Intelligent Monitoring Delivers Real-Time Pump Performance Data

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An energy efficiency and reliability study helped one plant save $1 million annually by avoiding downtime.

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The years leading up to the new millennium saw a rapid evolution of industrial communication networks from analog to digital. By 2000, information technology tools were becoming integrated into fluid handling products and systems. This marked the beginning of pump and automation technology convergence.

Process instruments, control valves and stand-alone controllers developed from individual hardware units to microprocessor embedded devices that could be digitally linked into a computer-based process management system. Intelligent pumps also joined the march forward in 2000. Today, "smart" centrifugal pumps with variable frequency drive (VFD) controls are becoming an integral component of the industrial process automation architecture.

Hard-wired communication systems in field devices are being replaced by wireless communication as the new standard. What does this communication revolution mean for the traditional pump and automation industry?

The migration from hardware to software enables new services that were practically undeliverable in the past. Widespread information flow from process assets helps plant operators make better life-cycle-cost decisions and perform true predictive maintenance in real time, without needing to collect data manually.

These changes drive stakeholder innovation and profitability. The old paradigm of business gives way to the life-cycle-costing approach. Organizational structures and stakeholder perceptions are changing. Suppliers are moving from selling commodity products and services to rendering unique, value-added services that are highly customized.

While all this may seem vague, new approaches are becoming part of industrial automation and fluid handling systems practice and management. The plan-do-check-and-act cycle now should mean making sound financial decisions that win today and in the future rather than first cost decisions that win today and fail decidedly in the future.

As an example of these changes, consider one pulp mill's maintenance strategy for dealing with a vat dilution pumping system that was causing repeated component and system failures and process

Widespread information flow from process assets helps plant operators make better life-cycle-cost decisions and perform true predictive maintenance in real time. *(Article images courtesy of ITT Corporation.)*

downtime. This approach included looking at the system holistically and also considered the use of more intelligent components. Decisions were ultimately made based on life-cycle costs.

Case Study

Regular pump breakdowns and undue wear resulting from heavy control valve throttling can cost companies millions each year. In one case study from 2001, a paper mill bleach plant was suffering financial losses from an oversized pump. After assessing the problem, plant personnel contacted a plant operation specialist.

The mill's energy team determined that nearly two-thirds of the facility's valves were less than 50 percent open. Many of them were less than 25 percent open. One key pump system had a capacity of 6,500 gallons per minute (gpm), but the average load was only 2,750 gpm—52 percent of total capacity. The peak flow demand was only 5,200 gpm.

The 10-inch ball-valve installed in a 14-inch discharge line was undersized. The large pressure drop and associated vibration were causing valve wear, pipe cracks, gasket leaks and frequent downtime. Also, it was difficult to keep the control loop tuned, which required manual operation of the modulating valve. The pump experienced almost 10 failures per year, all of which occurred while the pump was running and during startup and shutdown.

A pump is more susceptible to catastrophic damage during startup and shutdown than at any other time. This is primarily because of large pressure changes and water hammer across the pump system components. But the initial shock to the system upon startup involved more than pressure. There was also thermal shock from 220 F (104 C) filtrate entering the pipes when the pump motor was started.

The mill's reliability engineers conducted a thorough examination of the system. They determined that automated gate valves, which open slowly as pipes warm to avoid thermal shock and cracking, plus new operating procedures would provide incremental improvements and a reduction in failures. In addition to the gate valve automation, the plant operation specialist recommended installing a low-voltage motor and VFD, operated in pressure control mode, for the three vessels the pump was feeding.

Stabilizing the control loops and reducing pressure inside the system turned a frequently failing pump into a properly functioning component of the system. The bleach plant witnessed $18,000 in energy savings in 2002. Energy savings in the same process had climbed to $32,000 in 2013 as energy costs increased. Beyond the efficiency improvement, plant representatives also reported that the systems-based solution saved them more than $1 million annually in downtime and repair costs.

A Systems Approach

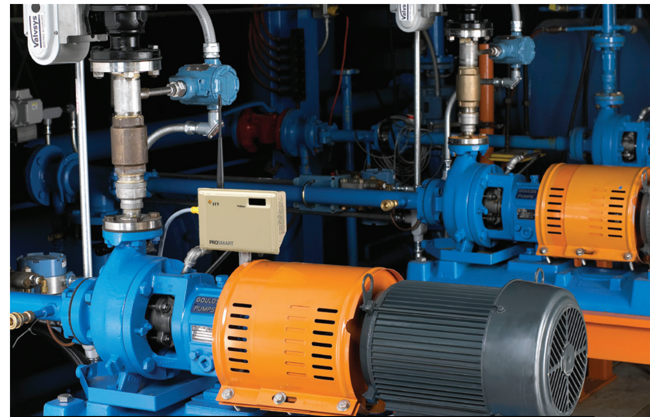
Plants haven't been clamoring to invest in efficiency for several reasons. One is simply a lack of experience with the methods and techniques used to raise efficiency. When components break, operators tend to buy what they think already works to replace them.

When deciding to modify systems, efficiency improvements may feel unnecessary. No one wants to interrupt day-to-day operation of the plant to overhaul functioning equipment or systems—especially if they aren't part of the plant's specialized production equipment. However, critical subsystem issues in many plants have too long been ignored. Engineers and suppliers are still oversizing pumps, for a variety of reasons. Some prepare for increased demand, imagining future capacity increases that never come.

Pump optimization activities allow an increase in the level of condition monitoring through broader use of intelligent motors, pumps with embedded chips, VFDs and wireless vibration monitoring. These tools offer real-time information on pump system performance.

Pumps are not considered to be an integral component of the process automation architecture. As a result, plant information systems—such as distributed control systems (DCS) and computerized maintenance management systems (CMMS)—typically lack continuously monitored asset data for diagnostic use.

Although the DCS monitors most of the key process parameters required for traditional process control, up to 60 percent of the pump systems lack a flow measurement on the discharge line. For all practical purposes, almost all of the work orders and asset information is manually entered into the CMMS.



The latest advances in technology offer real-time information on pump performance, helping plant operators make more informed decisions related to their service.

Furthermore, other underlying assets, including compressors, blowers, fans and control valves, are rarely connected to the CMMS. The lack of information is a missing link in an e-manufacturing strategy. It can mean that large potential cost savings go unrealized. According to the ARC Advisory Group, up to 40 percent of manufacturing revenues are devoted to maintenance and up to 60 percent of scheduled maintenance checks and motor-driven systems are unnecessary.

With consideration given to proper mounting, alignment and lubrication, the three primary determinants of pump reliability are speed, distance operated from BEP and impeller diameter. If a mill optimizes 30 percent of existing pump systems, overall mill process availability will dramatically increase while pump seal and bearing failures will significantly decrease.

Reliability improvements can be predicted, and past work orders and CMMS records can be used to estimate annual maintenance costs. In many cases, process control benefits can be identified in terms of reduced raw material variability, and life-cycle-cost savings can be estimated based on current costs compared with optimized costs.

Making decisions based on long-term operating costs—rather than keeping a large safety margin that allows unnecessarily high flow production—will create an opportunity for the plant of the future. This kind of plant will be available, adaptable and sustainable as required. This thought process needs to be implemented and is increasingly becoming a regulatory requirement. P&S

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