



Taming the beast

With applications for industrial compressors expanding, their demand for energy has reached unnecessarily dizzying levels. Brian Tinham and Brian Wall look at how to put the beast back in its cage

Natural selection

So how exactly should you set about selecting new compressed air equipment? “Specifiers should always consider that the initial purchase price makes up a very small fraction of the total lifetime costs of the equipment,” cautions Andy Jones, general manager of Mattei. “The energy efficiency of the product must be assessed, as the electrical running costs can typically account for 75% of the cost of ownership over five years.

“It’s also important to remember that the efficiency of any compressor is largely dependent on the way it’s installed and where it’s sited. One of the other main considerations should be air flow into the compressor. It needs to be unrestricted, cool, reasonably clean, and free from solid and gaseous impurities. The distance between the compressor and where the compressed air is used can have important implications, too. Meanwhile, pipes should be suitably sized for the air delivery capacity, with bends kept to an absolute minimum.”

All good, solid stuff – and a proper maintenance programme is also key. “A poorly maintained compressed air system will not run as efficiently as it should,” insists Jones. “So, ultimately, running costs and carbon emissions will increase. As well as checking the compressor, filters and any dryers regularly, it’s also important to assess the pipework.”

Industrial compressors are hungry beasts. They consume close to 20% of electrical energy generated worldwide. Take the US: in the summer months, air-conditioning and refrigeration units devour almost a quarter of the nation’s energy production. Meanwhile, compressors are commonplace throughout industry, on process plants every bit as much as factories – all the way out to compressing helium and hydrogen in cryogenic loops for the Large Hadron Collider.

Clearly, improving efficiency is paramount, if consumption and costs aren’t to get out of hand. There are bright spots in this dark picture. One is in City University London’s Centre for Positive Displacement Compressor Technology. This engineering hub – established at the School of Engineering and Mathematical Sciences 17 years ago to assist in the manufacture of screw compressors – has majored on energy efficiency.



The centre was initially funded by the Royal Academy of Engineering and machine tools manufacturer Holroyd. Then, in 2008, it started collaborating with Glasgow-based Howden Compressors, which led to new methods and tools for compressor design and eventually an R&D partnership under Professor Ahmed Kovacevic.

'N' rotor profile

In 2009, the team rolled out four initial projects worth just under £2.5 million. Commercialising some of these enabled Howden to double its turnover last year and increase employment by 30%. Just as important, from a technology perspective, Kovacevic put City's patented 'N' rotor profile into operation on Howden's largest screw compressor – achieving greater flow area, less leakage, reduced internal friction and greater lobe strength, without changing the unit's overall design.

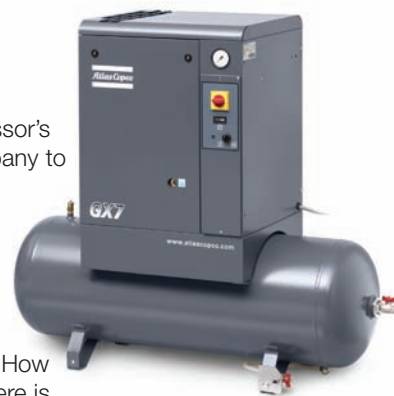
Claims for the 'N' rotor profile include up to 6.5% increase in capacity and a reduction in specific power of 2–2.5%, compared with other rotors of the same size, and compressor speed and inlet and outlet pressures. Indeed, Howden

managed to increase its WRV510A compressor's capacity and efficiency enough for the company to secure a major coal-bed methane (CBM) contract in Australia.

Meanwhile, although pioneering work, as carried out by such R&D initiatives, is vital, so is increasing the adoption of variable speed drive (VSD) technology – particularly on applications with unpredictable demand. How vital? Very: recent research suggests that there is much more scope for implementing VSDs on compressor systems and that industry is losing out massively on energy savings, as well as carbon emissions mitigation.

As Paul Clark, business line manager, Industrial Air Division, Atlas Copco Compressors, puts it: "Research carried out by The Carbon Trust found that UK businesses could make annual savings of over £630 million, simply by using more efficient electric motors and variable speed drives... With around 10% of all electricity in industry attributable to compressed air applications, the potential savings are highly compelling."

His company offers weighty figures to back up this assertion – notably that UK plants will save a



Left: Butchers Pet Care says its new CompAir compressor system is maximising efficiency and minimising energy waste

Above: A tank-mounted Atlas Copco GX7 compressor

Right first time

All too often, compressors are incorrectly specified, agree the experts. Andy Jones, general manager of Mattei, cites a case in point: "We recently found a company running a 75kW compressor that could actually fulfil its compressed air requirements with a 45kW machine. Estimated savings would be in the region of £12,000 a year."

And, as he says, new equipment will almost certainly result in energy savings – but savings won't be maximised, if the kit is just upgraded on a like-for-like basis.

Make sure you use the right technology, urges CompAir's Richard Hilton: "For example, if your application demands the highest quality air, you should specify an oil-free compressor to eliminate the risk of contamination."

Correct specification should also extend to location. Some compressors can be sited close to production lines, but not all. Check out the noise implications on nearby workers.

Heat recovery

All the experts agree that heat recovery can be a valuable sideline and energy-saving exercise to compressor use – the heat can be used for either water or space. "Most of the electrical power used by a screw compressor is transformed into heat, but up to 94% of compressor-generated heat can be recovered, rather than wasted," explains Sean Fairest of Atlas Copco Compressors.

A well-planned investment in energy recovery can provide a payback within one to three years, he states. Heat from a water-cooled, oil-injected compressor can be recovered as hot water, for example. "Connecting it to a heating boiler's return circuit helps reduce heating costs of washroom supply, radiators and process operations. In the case of air-cooled compressors, the hot air can also be ducted for direct space heating."

All well and good. The only caveat: Andy Jones, general manager of Mattei, reminds plant engineers that location is an important consideration: "If the hot water is used some considerable distance away across the other side of the factory [or plant] to where the compressor is sited, it probably isn't going to be efficient."

Butchers Pet Care improves efficiency with CompAir plant

Family-run pet food manufacturer Butchers Pet Care, which recently moved its Northamptonshire-based operations to a new plant, says its new CompAir compressor system is maximising efficiency and minimising energy waste.

“The new plant gave Butchers the opportunity to install a more comprehensive, energy-saving system, with increased reliability,” states Laurence Dawson, senior projects manager. “At the previous facility, numerous smaller compressors were installed across the plant... The compressors were from a variety of manufacturers, with a range of models, and did not provide the best energy efficiency,” he explains.

The new compressor plant is being used to power everything from moving can gates to pistons and cylinders on the new production lines. It is also used to prevent can deformation while pet food is cooked and then cooled within the can as part of the sterilising process.

In brief, two CompAir L90 fixed-speed compressors have been installed to operate as duty/stand-by machines. An L75RS regulated-speed compressor has also been installed to flatten peaks in air demand.

Dawson says this mix of fixed- and regulated-speed compressors ensures optimum efficiency, while providing consistent flow.

Oil-free compressors provide purity and energy savings for Princes Gate

Princes Gate Spring Water says it has achieved “significant” energy savings, as well as production improvements, at its Wales bottling plant by replacing the oil-lubricated compressor installation with Atlas Copco oil-free machines.

The company’s Narberth, Pembrokeshire plant bottles spring water and production requires a constant 108 l/s supply of high quality compressed air at 7bar for the line’s low-pressure air users, which include air cylinders, manifolds, filling equipment and inking machines.

According to Endaf Edwards, Princes Gate’s operations director, the company’s decision to install Atlas Copco oil-free compressors – a ZT37 VSD and a ZT18 – together with new AIRnet pipework, was influenced by the need to ensure optimum air quality and product purity.

Atlas Copco’s process air complies with the standard of air purity, ISO 8573-1(2001) and also the Class 0 industry standard, which measures all three forms of oil contamination: aerosol, vapour and liquid.

What’s more, the integrated frequency converter, which varies the speed of the drive motor to follow compressed air demand, minimises energy – saving Princes Gate up to 35% in costs.

“The Atlas Copco equipment is proving to be very efficient,” comments Edwards. “It produces the 100% oil-free, high-quality, dry air we need and is extremely reliable. In our view, the installation was carried out very professionally and we have no hesitation in recommending Atlas Copco’s equipment.”

massive 16.5 million kWh of energy in 2012 (based on a typical 25% saving, compared to a fixed speed compressor, and 4,000 running hours per annum), as a result of using its energy-efficient VSD compressor technology alone. “That is enough electricity to power 5,000 homes in the UK for a year,” states Clark. And when viewed in terms of CO₂ emissions, the figures are equally impressive, equating to nearly 9 million kg of CO₂ saved.

Why, then, are plant engineers who may be specifying new or replacement compressors still

largely not beating a path to the doors of VSD manufacturers? Hard to believe, perhaps, but one reason appears to be a plain lack of knowledge. Further, in some cases, engineers and technicians, and their managers, are simply not aware – or concerned about – currently wasted energy and the savings that can be made.

But there is another reason: It’s not the case that variable speed drives are right for everyone, says Andy Jones, general manager of Mattei.

“Sometimes, we find a company is running a variable speed compressor when a fixed-speed machine would be better. In recent years, variable speed compressors have been seen as a key way to reduce energy consumption... but they aren’t right for everyone.”

VSDs will only save energy, if there are real peaks and troughs in air demand – and then only if variations fall within the efficient working band of the compressor. “This sounds obvious, but it’s surprising how many [VSDs] are installed in workplaces with constant demands or where air demand lies outside of the compressor’s most efficient working range,” states Jones.

Monitoring services

In the right environment, however, variable speed compressors can benefit performance and the bottom line. “An energy audit of a compressed air system can identify potential savings and energy monitoring services very quickly,” comments Atlas Copco’s Clark (pictured above). “Atlas Copco has a detailed survey tool that provides an in-depth analysis of any system, with an overlay of how a VSD replacement would operate, saving operators money and reducing their carbon footprint.”

“Variable speed drives are particularly suited to many compressed air applications,” he says, “because of their ability to boost compressor performance by matching air supply to air demand most efficiently. In 80% of all compressed air installations, air demand shows fluctuations, which can prove costly, if compressors are constantly operating at high capacity or over-pressure,” he explains.

“The key point about a VSD compressor is that its integrated frequency converter can cut the cost of compressed air energy by up to 35%, compared to conventional compressors, with savings of 25% common.” **PE**

