Variable-speed drives save energy and improve air quality

submitted by the Australian National Team

An air compressor with a variable-speed drive has meant impressive savings for the Australian company Electronik Fabric Makers. Apart from the energy savings, which are produced by matching fluctuations in air demand by varying the motor speed and air output, the new compressor has also reduced the moisture content of the compressed air to almost zero. Along with other features of the installation, this has substantially reduced maintenance costs and downtime on manufacturing lines.

Introduction

When the company bought a new knitting machine in 1997, this seemed a good opportunity to rethink the compressed air supply to the plant. It was possible that the existing installation of two screw compressors (15 kW, 38 l/s and 30kW, 79.3 l/s) would not be able to cope with the additional demand for air. The compressors were also operating at the upper limit of the electrical power supply to the site, and adding a third compressor to the system would have required an expensive upgrade.

As often happens at small to medium-sized plants, the compressors at Electronik were not operating at optimum efficiency. Load demand in the plant fluctuates between about 40% of full production capacity, up to about 90% at times of heavy demand. As electric motors are most efficient when run at full-load, this meant that savings in power consumption could not be realised due to periods of low demand.

In order to overcome these difficulties, the two compressors were replaced with a single oil-injected rotary-screw compressor fitted with a variable-speed drive. Capable of 149 l/s at 7 bar, the 50 kW compressor now supplies all the compressed air requirements at the plant.

Variable-speed drives

The concept of matching motor speed to power demand has perhaps been one of the most broadly applied and successful innovations in motor technology in recent years. When coupled with compressed air, an area where substantial savings can still be made across industry sectors, a compressor unit with a variable-speed drive (VSD) can mean significant energy reductions to small and medium-sized businesses - up to 35% in some cases. The savings are most effective where there are large fluctuations in compressed air loads and standard compressors therefore run at part-load for a large proportion of the time.

In broad terms, VSDs respond to the fluctuations in air demand by matching the motor speed and the air output. When the demand for compressed air falls, the motor speed is adjusted to a level that is correct for the air output required. The electricity consumption is also reduced as the motor speed falls.

In contrast, most standard screw compressors (regulated by modulation) vary the air output by throttling the inlet valve down to 50% capacity. This results in a considerable drop in pressure over the inlet valve, which increases the pressure ratio over the screw compressor element. Power consumption therefore stays above 85%, rather than dropping to a lower rate in line with consumption needs.

Screw compressors that run on a load/no-load cycle function efficiently as long as they run at full-load. When the air demand falls, the compressor switches to no-load. The inlet valve closes completely, the internal pressure is blown off and stabilises at a minimum level after 60-90 seconds. Once the no-load running condition has stabilised the air output is 0%, but power consumption stays at 25% of full-load levels.

Effectively this means that screw or rotary vane compressors cannot take full advantage of the savings that could be made from changes in air demand.

Quality of air supply

An improvement in the quality of the compressed air supply has been a

welcome side effect of the new installation. The company produces high-quality fabric with intricate patterns and designs, and uses state-of-the-art electronic knitting machines, capable of producing the high level of quality and design complexity required. The compressed air supply is used to direct a constant supply of lubricating oil in a fine mist spray to the needles, and any water accumulating in the air supply can cause stoppages or damage.

The compressed air supply also powers handheld cleaning nozzles, which clean lint and fluff from knitting machines and the knitting room. The air supply to the nozzles also needs to be of extremely high quality.

Performance data

The VSD air compressor was installed in June 1997, and has since provided all the compressed air required by the plant. Since installation, power consumption at the plant has been significantly reduced, with energy cost savings of around AUD 7,000 per year in financial terms.

The savings in maintenance and downtime for the plant have also been considerable. The previous screw compressors required a large quantity of oil to make them function correctly. The new VSD compressor saves somewhere between AUD 300 and AUD 600 per month on oil costs.

Other savings have been achieved by the higher quality of the air produced. Prior to the new system, where the moisture content of the compressed air is almost zero, the water outlet in the old installation had to be emptied every three days, and there were production delays as the knitting needles were damaged by moisture in the oil. The reduced water content is the result of the improved compression system.

Conclusion

The new compressed air system clearly shows the benefits of variable-speed drives in small to medium-sized plants, where changing the motor speed of the compressor can make the most of the savings available from changes in demand. Where an existing compressed air system requires expensive maintenance, a retrofit incorporating a VSD can potentially provide an attractive payback.

For further information please contact the Australian National Team (address on back cover).