MOTOR SYSTEM MANAGEMENT TECHNIQUES

Major opportunities exist by correctly selecting components to reduce pressure drop.

Some general motor system management techniques and options, which can achieve significant energy savings while satisfying all process requirements, are described below:

GENERAL TECHNIQUE NO. 1:

Speed Modulation

Many systems operate with varying load requirements using throttling methods to control flow. Other methods of control include recirculation, venting and using relief valves. These traditional methods require that the machine run at one constant speed near full load; energy is wasted by dissipating it across control mechanisms. Recirculation wastes energy by maintaining a constant rate of energy consumption while the system provides no useful work to the process. Speed control offers an excellent opportunity to save energy by matching the speed of the equipment to the actual process requirements. In many fan, pump and compressor systems, power requirements vary with the cube of the flow. Flow varies directly with speed, so a 20%reduction in speed will result in approximately 50%savings in energy.

Speed modulation is accomplished in two ways:

- directly varying the speed of the motor; and
- using a fixed speed motor with adjustable power transmission systems.

Some systems require a wide range of operating points, so selecting an adjustable speed drive may be appropriate. These drives provide a number of advantages in addition to energy savings, including:

- precise process control;
- increased equipment life;
- soft starting; and
- regenerative braking.

Multi-speed motors are commonly used in applications requiring only a few discrete points of operation. They are less expensive than adjustable speed drive motors and are available in two, three and four speeds.

Application Considerations

- Speed modulation is particularly effective in variable torque loads.
- Avoid operating at resonant frequencies and lock out unstable machine operating ranges.
- At slow speeds, external cooling or separate lubrication systems may be required.

GENERAL TECHNIQUE NO. 2:

Equipment Sizing

Re-evaluate systems that are operating against partially closed throttling devices. Reduce energy use by resizing the entire machine or retrofitting internals such as impellers and then opening dampers and valves. Impeller resizing reduces the horsepower requirement of the equipment resulting in energy savings. Correct trimming of the impeller allows the system to provide all of the process requirements without operating in a throttled condition.

Application Considerations

- Resizing provides a permanent system de-rating.
- Equipment sizing is not suitable if additional capacity is occasionally needed.

GENERAL TECHNIQUE NO. 3:

Booster Applications

Systems that need temporary excess capacity can make use of a booster arrangement. A booster is a fan, pump or compressor that supplements systems that serve processes that have infrequent peaks or upset conditions. Primary equipment is sized to operate in the most efficient manner for normal operation; boosters come on line to serve periodic peaks. Frequently, systems encounter peak loads on startup and then, once the process has achieved equilibrium, the loads reduce.

Application Considerations

- Available space and cost may determine viability.
- The booster should run only intermittently.
- Because this control scheme works in steps, it is not as precise or efficient as speed modulation.

GENERAL TECHNIQUE NO. 4:

Equipment Upgrade

Upgrading turbomachines may save energy in the following areas:

- Modern more efficient equipment may be available to replace old designs.
- Processes and system requirements may have radically changed since the equipment was originally specified, requiring the turbomachine to be re-evaluated at the new point of operation.
- The system may benefit from a switch to HEMs.

Application Considerations

- Some higher efficiency impellers are not suitable for harsh environments.
- Consider replacing motors that are less than 50%loaded or those that have been rewound numerous times.
- Be aware of the possible higher speed of a HEM..

GENERAL TECHNIQUE NO. 5:

System Effect Factors

System effect factors are conditions that cause inefficient performance as a result of the system configuration. These conditions alter the machine 's performance characteristics so that it no longer performs at maximum efficiency. Energy is consumed to overcome flow resistance created by filters, dampers, silencers, coils, etc. Reducing the resistance of any component causing a pressure drop will require less power to produce the same flow. Other common factors include improper inlet connections and poorly designed discharge connections. Ensure components are clean and functioning properly.

GENERAL TECHNIQUE NO. 6:

Engine Drives

In some large motor applications, the use of reciprocating engines or gas turbines coupled directly to the load can provide significant benefits. These applications can be successful when there is a constraint on the electrical supply, the heat generated from the engines can be used in the process, and there is a cost-effective fuel source. These engines can also offer variable speed and over-speed capability for peaking loads of short duration. Engine packages offer a wide range of sizes, high-efficiency options and low emissions.

Application Considerations

- allows for a self-powered process and avoids upgrades to the electrical system
- can also be used for emergency backup power if coupled to a generator
- life-cycle analysis should consider fuel cost, capital cost, maintenance and heat value
- constant-duty engines have more robust components for longer life than standby units
- isolation switches should be installed when used in a standby generator application

GENERAL TECHNIQUE NO. 7:

Maintenance and Design

- Lubricants –Synthetic lubricants can be used to reduce frictional losses in gearboxes.
- Coatings – Frictional losses can be reduced by the use of various internal coatings and can also repair pitting and cavitation damage, thus further reducing losses.
- Running clearances – Maintaining equipment to specified tight-running clearances reduces leakage and bypass in various systems.
- Gear reducers –Converts a motor ’s high-speed, low-torque output to meet the low-speed, high torque required by the driven equipment.
- Worm gears –Inexpensive and simple to maintain. Efficiency varies with the turndown ratio, which can be as high as 94%for a 5:1 ratio and as low as 75%for a 40:1 reducer.
- Cycloidal gearsets –These have efficiencies higher than worm gears but slightly lower than helical designs. Each stage is capable of large ratios as high as 87:1.
- Helical gears –Gears have tooth faces on an angle to the shaft forming a helix. Efficiency depends on the number of stages to achieve desired speed, the type of bearings used, lubrication and quality of gear mesh.

A well-designed gear set can have an efficiency of up to 98%.

Reference:
http://www.oee.nrcan.gc.ca/infosource/pdfs/M92-165_1999E.pdf