# The Electrical Revolution

JOEL HANS, Associate Editor, Industrial Maintenance & Plant Operation (IMPO)

Those familiar to the world of electrically-driven systems in manufacturing facilities are likely aware of the reigning sentiment that the systems are the cause of an undue amount of global energy usage. Some estimate that electric motors and their associated components consume almost 50 percent of the total energy usage within the U.S. It’s a staggering number, and it’s partially inevitable, due to the inherent function of an electric motor, but many of the systems in use today are woefully inefficient. Thankfully, a combination of regulatory control and competitive innovation, manufacturers of electric motors, VFDs, and gearboxes -- along with all the other components to create a motorized “system” -- have pushed efficiency beyond what was previously thought possible.

Dean Neinhuis, Director of Marketing with Marathon Electric, explains the basics of the regulatory environment surrounding electrically-driven systems in recent history: “In the U.S., legislation went into effect in 1997, and that was called EPACT. In 2007, they passed the next version, which was known as EISA 2007. That legislation mandated the singular incremental jump in efficiency for motors between 0 and 200 horsepower.” EISA 2007 mandated what came to be called NEMA Premium electric motors, which forced manufacturers of electric motors to innovate and find new ways to squeeze the last bit of efficiency out of their products.

But more copper wire can only go so far. Simply adding more material to the inside of a motor can increase its efficiency, but manufacturers quickly ran into the principle of diminishing returns coupled with dramatically rising prices. Fortunately, these companies have innovated beyond the traditional copper-based construction. “If you were to … remove all of the copper out of the rotor, and instead put high-energy, rare-earth neodymium magnets into that rotor, now the rotor has magnetism standing still,” Neinhuis says. “All you have to do is get it moving in the right direction, and the rotor helps itself. That gives you the jump in efficiency. That is called a PMAC -- permanent magnet alternating current. They’re also sometimes called ‘brushless motors.’” These motors are made to comply with EISA 2007 standards.

Either way, John Malinowski, Senior Product Manager with Baldor Electric, says that it is important to look in the right places: “A user should look for the NEMA

Premium® logo for 1 to 500 HP three-phase motors to specify good efficiency levels. Single-phase motors should be avoided, if possible, as these are not as [efficient] as three-phase."

John Lytle, an application engineer for Grove Gear, points out that motors are not the only component in an electrically-driven system that are undergoing drastic improvements in efficiency. The gearbox is a critical piece of any system, and is often the culprit of major efficiency losses. Lytle explains, "In today's industrial environment, the most common form of right-angled speed reducers are inefficient worm gearboxer. This single component -- which can be less than 50 percent efficient -- plays a dramatic role in the overall efficiency of the power transmission system. Due to its contribution to the overall energy consumption of a system, highly-efficient gearing, like the Grove Gear E Series, is becoming a necessity. By utilizing helical-bevel gearing, these new systems can consistently transmit power at 90 percent across all ratios. Compounded with the fact that they are a drop-in replacement to multiple center distance worm gearboxes, they are an efficient solution that can bring dramatic benefits without hassle."

According to Neinhuis, in the "perfect world," all the components in an example system -- from the line, to the VFD, motor, gearbox, and more -- would have a 99 percent efficiency. After all the components are coupled together, that efficiency slides down to 94.2 percent, which is the best possible result, given the addition of each component's minute inefficiency. If even one component is lacking in efficiency -- for example, the gearbox, at 75 percent -- the overall efficiency of the system drops to a paltry 71.3 percent. Because of this accumulating drop in efficiency, it is critical for manufacturers to ensure that all components of their electrically-driven systems are as efficient as possible.

With this in mind, how does a manufacturer increase the efficiency of their electrically-driven systems? First, they can upgrade low-efficiency components for modern, high-efficiency ones, or they can eliminate components altogether.

Lytle claims that in many cases, it's better to replace a system's gearbox before even considering the motor. He says, "By replacing an inefficient gearbox, you can potentially save hundreds of dollars a year. Due to the more effective transmission of power, this action may also provide the opportunity to downsize the motor required, furthering energy savings."

The replacement can be as simple as dropping a new gearbox in, if you do your research and buy smart. A handful of gearbox companies are developing new systems -- such as the Grove Gear E-Series -- that can be ordered to seamlessly replace an older, inefficient worm gearbox system.

Marathon Electric, on the other hand, is hard at work developing new systems that aim to eliminate inefficient components altogether. By allowing motors to be more directly tied to the final component -- a conveyor, for example -- a significantly higher percentage of the input power is actually used for driving, and not wasted. Of course, these innovations would likely involve a more complete overhaul when compared to replacing a gearbox, for example, so each manufacturer needs to

weigh the cost and necessary downtime figures accordingly.

Baldor Electric, too, has been developing new systems that aim to increase the efficiency of electrically-driven cooling tower systems by eliminating conventional mechanical gear or belt drive speed reduction, and incorporating a variable speed control. With an already-efficient permanent magnet motor, the VS1CTD can help save manufacturers a great deal on the amount of energy required to keep their systems running.

By way of either component replacement or system overhaul, the act of upgrading old, inefficient systems allows any process to run more efficiently, which directly equates to a reduced power consumption. Capital purchases can achieve an ROI in months -- not years -- and engineers can simplify their systems to save time in future preventative and routine maintenance. If you’re mourning over your plant’s electric bill, it’s time to take an honest look at your electrically-driven systems -- they’re probably not nearly as efficient as you might think, or hope.

**Source URL (retrieved on *08/29/2014 - 12:39pm*):**
http://www.chem.info/articles/2011/04/electrical-revolution?qt-most_popular=1