non-Newtonian fluids as described by, e.g., Wilson and others (1996), which is the source of the page numbers cited below in square brackets. For laminar flow, the basic relationship [p. 75], expresses the shear stress at the pipe wall as a power of $(8V_m/D)$. This leads to the following expression for i_f.

$$i_f = A_1(V_m)^n/(\rho_w g D^{(1+n)}) \qquad (1)$$

where A_1 is coefficient, n is a power (usually considerably less than unity), ρ_w is the density of water, and g is gravitational acceleration. The coefficient A_1 is strongly dependent on the concentration of solids [p. 90], and can be written as $A_2(C_v)^m$, where m was approximately 3.5 for this example [p.91]. As ρ_w and g are constants, they can be incorporated into the coefficient, which is now written simply A, giving

$$i_{fL} = A(C_v)^m(V_m)^n/D^{(1+n)} \qquad (2)$$

This equation is applicable for laminar flow, which will often occur for non-Newtonian materials.

In other circumstances the flow will be turbulent, and in this case the fluid-effect component i_f will be proportional to $[V_m^2/(2gD)]$ and to the mixture density effect $[1+X(S_s-1)C_v]$. Here X is the fraction of the solids effective for this type of flow (X lies between 0 and 1.0, and is equivalent to the coefficient A' [p. 52]). Introducing a coefficient f to represent the friction factor, one obtains the expression for i_f in turbulent flow as

$$i_{fT} = f[V_m^2/(2gD)] [1+X(S_s-1)C_v] \quad (3)$$

The next step is to obtain an expression for the solids-effect component, i_s. This will increase with the overall volumetric concentration of solids, C_v, but not necessarily in the direct proportion assumed for settling slurries in turbulent flow. As noted in references cited in the introductory paragraph, particles settle slowly in non-Newtonian media, and thus settling will still be taking place for a considerable time after a given portion of the slurry passes through a pump. For a particular section of the pipeline this time will be proportional to the mean velocity V_m and to the average distance that a particle falls, which in turn is proportional to the pipe diameter D. The proposed power-law relationship expressing this behaviour can be written

$$i_s = B(C_v)^p/(V_mD)^q \quad (4)$$

where B is a coefficient, the power p in the order of unity and the power q is expected to be considerably smaller. Combining Equation (2) or (3) with (4) gives the expression for i_m as

$$i_m = MAX[i_{fL} . i_{fT}] + B(C_v)^p/(V_mD)^q \quad (5)$$

Like the relationship for particulate slurries in turbulent flow [p. 130], Equation (5) produces a minimum when i_m is plotted against V_m (with other quantities held constant). This minimum can be obtained by setting $\partial i_m/\partial V_m$ equal to zero, but the details will not be given here. As with the particulate case, it is not expected that i_m will show a minimum when C_v is varied. However, this is not necessarily the case when specific energy consumption (SEC) is considered (for particulate slurries, see Wilson 2004). For laminar flow, the variable portion of SEC is the ratio i_m/C_v, which for Equation (5) becomes

$$i_m/C_v = A(C_v)^{(m-1)}(V_m)^n/D^{(1+n)} + B(C_v)^{(p-1)}/(V_mD)^q \quad (6)$$

On differentiating this expression with respect to C_v, it is found that a minimum only exists if $p < 1$.

MODEL CALIBRATION

The new model has eight numerical parameters: the coefficients A, B, f and X, and the four powers m, n, p and q. These parameters will differ for various types of phosphate slurry, and it is expected that the coefficients A and B will be more sensitive than the powers. It is difficult to evaluate so many parameters from the corpus of data obtainable from full-scale pipe-loop tests, but small-scale rheological testing of slurries made with the non-settling fraction of solids should be useful in estimating the powers m and n. For the other powers, an educated guess might suggest that q is roughly equal to n and p in the range of (1-n). The coefficients A (or f if the flow is turbulent) and B are best evaluated from pipe-loop tests, although estimates of the relative values of A for various slurries can be made from rheological test results.

This model has been incorporated into the Excel® spreadsheets developed by Mr. R.J. Visintainer, which now include a best-fit method for estimating the numerical parameters. This technique has been used to produce graphical representations of pressure gradient and specific energy consumption in terms of production (tons/hr) and gun water.

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