Super premium efficiency WEG IE4 motors a zero premium route to optimum efficiency

Zest WEG is introducing WEG IE4 super premium efficiency motors into Southern Africa, at the same price as its premium efficiency IE3 range. For those wishing to improve on energy efficiency and save money, Fanie Steyn, manager for electric motors at Zest WEG, outlines why no other motor choice makes sense.

"In 2008/2009, when industry first started to look at improving the efficiency of electric motors, the IE2 was the highest efficiency motor available. These IE2 motors tended to increase the asynchronous motor speed by between 5.0 and 15 RPM, which in some systems, such as pumps and fans, adversely affected overall pump/fan system efficiency. As a result, IE2 motors were excluded from ESKOM's Demands Side Management (DSM) subsidy programmes of that time," Steyn begins.

"But things have changed significantly since then," he continues. "By carefully balancing the combination of active material and the inertia in the rotor, the asynchronous speed of both IE3 and IE4 motors has been returned to historic industry standards, which means that they are functionally compatible with lower efficiency equivalents and all the efficiency gains of the new IE4 motors will translate directly into cost and energy reductions in any installed system," he says.

As was done when Zest WEG first introduced WEG IE3 premium efficiency motors, WEG IE4 super premium units are being offered at a zero cost premium, meaning that all the energy savings that accrue will be of direct and immediate benefit to users. "There is absolutely no reason to favour an IE3 or an IE2 electric motor over a super premium efficiency WEG IE4 motor," Steyn notes.

Like the IE3 motors, the new IE4s will be available in the power range 45 to 355 kW. "In these power ranges, efficiency saving of between 1.0 and 3.0% can translate into massive cost savings over time. We do still offer IE1 motors. However, with IE4 prices remaining at IE3 and IE2 levels and with the premium between an IE1 and an IE4 motor being in the region of just 15%, this makes the payback and cost arguments compelling," he says.

WEG super premium efficiency IE4 motors are available in the power range 45 to 355 kW.

Using a new 110 kW IE4 motor and comparing it with a new IE1 motor, he says the initial capital costs are in the region of R86 000 and R75 000 respectively. "That puts the premium for buying an IE4 motor instead of the cheaper IE1 at about R11 000. When the energy costs are taken into account, however, the cost equations quickly swing in the other direction," Steyn tells *MechChem Africa*.

The annual cost to run a 110 kW motor continuously (8 760 hours/year), if it is drawing 100 kW of electrical power at an assumed cost of roughly R1:00/kWh, is in the region of R876 000: that is more than 10 times the initial cost of the more expensive IE4 motor.

Also, since the 110 kW WEG IE4 motor has an efficiency of 96.3%, which is 2.2% higher than the 110 kW WEG IE1 motor, the IE4 motor draws 97.8 kW of power from the grid, saving R19 200 every year. That means the R11 000 premium paid to buy the more expensive motor will be recovered in much less than a year (0.6 years), and a net gain of R8 200 will accrue by the end of the first year of use.

Over a 10 year period, this gain increases every year by a further R19 200/year, putting the total gain of buying an IE4 motor at R181 000 – and this assumes, unrealistically, that electricity prices will remain at R1:00/kWh for that entire period.

"This is simply an illustration – motors are seldom run continually for 10 years – but the trend is clear and we can point to several realistic scenarios to prove that buying an IE4 motor is almost always cheaper than saving a relatively small amount of money on the initial investment," argues Steyn.

Typical payback times to run a 110 kW IE4 super premium efficiency motor instead of a standard efficiency equivalent go from just over seven months (31 weeks) for a motor running 24/7, to just less than 22 months (94 weeks) if the motor is run for 12 hours a day for five days per week (3 120 hours/year). And if the motor is run for only 1 000 hours per year, equivalent to less than four hours per day for five days per week, the payback time on the 15% cost premium is still only 5.5 years.

Listing some of the additional improvements associated with super premium IE4 technology, Steyn notes that there is more active material in these motors – more copper and more lamination steel in the core of the motor – which reduces the stator resistance and iron/magnetic losses, while more precise machining of the air gap between the rotor and the stator reduces stray losses.

"The lamination steel now being used is quite special. In the past, any motor repair/rewind would have resulted in an efficiency loss of between 3% and 8%. The use of high silicon C4 lamination steel, which can withstand varnish burn-off temperatures as high as 500 °C, enables WEG IE4 motors to be repaired without this efficiency loss, making it possible to refurbish them to as-new OEM specifications," Steyn adds.

Lower losses translate into less heat generation, so these motors run cooler with a smaller fan in some cases. "A few useful tweaks have also been incorporated: a longer grease pipe on the drive end to make it easier to lubricate the front bearings without having to remove safety guards; and a removable gland plate for frame sizes of 280 and up makes it easier to disconnect and reconnect the power cable to the terminal box when removing and reinstalling a unit.

Reinforcing the WEG IE4's green credentials, a brighter green colour has also been adopted, Steyn notes.

The further advantages of using VSDs

As discussed above, the running speed of a system such as a pump or a fan, and to a lesser extent, a conveyor, directly affects the energy drawn by a motor and its running costs. As with all WEG motors, the speed can be accurately changed and controlled, depending on the immediate need, by using a variable speed drive (VSD).

"VSDs allow users to implement electronic and automated speed control on their systems, which on pumps, fans and compressors, avoids having to use strategies such as throttling, recirculating, venting or, for compressors in chillers and HVAC systems, using relief valves or switching the motor on and off to keep a system at its setpoint," Steyn explains.

A centrifugal pump driven by a WEG IE4 motor with a VSD can easily result in 15 to 30% energy savings.

Using a VSD enables motor speed to be controlled based on instantaneous demand, so the energy consumed far more closely matches the energy actually needed. "This can have a massive effect on the energy efficiency of a system, particularly if the requirements are continually changing," he adds.

For a pump system where throttling valves are used to regulate flow rate, for example, a VSD enables all valves to be fully opened to minimise losses, with the demand flow being controlled directly by a VSD that reduces the motor and pump speed. The resulting energy savings that accrue can be massive, often making the payback period for adding the VSD very short. "On a centrifugal pump, 15 to 30% energy savings are easily achievable on a system, and VSDs are becoming much more affordable compared to what they were," Steyn notes.

"Surprisingly, our farmers have been very quick to realise the potential of VSDs. Most irrigation pumps are oversized and installing a VSD removes the need to regularly adjust flow control valves. VSDs make the farmers' lives easier, reducing their monthly electricity bills and, often, reducing the peak demand tariff they have to pay," he points out.

Although not as dramatic, using a VSD on a conveyor system can also result in savings, where energy use will reduce in direct proportion to the belt's speed reduction.

Steyn assures that the same VSDs can be used on IE4 motors as for all other WEG asynchronous motors. "The only difference between an IE1 and an IE4 motor is that the inrush current might be higher when using super premium efficiency technology, although this is also the case for premium efficiency IE3s. So for direct online systems, a better suited breaker might be needed if upgrading from IE1 or IE2 technology to allow for this. This is a minor issue, however, and completely unnecessary if replacing an IE3 motor or if using a VSD, which gently ramps up the current at start up.

"Not only is the new WEG super premium efficiency IE4 motor more efficient than ever, it is also more robust and more serviceable. If basing motor investment decisions on true total costs of ownership, there is no better choice," Steyn concludes. ❑

In an industrial application, using WEG IE4 super premium efficiency motors can save an additional 1 to 3% on energy consumption.