Energy efficiency and beyond – The benefits of variable speed drives

Variable speed drives have been around for many years, but they are still breaking new ground and finding new uses throughout all sectors of industry. Matt Handley, Mitsubishi Electric's Product Manager for Drives and Low Voltage, considers the current hot buttons for drives.

Today, the three most important topics for drives are energy, energy and energy! After that you can list developing standalone drives systems, networking drives and servos, and integrating safety into drives as almost as significant.

Several years ago governments finally woke up to the fact that carbon emissions were getting critical and set about encouraging energy users to look for ways to cut their power demands. The tool they are using for this is basically tax. Details vary from country to country, but organisations that reduce their consumption stand to save significant amounts of money.

Drives are brilliant at saving energy. If you reduce the speed of a motor, it is possible in the majority of pump and fan applications to save energy proportional to either the square or cube (depending on the application) of the reduction. It may be that in a particular application you never need full speed and power, so a drive can trim output to a lower optimum level.

In other applications you may need full speed, but not all of the time. Sometimes half speed is appropriate, while at other times quarter speed is adequate. You can set a drive up to provide this sort of variable output, either on a timer or as a response to real-time sensor inputs.

And of course in some applications there may be the possibility of stopping the motor altogether for significant periods of time. Savings like that soon add up!

Another way of energy saving that is gaining in popularity is using a drive to regenerate power that would otherwise be wasted. Most applications have deceleration stages in their duty cycle – that is to say kinetic energy is removed from the moving load. Traditionally this is simply lost, perhaps through braking resistors or a mechanical brake. However a drive can capture this energy and feed it back into the mains, often leading to significant net energy savings.

Regeneration is also possible if a conveyor runs downhill, if an air or water flow is reduced, or if a load is lowered.

It is estimated that something like 66% of all industrial electricity generated is used to run motors which equates to about 25% of total UK consumption. A large percentage of these motors where speed or load could be varied are yet to be fitted with variable speed drives. So the potential for drives to make a significant contribution to carbon reduction is enormous.

But we also need to look at the operating efficiency of the motors. On the face of it motors are very efficient, but dig a little deeper and several issues come to light. Many motors are oversized for the job they are doing; swapping them for a smaller one will provide constant energy savings – and a drive can be used to 'beef up' output for those parts of the duty cycle where extra power is needed. Induction motors are the workhorses of industry, but in many cases switching to permanent magnet motors will pay handsome energy dividends, and again a drive will optimise energy usage.

Networking and precision motion

Discrete parts manufacturing, process control, building management… Nearly every technical system you can name is becoming more intelligent. Various parts of the system communicate with one another to optimise overall performance.

This requires that individual devices, such as drives, PLCs, HMIs, and sensors can send and receive data – and act intelligently on it. For instance, modern drives can receive a temperature signal and adjust the speed of a ventilation fan or water pump accordingly utilising built in PID controllers. Other drives may work with counters or timers to control parts production. A motion detector in a building's security system could work with a drive to close a shutter, turn down the air conditioning, open a car park gate, etc.

Modern drives are offering ever greater levels of motor shaft control and this is especially important when they are used in motion control applications. A good example of this is when they are networked together with servo drives over specialist high speed fibre optic networks such as SSCNet. The servos will control the high precision axes in the system, and they will be

communicating with the inverter drives on the general axes to improve overall system performance. It is worth noting that a top-of-the-range drive can enhance an industrial motor's dynamic performance to near servo capability, so is suitable for axes where some extra precision is required.

Standalone drive systems

A very interesting trend in drives engineering is the rise of standalone systems. The water industry, other utilities, agriculture, environmental monitoring, security and many other sectors are characterised by the fact that they often have systems that are physically remote from one another. Until a few years ago, accepted wisdom was to keep these as simple as possible.

However, attitudes are changing, driven partly by a desire to reduce their energy consumption and partly the need for remote interrogation. Drives play a major part in this offering a series of 'keep on running functions and drives designers are rising to the challenge of developing systems that can run intelligently but unattended for perhaps months at a time.

Integrated safety

The final trend that I would like to discuss is Safety. We all like to moan about it, but the truth is that when I was starting out as an apprentice (and it wasn't that long ago!), machinery could be dangerous to life and limb. You had to be constantly alert, be wary of any plant or machinery you went near and be ready to react if things went awry.

Physical guards and barriers improved safety, but they could compromise performance and take up a lot of valuable space.

Changes to the machinery directive have meant that machinery designers now have to design in more rigorous safety systems and carry out more in depth risk assessments. Inverter drives can be a key component in a machine and so the move for drive manufacturers to embed safety functionality into their drives has grown. This safety functionality is equally important if the machine is redesigned. Embedded safety features means it is possible to cut down on components and so reducing overall machine build costs.

I have worked with drives for most of my career, and their constantly developing capabilities mean I am still enthralled and surprised by them

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