CADDET energy efficiency IEA OECD

UK 00.514/2C.F00

Variable speed drive compressor saves energy

Variable speed drive compressor reduces costs and energy usage

Summary

Lewis and Towers Ltd, a UK manufacturer of specialist glass containers, decided to replace their obsolete and inefficient fixed-speed compressors with a combination of modern variable speed drive (VSD) and fixed-speed models. The project showed that, on sites with more than one compressor, a combination of fixed and variable speed compressors could reduce energy usage. One VSD compressor can be used to top-up supplies, leaving the fixed speed compressors to provide the base load. The viability of using VSD compressors is heavily influenced by average loads, with VSDs most applicable to sites that have occasional peaks in demand.

Highlights

- **Annual savings of GBP 3,500**
- **Possible payback of under two years**
- **Precise pressure control**

Energy efficiency using variable speed control.

Aim of Project

Lewis and Towers produce specialist glass containers, ranging from 30 ml pill bottles to 5 litre containers for chemical storage. A reliable source of compressed air is essential to the bottle blowing process and a decision was made by the company to make improvements to their compressed air system. The objectives of this project were to obtain more precise pressure control, reduce the cost of providing compressed air to the site and save energy.

The Principle

The company has a central compressor house from which air is distributed around the factory. However, analysis of the supply suggested a number of problems:

- obsolete and unreliable compressors;
- ineffective air dryer allowing carry-over of water with the compressed air;
- under-sized main distribution pipework, leading to unstable and sometimes inadequate pressure for production.

Their original intention was to install four fixed speed rotary screw compressors. However, one supplier proposed the use of a VSD compressor in place of one of the fixed speed machines. Whilst the VSD compressor would be, initially, more expensive, it was projected that the extra cost would be quickly recouped through reduced electricity consumption. Lewis and Towers decided to adopt the recommended configuration of one variable speed and three fixed speed compressors.

The Situation

The company decided to replace the air dryer and key sections of the distribution main, and to install a combination of VSD and fixed-speed compressors.

Previously, the methods used to vary the output of the fixed speed compressors were fairly basic. They could either be switched on or off (that is, delivering full air output or zero air output), or capacity could be regulated by a motorised valve, which restricted the amount of air drawn through the inlet. Both of these techniques were inefficient, with up to 65% of full load power being consumed, even when no air was being produced.

However, the VSD compressor offered improved energy efficiency, as the relationship between air delivered and power consumed is nearly linear. In addition, the VSD-type enabled closer control of output pressure and this offered operability benefits and provided an additional energy saving of between 2 - 4%.

The relationships between the air delivered and the power consumed for the three methods of regulation are shown in Figure 1. This shows that, although a VSD compressor consumes slightly more power than a fixed speed machine at high loads (due to

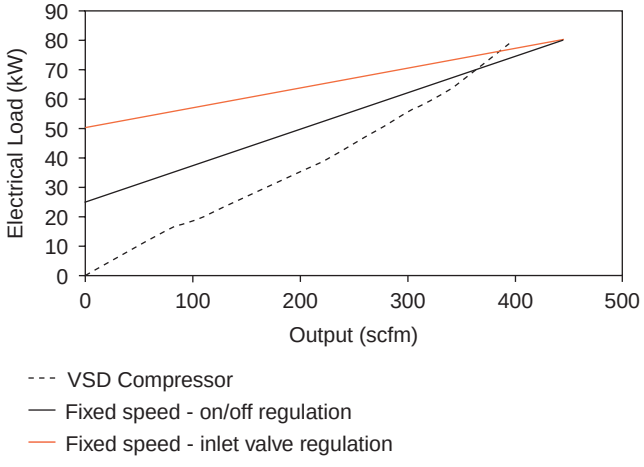

Figure 1: Comparison of compressor performance.

electrical losses in the variable speed drive), it is much more efficient under all other conditions.

The project has demonstrated that, on sites where more than one compressor is required, only one VSD type is needed. Fixed speed compressors, which are cheaper and more efficient at full load, should be used to provide a base load, leaving the VSD machine to 'top up' the load as demand changes.

The air demand at Lewis & Towers is predictable and can be generally met by two to three units. Consequently, the company is able to adopt a very simple control strategy, with two fixed speed compressors set to start on-load when system air pressure falls below 6 barg and to go off-load when it rises above 6.4 barg. The VSD compressor is set to control at 5.6 barg, which is the required system operating pressure. This arrangement ensures that the fixed speed compressors run continuously at full load, leaving the VSD machine to modulate. The third fixed speed compressor is usually left off-line for standby purposes.

In applications with more variable air demands, it will be necessary to install a sequence controller to step successive fixed speed compressors in or out of service. This will help to maintain the VSD machine within its modulating range.

The Company

Lewis and Towers Ltd are located in Edenbridge, Kent. The company manufacture specialist glass containers, ranging from 30 ml pill bottles to 5 litre containers for chemical storage. The wide range of items necessitates many small batch runs, with process changes occurring daily.

Generally, bottle blowing requires a reliable source of compressed air and the company's diverse product range leads to significant variations in air demand.

Economics

The results show that the viability of a VSD compressor is heavily influenced by its average load. As a result, VSD compressors are likely to be most applicable on sites which have occasional peaks in air demand, but which, normally, have much lower loads. They can also be useful for providing flexibility for any future expansion in air demand, without incurring the low load inefficiencies normally associated with an over-sized plant.

During this project, one of the fixed speed compressors was found to be faulty. After making adjustments for its performance, the combination of VSD and fixed speed compressors is estimated to have saved the company around 83,100 kWh/year, worth approximately GBP 3,530/year. This gives a payback period of 1.7 years on the capital investment of GBP 6,000.

Lewis and Towers have found that their VSD compressor is reliable and requires no more maintenance than fixed-speed machines. As this case study shows, a good understanding of the site's compressed air demand is important when assessing the viability of using a VSD compressor.

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* IEA: International Energy Agency
OECD: Organisation for Economic Co-operation and Development

IEA

The IEA was established in 1974 within the framework of the OECD to implement an International Energy Programme. A basic aim of the IEA is to foster co-operation among the 24 IEA Participating Countries to increase energy security through energy conservation, development of alternative energy sources, new energy technology, and research and development (R&D).

This is achieved, in part, through a programme of energy technology and R&D collaboration currently within the framework of 40 Implementing Agreements, containing a total of over 70 separate collaboration projects.

The Scheme

CADDET functions as the IEA Centre for Analysis and Dissemination of Demonstrated Energy Technologies. Currently, the Energy Efficiency programme is active in 11 member countries and the European Commission.

This project can now be repeated in CADDET Energy Efficiency member countries. Parties interested in adopting this process can contact their National Team or CADDET Energy Efficiency.

Demonstrations are a vital link between R&D or pilot studies and the end-use market. Projects are published as a CADDET Energy Efficiency 'Demo' or 'Result' respectively, for ongoing and finalised projects.

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