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Slurry Pump Development
using the DaqBook®

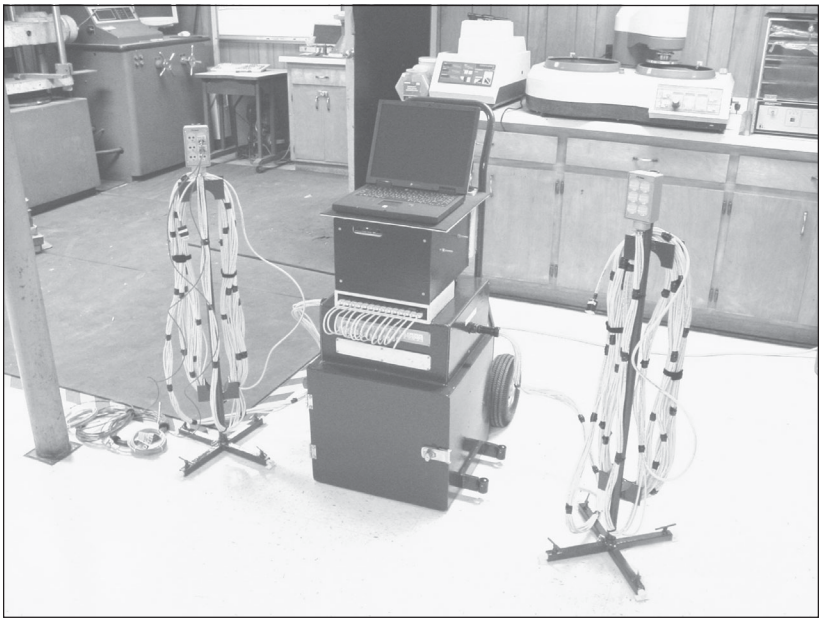
Industrial

Application Note #90

Application Summary

High-volume centrifugal pumps for transporting slurries at a rate of 80,000 gal/min or 7,000 tons/hr are commonly used for dredging harbors and rivers. The pump casings alone can weight as much as 33,000 lb. Smaller pumps are used for fertilizer processing and transport (such as in the phosphate industry), but still have impeller blade diameters to 62 in. and require an input power of 1,500 hp (1,120 kW) or higher. In addition to mud and fertilizers, slurries may be composed of other watered-down mixtures of insoluble matter such as coal and salt in brine, or crude oil in sand, and product from other metallurgical mining operations. Because these substances are highly abrasive, and in many cases extremely corrosive, the materials used to make these gigantic pumps require unique properties. The recipes needed for new materials and proper heat-treating of finished parts as well as procedures for combining these special high-alloy iron, steel, ceramic, and rubber components come from intensely focused research and development efforts and many years of experience solving extremely difficult manufacturing problems.

GIW Industries, Grovetown, Georgia, has been in the centrifugal slurry pump manufacturing business for more than 90 years and has accumulated vast experience and the resources for producing exceptionally high-quality pumps. Harry Tian, Ph.D., Manager of Metallurgical/Materials R&D at GIW Industries claims that a large part of this immense materials and metallurgical research effort entails instrumentation for measuring and recording thermal profiles, such as temperatures during the melting, refining, solidifying, heat treating, and cooling stages of the cast parts to achieve desired microstructure and properties. Such instrumentation requires numerous channels of accurate, dedicated temperature-measuring thermocouples strategically placed about the product under development.



GIW Industries, Grovetown, Georgia, devised a mobile data acquisition system in a small cart, which contains an IOtech DaqBook and signal conditioners, a laptop computer, and special thermocouple cables for measuring the temperatures of cast components during various processing steps in manufacturing and development.

Potential Solution

The test setup used for research projects on cast pump components required that at least a dozen thermocouples be installed on test parts. Tian's initial data acquisition equipment was composed of dedicated thermometers, temperature gages, and analog or digital readout devices that the researchers and technicians had to interpret and log manually. A few two-channel thermocouple indicators and switch-boxes were also purchased, but they were limited to manually switching individual channels of input to a single read-out device, which was insufficient for detailing any worthwhile temperature profiles.

IOtech's Solution

Tian needed a temperature profile of all channels simultaneously in order to characterize temperature gradients among a number of localized spots. This ensures that a relatively uniform, homogeneous condition will be established for producing parts without thermally related flaws or failures. Based on his past experience with IOtech equipment, and after some investigation of newer instruments, Tian purchased an IOtech DaqBook® with a DBK52™, a 14-channel input signal-conditioning module. Then, Tian and his assistant, Perry Barsh, were able to install 14 thermocouples and collect temperature data on all channels simultaneously. This provided the heating and cooling temperature profiles they needed to ensure a flawless part.

"The DaqBook data acquisition system was installed on a cart so it could be moved around the facility easily and adapt to a variety of applications," says Tian. "I also use type-K thermocouples for measuring temperatures of the heat-treating ovens and a type-S for monitoring the metal solidification step." Furnace temperatures reach 2,500 to 3,000˚F, and sometimes more. "In a few cases, I can weld the thermocouple directly to the

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specimen under test to obtain an ultimately intimate connection," says Tian. He also has the capability to make his own thermocouples with a small, precision portable welder.

Says Barsh, "The software is very functional. Some of the thermocouple leads are pretty long and I can add coefficients in the software to compensate for this extra lead length. I also use DASYLab® software to perform mathematical differentiation on the temperature readings that we accumulate."

"I also like the ability to easily switch among various units of measure with the software, says Tian. "The DaqBook is also easy to use, it's very accurate, and the small size is convenient, although it's on the cart most of the time. Accuracy is especially important to me because of the shrinkage that takes place upon cooling. It may require 25 tons of molten metal to produce a sound 15-ton final casing. Those are the kinds of details we need to know. And the DaqBook provides us with accurate data."

Conclusion

GIW Industries, Grovetown, Georgia, manufactures gigantic dredging pumps that remove and transport slurries from harbors and rivers, as well as coal in water, oil in sand, and salt brine. The pumps have critical wear properties that depend upon monitoring and recording vital heat-treating and processing temperatures during the manufacturing of their component parts. GIW keeps the process under control and makes these measurements during the verification stages with an IOtech DaqBook data acquisition system and a dozen or more thermocouples connected to large castings during heat-treating, cool-down, and other manufacturing operations.

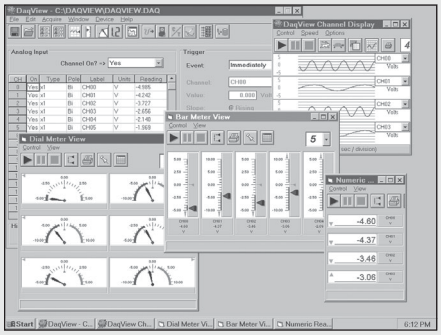
DaqBook/2000 Series

The DaqBook/2000® series of portable data acquisition devices can synchronously measure analog inputs, frequency inputs, and digital inputs. The 16-bit/200-kHz DaqBooks come equipped with built-in signal I/O capability, which can be further expanded and enhanced with over 40 DBK series expansion and signal conditioning options.

The DaqBook/2000 series includes a built-in 10/100BaseT Ethernet interface capable of transferring acquired data back to the PC at the full 200 Kreading/s measurement rate of the DaqBook. Multiple DaqBooks can be attached to a single PC via an Ethernet hub or switch, and are capable of being synchronized and of transferring data continuously at full speed into the PC. Up to 10 DaqBooks can be transferring 200 Kreading/s back to a PC concurrently, with no loss in data.

Features

- Analog input, analog output, frequency input, timer output, and digital I/O; all in one compact and portable enclosure
- Built-in Ethernet connection provides continuous streaming to the PC with no data loss
- 16-bit, 200-kHz A/D converter
- Operates from -30˚ to +70˚C
- Powerable from 10 to 30 VDC, or with included AC adapter
- Synchronous analog, digital, and frequency measurements
- Trigger modes include analog, digital, frequency, and software
- Virtually infinite pre-trigger buffer
- 4 channels of 16-bit, 100-kHz analog output (models /2001 and /2020)
- DaqBook/2020 offers convenient front panel connectors for thermocouple, voltage and frequency measurements all in one box
- DaqBooks attach to over 40 DBK signal conditioning options to assemble a low-cost system, customized to your particular application



DaqView™ graphical data acquisition and display software is included with all DaqBook systems

Signal Conditioning Options

- Signal conditioning and expansion options for thermocouples, strain gages, accelerometers, isolation, RTDs, etc. — over 40 DBK I/O expansion options are available

Software

- DaqView™ software included for effortless data logging
- Includes support for Visual Basic®, C/C++, ActiveX/COM, LabVIEW®, MATLAB®, and DASYLab®

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