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Compressor CARE

Maintenance Tips Help Keep Your Screw Compressor at Peak Performance

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Make Your Compressor LAST 100,000 HOURS

Following some basic maintenance tips can help you maintain your screw compressor at peak performance for 100,000 hours before having to consider an overhaul or replacement.

By John Ansbro, York Refrigeration/Frick, A Johnson Controls Co.

Just how long is 100,000 hours? That's 4,167 days, or nearly 12 years. If your automobile ran at 60 mph for 100,000 hours, you would have traveled nearly 6 million miles. And if you had rebuilt your engine every 250,000 miles, you would have rebuilt it 24 times. One hundred thousand hours is the amount of time your screw compressor can last without a major overhaul — if it is maintained properly.

Use the Right Lubricating Oil

The lifeblood of any screw compressor is the lubricating oil. Screw compressor manufacturers painstakingly test lubricating oil with their compressors to determine the best oil and additive package to meet the needs of every screw compressor application. The lubricating oil used in a cold storage warehouse application is vastly different from the lubricating oil used in a natural gas gathering application. Therefore, the simplest and easiest recommendation is to use the lubricating oil recommended by the screw compressor manufacturer.

In addition to lubricating the machine, the lubricating oil also seals internal clearances to maintain high efficiency, helps to protect the screw compressor's bearings and assists in the bearings' performance. Bearing life is defined as the number of operating hours that a bearing is capable of enduring before the first sign of fatigue occurs on one of its rings or rolling elements. An occurrence is defined as a 1.0 mm square spall.

The standard method for calculating bearing fatigue life is L10, which is the life that 90 percent of a sufficiently large group of apparently identical bearings can be expected to attain or exceed. The median life of these bearings is approximately five times the calculated L10 life, or 50,000 hours for a bearing with an L10 life of 10,000 hours. For example, a bearing with an L10 life of 10,000 hours means that 90 percent of a population of bearings will run longer than 10,000 hours in an operation without developing a 1.0 mm square or larger spall.

Figure 1. When every bearing in a compressor looks distressed, it is most likely due to a lubrication problem rather than a bearing problem.

Bearing manufacturers take L10 life further through the use of a "new life" equation. A bearing's new life is equal to the L10 life times a life adjustment factor. The life adjustment factor increases the multiple of times the L10 life is increased by accounting for improved oil viscosity and reduced particle count in the lubricating oil. The conclusion of the new life method is that the proper oil viscosity and oil cleanliness are crucial to increasing a screw compressor's operating life.

Most screw compressor failures are caused by lubrication problems (figure 1), which can occur due to high water content, refrigerant liquid, dirty oil and the improper viscosity oil for the application. To prevent or minimize the effect of these problems on your equipment, analyze your compressor's lubricating oil at regular intervals to determine whether its quality is acceptable or diminishing. This analysis should be performed at least twice a year — more frequently if a previous oil analysis indicated the potential for problems.

Many different companies analyze oil for various lubricating oil applications, and

not all analyses are the same. For screw compressors in refrigeration applications, the lubricating oil should be analyzed for the Karl Fischer Water Test, particle counts, viscosity and total acid number (TAN) for oil breakdown, as well as metals detection for contaminants or wear. The analysis should address not only the lubricating oil but also the refrigerant and oil combination. Importantly, the analysis results should be communicated in a timely manner to the operator and maintenance personnel so that they can promptly correct or modify any operating issues.

Figure 2. This filter was incompatible with the application in which it was installed. The filter materials broke down during operation and released particles into the bearings.

Use the Recommended Oil Filters

Along with monitoring the lubricating oil of your screw compressor, using the manufacturer's recommended oil filters and coalescers is crucial to ensuring that your equipment will maintain peak performance. Many oil filters exist, and all have varying claims to effectiveness. However, the nominal rating of an oil filter is not enough information to select a proper filter. Screw compressor manufacturers prove the effectiveness of oil filters through laboratory testing with both the lubricating oil and refrigerant. Some filter and coalescer materials are incompatible with certain refrigerant and oil combinations, so it is important to follow the manufacturer's recommendations. Figure 2 shows an installation in which an incompatible filter was used. The filter materials broke down during operation and released particles into the screw compressor's bearings.

Figure 3. The deposits on this coalescing filter were caused by an oil additive that was not recommended by the screw compressor manufacturer.

High-quality oil filters should have full-flow capabilities, a high dirt-holding capacity (greater than 150 grams), and should be rated in absolute rather than nominal terms. These criteria are crucial to delivering clean oil to the screw compressor while maintaining machine uptime.

Filters are rated by a beta ratio, which defines a filter's efficiency in particle capture in one pass of particles of a given size and larger. For instance, when comparing two filters, one that is rated for 15 µm beta 2 (nominal rating) and one that is rated for 15 µm beta 75 (absolute rating), the first thing you will probably notice is that the beta 2 filter is less expensive than the beta 75. This is because the filter with the beta 2 rating is 50 percent efficient at removing 15 µm particles and larger after one pass, while the beta 75 filter is 98.6 percent efficient at removing 15 µm particles and larger after one pass. In a typical screw compressor, the rotor-to-rotor clearance can vary from 5 to 20 µm, and the proper selection of an oil filter will take this clearance into account.

Beware of 'Magic Bullet' Claims

Beware of any "magic bullet" claims of improving the efficiency of your screw compressor by using a certain filter, coalescer or lubricating oil additive. The total friction in a screw compressor is approximately 3 to 6 percent of the total power consumed; claims of improving performance cannot exceed this amount. Furthermore, if you are considering an enhancement that is not recommended by the equipment manufacturer, be sure that it is tested in your application before using it in production. Figure 3 shows the results of a screw compressor oil-additive package that claimed to boost efficiency by reducing energy consumption. However, this non-recommended additive only served to interrupt the performance and uptime of this plant's refrigeration screw compressor.

Figure 4. Bearings from most high-hour compressors still look good at 100,000 hours when proper lubrication has been maintained.

Bearings from most high-hour compressors still look good at 100,000 hours when the proper lubrication and filtering practices have taken place (figure 4). By following the manufacturer's recommended guidelines, using high-quality oil, performing regular oil analyses and using the right filters, you can make your compressor last 100,000 hours — and beyond. **PCE**

John Ansbro is the director of marketing and business development at York Refrigeration/Frick, A Johnson Controls Co. The manufacturer of industrial refrigeration systems is located in Waynesboro, Pa.

For more information...

Call (717) 762-2121.
Visit www.johnsoncontrols.com.
E-mail john.p.ansbro@jci.com.

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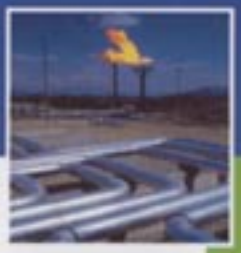

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