

A technical revolution?

Mark Ranger takes a look at evolution and revolution in lower pressure air and rough vacuum generation.

Of all the energy utilities available to industry, the production of compressed air and of vacuum generation represent two of the largest opportunities for increasing productivity while achieving significant energy and carbon savings on any process site. That is why the compressed air industry is continually seeking innovative solutions and developing technology that can deliver the optimum levels of reliability, performance and energy efficiency for a wide spectrum of applications.

The success of this endeavour is clearly demonstrated in the latest development of low pressure compressed air systems below 4 bar. In parallel with this, rough vacuum pumps have evolved to share an air movement synergy – a breakthrough that is not far short of a technical revolution in comparison to traditional equipment principles and practice.

Low pressure no longer means high costs

While there are many rotary and centrifugal compressor options available to industry, dependent upon the low pressure application, the most ubiquitous is probably the lobe type blower.

In less demanding times, the means of providing a supply of low pressure air for duties such as water treatment aeration, pneumatic conveying and other industry applications required relatively simple and unsophisticated equipment. The limitations of traditional lobe blower design in terms of reliability and performance were accepted, even for the most critical applications, because there were few alternatives available at the time.

However, low pressure applications invariably involve fluctuations in air demand for the process need. In the case of conventional lobe blowers, when demand falls, the operator's most likely response is supply turndown, which proves highly



uneconomic in terms of energy efficiency. These penalties are even more evident in the case of materials conveying processes. It is not uncommon to rely on 7 bar plant air and utilise a control unit to limit the conveyor system air to 1 bar pressure, in order to overcome blockage and flow problems.

Thankfully, both obstacles have been overcome by modern blowers utilising rotary screw technology. These are capable of operating from 100% capacity down to 25% with very little change in their specific power requirements, which is hugely beneficial in terms of reducing energy costs.

It is a proven fact that lobe blowers have to work harder because the delivered air is compressed externally and depends on back pressure from connected pipework in order to maintain the required air flow and pressure. What's more, resistance to internal

airflow can lead to substantial pressure drops and increased energy consumption. When you add transmission losses from traditional belt and pulley coupling of motor shaft and compression elements, there are further energy penalties to consider.

By comparison, oil-free positive displacement screw blowers represent a step change away from conventional techniques. Designed from the outset to meet today's carbon economy needs, they are on average 30 per cent more energy efficient than conventional lobe low-pressure solutions.

The full picture is a catalogue of comparative technical features and benefits that merit earnest consideration by progressive plant managers at the point of equipment replacement or site expansion decisions. It is a choice between a rudimentary workhorse and the efficiency



of state-of-the-art technology embodied in the design of modern screw blowers that integrate all individual components into a plug-and-play solution.

A new generation of vacuum pumps

Air movement provided by vacuum pumps is a vital component of many critical industry processes. Yet, while compressor solutions have progressed in terms of innovative technology, energy efficiency and control sophistication, the equipment used for rough vacuum duty has, until recently, suffered from under-development.

The technical similarities between the operating principles of compressors and the latest oil-sealed screw technology vacuum pumps mean that advanced companies view these two solutions as the ‘yin and yang’ of air movement. In practice, this synergy confers the benefits of improved operational efficiency, increased uptime and system integrity, plus the reward of long-term energy savings.

However, this consolidated thinking is not yet widespread. It is estimated that, on average, there may be one vacuum pump for every three compressors installed on a production site. The problem is that these vacuum pumps are often found to be operating at the minimum performance level and represent an uneconomic burden in terms of energy consumption. Ironically, they typically underperform compared with state-of-the-art compressors that are performing far more efficiently on the same site.

Now, major investment in the

development of new vacuum technology, carried out alongside production of world-leading compressed air solutions, has addressed this paradox. This work has culminated in the introduction of a new generation of robust rough vacuum pump systems manufactured to the same level of quality and reliability as those of compressors.

The latest vacuum pumps have been designed from the outset to consistently help production operators become more efficient by lowering the cost of ownership, increasing sustainable productivity and enhancing final product quality.

How are these advancements achieved? For a start, efficient, on-site vacuum in the operating pressure range 0.5 mbar(a) to 500 mbar(a) can be produced by oil-sealed rotary screw systems whereby two screw elements rotate at slow speeds, enabling the pump to run at a sound level as low as 69 dB(A).

Such silent operation allows installation close to the point of use, with the added benefit of minimum pipework connections and a corresponding reduction in energy losses resulting from pressure drop.

These units offer superior performance against benchmarked oil-sealed and dry vane vacuum pump technologies and, with variable speed drive options, can realise up to 50 per cent savings in energy costs compared with dry vane operating equivalents. As an added energy-saving bonus, there are facilities for process heat recovery from individual pump units.

There is also a close parallel

between the size and rating of vacuum pump drive motors and those of screw compressors. One distinct advantage of this is that such units fall within the boundaries of the BCAS uniformity of energy reporting initiative – a yardstick which does not apply to other types of vacuum drive systems. The commonality of motors, drive trains and components strengthens the case for maintenance programmes designed to cope equally effectively with compressors and vacuum pumps from the same manufacturer or service provider.

By looking at all air movement demands collectively, whether for compressed air or vacuum applications, plant operators can realise considerable improvement in terms of cost- and energy-efficiency, plant uptime and system integrity. What is more, rapid advances in energy-saving technologies promise even greater productivity benefits for the future.

Looking forward

Today's major advances in connectivity technology, enabling transmission of equipment performance data to a central point, have resulted in remote monitoring being adopted increasingly within manufacturing industries. This is particularly evident where a proactive approach to the servicing and maintenance of factory equipment and machinery is practised.

However, remote monitoring is more than just a watchful eye. The possibilities of smart, customisable, user-friendly and easily-installed solutions for data monitoring are clearly established now. Where compatible, compressors, central vacuum systems and individual machines can communicate with a company's engineering team, delivering crucial data to a mobile phone, smartphone, PC or tablet. So, whenever and wherever there is access to the internet, it is possible to display the information needed from machine alarms and faults to visualised representations of demand and load for complete site installations.

However, there are more advances to come. Remote monitoring is likely to become even more prevalent with the burgeoning Internet of Things, which promises to connect a vast array of devices, equipment, machines and people via the web, using multiple sensors to assess the performance, efficiency and condition of vital equipment both in real-time and in retrospect.