Maximizing Electrical Investment:

The financial impact of motor selection

By Doug Post

In terms of energy budget items within your control to adjust, motor selection is perhaps the most obvious way to cut costs at a processing plant.

Did you know that the annual energy cost of running a motor is many times greater than its initial purchase price? For example, at a rate of 6-cents per kilowatt-hour, a typical 20-horsepower, continuous-running motor uses almost $9,000 worth of electricity annually, about nine times its initial purchase price.

As you can see, a small improvement in motor efficiency can dramatically reduce your energy costs. Replacing an old, standard efficiency 20-horsepower motor can immediately reduce your annual electricity cost to $8,000.

Two common motor selection mistakes keep many industrial clients from realizing great savings in motor operation costs.

One mistake is putting too much emphasis on initial cost when selecting motors. As you can tell from the figure, the purchase cost of a motor is insignificant when compared to the costs of operating that motor over time.

Over the past 15 years, motor efficiency has improved substantially. Today's energy efficient motors produce the same power but use less electricity due to superior construction materials and manufacturing practices. Replacing your old, pre-1993 motors with high-efficiency models results in reduced electrical operating costs of 5 percent to 15 percent, depending on motor size (small motors have the larger improvement.) With installation costs included, payback is usually achieved in less than 18 months at continuous process facilities.

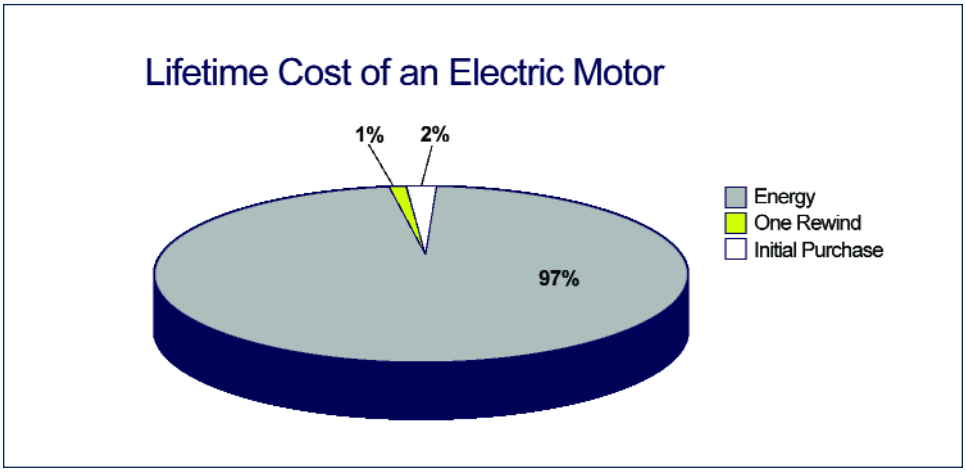
You must also choose between today's standard and high-efficiency motors. High-efficiency motors typically cost 15 percent to 30 percent more than their standard counterparts, but they typically reduce your electrical operating costs by up to 3 percent. This means that replacing worn-out motors with high-efficiency motors is the prudent thing to do since the higher purchase cost will be recovered in less than six months. Depending on your facility, it may also make sense to replace functioning standard-efficiency motors as well. (Note: many utilities offer rebates as high as 15 percent on the purchase of high-efficiency motors.)

Other benefits of high-efficiency motors include reduced electrical load and the resulting system capacity, reduced peak demand utility bill values, lower noise of operation, cooler motor operation (resulting in lower HVAC costs) and longer motor life.

A second mistake is to "play it safe" and select an oversized motor. In past decades, engineers and contractors selected motors using the notion that motor life would be prolonged and failures and downtime would be minimized if motors were selected to deliver only about 2/3 of their nameplate horsepower ratings.

What this did, however, was guarantee that not only was the motor operating very inefficiently, but it also caused the motors to operate at very lagging power factors.

Load factor is defined as the ratio of the actual amount of load a motor carries with respect to its rated full load carrying capacity. For example, if a 10-horsepower motor is operating a 4-horsepower load, it is operating at a load factor of 0.4 or 40 percent. However, motor energy efficiency is maximized at a 75 percent to 90 percent load factor and drops off dramati-



cally below 50 percent. This means oversized motors cost you in three ways: (1) increased purchase cost, (2) increased power factor penalty charges, and, most significantly, (3) decreased operating efficiency.

Over 40 percent of today's industrial motors are operating under 40 percent load factor. If your motors are running at levels less than 75 percent of their nameplate amps, consider a study to determine the payback on replacing this motor with a properly sized, high-efficiency motor.

An exhaustive report by the Department of Energy shows that only 15 to 22 percent of motor users are taking advantage of these significant opportunities to increase operating profits via good motor selection and sizing criteria.

ASDs & VFDs

Utilizing adjustable speed motor drives (ASDs or VFDs) can also increase your profits.

Variable torque loads such as centrifugal pumps and fans are the best candidates for energy saving VFD applications. Pumps and fans are often sized for worst-case conditions but usually operate at 30 percent of their rating.

Traditionally, these motors are operated at full speed and control valves or air dampers are utilized to control—or block—the extra output not required by the process.

Since power requirements for variable torque loads drop off by the cube of the speed decrease, a VFD can be used to decrease the motor speed so that only the needed energy is utilized. This results in significant savings whether you are considering a new pump or fan application, or contemplating a system retrofit.

For example, a typical pump application has a 100-horsepower motor operating a centrifugal pump 24-hours per day, 365 days per year. This requires about $27,500 worth of electricity per year, at 4 cents per kilowatt-hour. If the control valve is replaced with a VFD, the pump may require only 30 horsepower to operate the pump at half speed. This results in a savings of $12,500 per year. This is a payback of less than six months, and the energy savings continue thereafter.

The following Web sites offer more information on VFDs: www.drivesmag.com and www.oit.doe.gov/bestpractices/energymatters (and do a word search for ASDs). Learn more about motor efficiency at: www.oit.doe/gov/bestpractices/motors, www.nema.org, and www.motorsmatter.org. EP

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