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The benefits of vane technology

The belief that vane compressors are outdated is unfounded, believes Andy Jones. They can still offer significant advantages over screw compressors, especially when it comes to energy efficiency

Screw compressors currently account for the majority of industrial compressed air installations, and there are undoubtedly more manufacturers making screw compressors than vane compressors – perhaps because the technology has been easier to replicate, and patents have been simpler to overcome. This has led to the common misconception that vane technology is the older, more outdated of the two.

While vane and screw compressors share some similar components and are designed to produce the same end result, the two technologies differ quite considerably. A vane compressor comprises a rotor with longitudinal slots, which house individual sliding vanes. The rotor is offset within a stator (a cylinder), in which it rotates. While the rotor turns on its axis, the vanes are pushed against the stator wall by centrifugal force, and the air is compressed.

Meanwhile, a screw compressor has two parallel rotors – a male and a female – which engage into each other. These two rotors intersect longitudinally with a critical minimal clearance and are in turn fitted into a stator. During rotation, the profiles mesh into each other, compressing the air.

Energy efficiency advantages

Vane machines can offer advantages in several important areas – namely energy efficiency, operating speeds, volumetric efficiency, and wear and maintenance.

For a compressor to work efficiently, it is essential for air leakage paths to be kept to an absolute minimum – because air lost during compression equals lost energy. Keeping internal leakages low increases the volumetric efficiency, and reduces the power required for a measured unit of delivered air.

In a vane compressor, internal air leakage is minimal. The vanes move freely in their slots but are always in contact with the internal surface of the stator (albeit not directly, due to lubrication). As a result, the air seal is nearly perfect. The clearances between the rotor, stator and end covers are also sealed by oil that is injected into the stator to lubricate the moving parts and to cool the air during compression.

Vane compressors can offer gains in energy efficiency and wear and maintenance

In comparison, screw compressors, by the very nature of their design, will have a 'blow hole', where the external profiles of the rotors meet. The air under high pressure returns to the area of lower pressure through this hole. Manufacturers of screw compressors have tried to reduce the 'blow hole' effect, but it is impossible to eliminate it completely.

To compensate for these air leakage paths, screw compressors need to run at high speeds, often relying on speed-increasing gears or belt transmissions. Only recent optimisation of the screw profiles has allowed some manufacturers to engage their compressors through a direct drive, hence improving efficiency.

The efficiency of the vane compressor has actually been enhanced in recent years – and, with the energy required to produce a given flow of air at a certain pressure being the most important feature of any air compressor, this is a crucial point. Traditionally, off-load energy consumption was considered too high with vane machines. Today, however, due to improvements in internal lubrication, Mattei has been able to reduce its off-load operating pressure – significantly improving the off-load energy efficiency.

There is only minimal wear on the vanes as a result of a film of lubricating oil between the vanes and the stator wall

Compressor wear and tear

Another important factor to address is compressor wear and maintenance. There is a common misconception that the sliding vanes used in a vane compressor will deteriorate, and will need to be changed regularly. However, in reality, there will only be negligible wear on the vanes, because the lubricating oil forms a film on which the vanes slide, meaning there is no direct metal-to-metal contact between the vanes and the internal stator wall.

Most significantly, a rotary vane compressor does not require roller bearings as used in a screw compressor. The vane compressor's rotor shaft is supported by simple white metal bearings, which ensure a long and inexpensive operating life.

So, providing it is looked after in accordance with the manufacturer's instructions, the operating life of a vane air compressor is virtually unlimited, and maintenance is minimal.

Replacement of bearings

In comparison, screw compressors cannot offer the same levels of longevity. Because the rotors have to operate with high axial and longitudinal loads while maintaining minimum clearances, screw compressors use roller bearings by necessity. However, in order to prevent an expensive air end failure, screw manufacturers recommend that these bearings are replaced as frequently as every 24,000 hours. This re-bearing has its own cost implication, which is often overlooked at the time of purchase. Also, as there is no wear in the air end of a vane compressor, its efficiency remains constant throughout its operating life, whereas a screw compressor's efficiency will deteriorate over time.

A screw compressor also utilises additional parts, which aren't used in a vane compressor. Therefore, items such as gear trains and drive belts could potentially need replacing. Due to their design, vane compressors require fewer hydraulic hoses than screw compressors, therefore reducing the risk of leakage and failure.

All of this means that vane compressors offer lower maintenance costs, greater reliability and guaranteed lifetime performance.

• *Andy Jones is general manager of Mattei Compressors Ltd*