Priming The Pump To Save Energy

The statistics—both staggering and sobering—are sounding the alarm for a radical transformation in the energy efficiency of pumping systems. After motors, pumps are the second most used machines in the world. According to U.S. Department of Energy (DOE) estimates, pumping systems account for 25 percent of the 679 billion KWH of electricity consumed by electric motor systems.

The DOE also indicates that pumping systems account for nearly 20 percent of the world’s electrical energy demand, and frequently consume from 25 percent to 50 percent of the energy in industrial process plants. The U.S. consumes 35 percent more energy than it produces and three times more than China. American manufacturers, according to the National Association of Manufacturers, face an external cost burden of 31.7 percent in doing domestic business—while competing in the global marketplace. Rising energy costs are a significant component of these costs.

Today, some progressive companies are capturing the bottom-line cost savings associated with energy, systems optimization and lifecycle cost approaches to purchasing capital equipment, thus improving their ability to compete in the global marketplace. However, many users are not aligned around these goals. Many still purchase pumping systems based on initial cost, without considering overall lifecycle costs (of which the initial purchase price is typically a very small fraction).

Further, a pump applied incorrectly in a system or one that is oversized for its application, does not operate at its best efficiency point (BEP). Pumps not operating at BEP increase overall systems energy consumption, decrease reliability and shorten life expectancy.

The potential energy and cost savings through a systems approach to optimization typically far outweigh the sum of the savings through component optimization. A systems approach to this problem entails an analysis of both the supply and demand sides of a pumping system, and how components interact, shifting the focus of the analysis from individual components to total system performance.

A survey of the components of an existing pumping system may reveal opportunities for upgrading to an energy-efficient NEMA premium motor, replacing a leaking valve, adding a variable-speed drive or adjusting an energy management system. This may result in up to a 20 percent reduction in energy costs, while more savings are possible.

In comparison, pumping system analysis using a systems approach could possibly identify a varying load profile that may best be met through a two-pump arrangement, resulting in a 40 to 50 percent savings. And other techniques are possible as well.

This method also applies to new systems. Many users do not know how to properly select and apply a new pump in a system, so operating costs are inadvertently increased. With pump/piping software tools, users can optimize pump systems design to ensure that a myriad of design and equipment selection factors are considered.

Because of such pump misapplication and the lack of focus on overall system optimization, three key needs exist:

1. Pump manufacturers need to offer value-added products and solutions to end-user markets to remain competitive.2. End users need to focus on asset optimization to help manage volatile energy costs and climate change initiatives, and to improve productivity and profitability.3. Utilities need cost-effective energy savings to meet demand, as well as educational resources to address efficiency improvements among their customers, including offering incentives for pumping systems as they do with motors, lighting and other equipment.

All About Optimization

To meet these needs, decrease energy costs and optimize pumping systems, the Hydraulic Institute and its members developed a market transformation educational initiative called Pump Systems Matter™ (PSM) in 2004 to help pump users gain a more competitive advantage through strategic broad-based energy management and pump system performance optimization. The organization seeks to provide end users with tools and collaborative opportunities that integrate pump system performance optimization and efficient energy management practices into normal business operations.

PSM already offers tools and educational programs to accomplish this goal. One is the Pump System Improvement Modeling Tool (PSIM) - a free downloadable program that provides pump systems engineers with a glimpse into how modeling tools can reduce cost and conserve energy. Users are able to calculate pressure drop and flow distribution in straight-path, simply branched or looped pumping systems.

Users can also explore net present valve concepts and build models of pumping systems with PSIM. They can focus on system hydraulic calculation, centrifugal and positive displacement pumps, pump energy usage and cost over time, pump efficiency and BEP evaluation, variable speed pumps, flow and pressure control valves, impeller trimming, automatic pump curve viscosity corrections, NPSH calculations, and pump vs. system curve generation.PSM also makes available the Department of Energy’s Pump System Assessment Tool (PSAT), which helps users assess energy savings opportunities in existing pumping systems. PSAT relies on field measurements of flow rate, head and motor power or current to perform the assessment. Using algorithms from HI standards (www.Pumps.org [1]) and motor performance characteristics from the U.S. Department of Energy Motormaster database, PSAT estimates existing pump and motor efficiency and calculates the potential energy/cost savings for an optimized system.

PSM works with several different efficiency programs and utilities for the propagation of wise energy practices. Some examples of current programs or initiatives include: the Northwest Energy Efficiency Alliance, Xcel Energy, the Industrial Efficiency Alliance, BC Hydro's Power Smart Program and the Wisconsin Focus of Energy.

The average energy savings potential through the implementation of economically viable pumping system optimization projects is approximately 20 percent. If all facilities in the U.S. implemented such measures, the savings would equal over 28,000-GWh per year, based on a midrange estimate according to the DOE.

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