

Energy efficiency

Saving energy with variable speed drives

Using a variable speed drive is one of the most effective ways to save energy, argues ABB's Jukka Tolvanen. While other energy-saving methods may shave singular percentage points off the overall consumption, a variable speed drive frequently can save 50% or more of the energy in applications that use pumps and fans.

Electric motors use two-thirds of all electricity in industry, so any chance to reduce this load, even by single figures, is highly significant. Offered the chance to cut energy consumption by up to half, industry ought to jump at the opportunity. Yet, variable speed drives (VSDs) are only installed in a minority of applications. The reasons often boil down to the fact that the people who design these applications are not the same people responsible for the energy bill. At the same time, those in charge of the energy bill, in most cases, are not engineers and are not aware of the benefits VSDs can offer.

How VSDs can help

Variable speed drives reduce the output of an application component, such as a pump or a fan, by controlling the speed of the motor, ensuring that it runs no faster than it needs to. When other control methods are used, the motor runs at full speed and the flow of the output is throttled; for instance, the flow through a pipeline may be reduced by a valve. This is wasteful, because the motor keeps running at its nominal speed regardless of the requirement. The pump delivers maximum output and the excess is reduced at the valve, where the surplus energy is wasted through friction.

The relationship between a pump's speed and its energy requirement is known as the cube

law, because the need for power increases with the cube of the speed. This means that a small increase in fan speed requires a lot more power, but also that a modest speed reduction can result in significant energy savings. A pump or a fan running at half speed consumes only one-eighth of the power compared to one running at full speed.



Food manufacturer Northern Foods in the UK is saving over £30,000 a year in electricity costs thanks to the installation of three ABB variable speed drives at its Riverside Bakery in Nottingham.

The problem of energy waste is made worse by the fact that many motors are oversized, using more energy than the application actually needs. This is because motors are only available with a certain number of fixed speeds. Users tend to fit the next bigger size relative to the requirement and then throttle the output.

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Normally, electric motors only have one speed; if you want a different speed, you must buy a different motor. Variable speed drives work by controlling the waveform of the current and voltage supplying the motor. The movement of the motor shaft can be adjusted with great accuracy, which ensures that the application gives the performance needed.

Life cycle costs

Many users favour traditional control methods because these methods are easy to implement and straightforward to understand.



Jukka Tolvanen, ABB's low voltage AC drives market manager for energy efficiency.

Many of those same users justify their approach by assuming that the cost of the wasted energy is less than that of buying a VSD. However, this is not true. Unlike many other energy-saving methods that may only reduce energy consumption by one or two percent, the significant savings produced by a VSD means payback is often achieved in a year or less. The application will then continue to make a significant contribution to energy savings, year after year, for as long as it remains in use.

In addition to the energy savings, a VSD delivers accurate control and produces less mechanical wear, which reduces maintenance and extends the life expectancy of the system. Payback is often less than six months on energy alone. Variable speed drives capable of all these savings can cost as little as €130 to buy.

Case study: £30,000 savings

Food manufacturer Northern Foods in the UK is saving over £30,000 a year in electricity costs thanks to the installation of three ABB drives on pumps at its Riverside Bakery in Nottingham.

The plant, which produces chilled pre-prepared foods for retailers such as Marks & Spencer and Sainsbury, uses large refrigeration units to store both the ingredients and the finished products. The refrigeration units are fed by cooling water pumped by three, 75 kW motors.

Soft-start control panels have been used to control the motors since the plant was built 22 years ago, but as part of a wide-ranging energy saving plan, Northern Foods was keen to find a way to improve the energy efficiency of the pumping system.

Inverter Drive Systems, an ABB Drives Alliance partner, conducted a preliminary energy survey of the motors. Once the project had been agreed to with Northern Foods, Inverter Drive Systems removed the existing soft-start control panels and supplied three 55 kW ABB industrial drives in control panels.

Also supplied by Inverter Drive Systems was a 4-20 mA analogue temperature sensor connected to the inverters integral proportional-integral-derivative (PID) controller, which uses the return temperature of the chilled water as its feedback signal. When the plant is working hard, the requirement for chilled water increases and the pumps run faster. When the plant is idling at weekends and holidays, the pumps run at a minimum speed, as the return temperature of the chilled water is already cool.

Inverter Drive Systems also performed post-installation energy monitoring. Average power reduction was found to be 65% per pump. Energy consumption had been cut by 769 MW/h per year, saving 338 tonnes of CO₂. The drives had reduced the company's electricity bill by £30,000 annually, with a payback time of just 10 months.

In addition to the energy saving benefits, the system also provides accurate control of the chilled water temperature to the plant.

Energy audit

In order for a company to reduce energy costs, it first needs to evaluate how it uses energy. An energy appraisal is a systematic examination of key pump and fan applications that includes the monitoring of energy consumed both before and after the change to VSDs.

The audit defines where energy can be saved and quantifies how much energy can be saved with the installation of VSDs. These figures are then translated into a possible monthly saving, the amount of money that will be saved, in energy bills alone, if the equipment is installed.

It is not unusual for users to dismiss the promise of 50% energy savings on a 20% speed reduction as the exaggerated claims of a manufacturer. However, the savings can be verified and the best way to start is with an energy survey. This will show the potential savings in black and white, enabling you to make the decisions that bring your company improved profitability. ■



ABB offers one of the world's most extensive low voltage AC drives ranges, the majority of which are used on pump and fan applications.

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