Match Pumps to System Requirements

Suggested Actions

- Survey your facility's pumps.
- Identify flow rates that vary 30% or more from the BEP and systems imbalances greater than 20%.
- Identify misapplied, oversized, or throttled pumps and those with bypass lines.
- Assess opportunities to improve system efficiency.
- Consult with suppliers on the cost of trimming or replacing impellers and replacing pumps.
- Determine the cost-effectiveness of each improvement.

An industrial facility can reduce the energy costs associated with its pumping systems, and save both energy and money, in many ways. They include reducing the pumping system flow rate, lowering the operating pressure, operating the system for a shorter period of time each day, and, perhaps most important, improving the system's overall efficiency.

Often, a pumping system runs inefficiently because its requirements differ from the original design conditions. The original design might have been too conservative, or oversized pumps might have been installed to accommodate future increases in plant capacity. The result is an imbalance that causes the system to be inefficient and thus more expensive to operate.

Correct Imbalanced Pumping Systems

If the imbalance between the system's requirements and the actual (measured) discharge head and flow rate exceeds 20%, conduct a detailed review of your plant's pumping system. Calculate the imbalance as follows:

Imbalance (%) = $[(Q_{meas} \times H_{meas})/(Q_{req} \times H_{req}) - 1] \times 100\%$, where

Q_{meas}= measured flow rate, in gallons per minute (gpm)
H_{meas}= measured discharge head, in feet
Q_{req}= required flow rate, in gpm
H_{req}= required discharge head, in feet.

A pump may be incorrectly sized for current needs if it operates under throttled conditions, has a high bypass flow rate, or has a flow rate that varies more than 30% from its best efficiency point (BEP) flow rate. Such pumps can be prioritized for further analysis, according to the degree of imbalance or mismatch between actual and required conditions.

Energy-efficient solutions include using multiple pumps, adding smaller auxiliary (pony) pumps, trimming impellers, or adding a variable-speed drive. In some cases, it may be practical to replace an electric motor with a slower, synchronous-speed

motor—e.g., using a motor that runs at 1,200 revolutions per minute (rpm) rather than one that runs at 1,800 rpm.

Conduct quick reviews like this periodically. Especially for multipump systems, this can be a convenient way to identify opportunities to optimize a system at little or no cost.

One 3,500-gpm pump is therefore replaced with a new 1,250-gpm pump designed to have the same discharge head as the original unit. Although the new pump requires only 50 bhp, it meets the plant's chilled water requirements most of the year (in all but the summer months). The older pump now operates only in the summer.

Assuming continuous operation with an efficiency (η_m) of 93% for both motors, we can calculate the energy savings from operating the smaller pump as follows:

Savings = (200 hp – 50 hp)/η_m x 0.746 kW/hp x (9 months/12 months) x 8,768 hours/year

+ 790,520 kWh/year

At an average energy cost of 5 cents per kWh, annual savings would be about $39,525.

References

Variable,=Speed Pumping: A Guide to Successful Applications, Hydraulic Institute and Europump (www.pumps.org), 2004.

Conduct an In-Plant Pump Survey, DOE Pumping Systems Tip Sheet, 2005.

Trim or Replace Impellers on Oversized Pumps, DOE Pumping Systems Tip Sheet, 2005.

Optimize Parallel Pumping Systems, DOE Pumping Systems Tip Sheet, 2005.

Adjustable Speed Pumping Applications, DOE Pumping Systems Tip Sheet, 2005.

RESOURCES

Hydraulic Institute (HI). Hydraulic Institute, the largest association of pump producers in North America, serves member companies and pump users worldwide by developing comprehensive industry standards, expanding knowledge by providing education and training, and serving as a forum for the exchange of industry information. In addition to the ANSI/HI pump standards, HI has a variety of resources for pump users and specifiers, including Pump LCC and VSP guidebooks, "7 Ways To Save Energy" training program and more. To download FREE executive summaries of HI's "Pump Life Cycle Costs", "Variable Speed Pumping", and an index to ANSI/HI Standards, visit www.Pumps.org and www.PumpLearning.org.

Pump Systems Matter™ (PSM). Developed by the Hydraulic Institute, PSM is an educational initiative created to assist North American pump users gain a more competitive business advantage through strategic, broad-based energy management and pump system performance optimization. PSM's mission is to provide end-users, engineering consultants and pump suppliers with tools and collaborative opportunities to integrate pump system performance optimization and efficient energy management practices into normal business operations.

PSM is seeking the active support and involvement of energy efficiency organizations, utilities, pump users, consulting engineering firms, government agencies, and other associations. For more information on PSM, to become a sponsor, or to download PSM's *FREE Pump System Improvement Modeling Tool*™ (PSIM), an educational tool designed to show pump systems engineers how modeling tools can reduce cost and conserve energy, visit www.PumpSystemsMatter.org.

U.S. Department of Energy (DOE). DOE's Industrial Technologies Program (ITP), through partnerships with industry, government, and non-governmental organizations, develops and delivers advanced energy efficiency, renewable energy, and pollution prevention technologies for industrial applications. ITP has launched the **Save Energy Now** initiative to help the nation's manufacturing facilities continue to thrive during a time of diminished energy supplies and rising costs. As a part of this initiative, ITP is sending DOE Energy Experts to the nation's most energy-intensive manufacturing facilities to conduct 200 Energy Savings Assessments. See www.eere.energy.gov/industry for additional information on DOE's energy efficiency activities.

BestPractices emphasizes opportunities for savings in plant systems such as motor, steam, compressed air, and process heating systems. BestPractices is a part of the Industrial Technologies Program, and offers a variety of resources addressing ways to reduce energy and maintenance costs in industrial process systems. This includes training workshops, software tools, a series of sourcebooks, case studies, tip sheets, and other materials, including several which focus on opportunities in pumping systems. For example, the Pumping System Assessment Tool (PSAT) aids in the assessment of pumping system efficiency and estimating energy and cost savings.

For more information, please contact: EERE Information Center; 1-877-EERE-INF (1-877-337-3463); www.eere.energy.gov/industry/bestpractices.