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Update your oil mist lubrication knowledge

We recently had occasion to review supposedly new, but nevertheless seriously outdated, information on the subject of oil mist lubrication. The flawed material appeared in a write-up based on a certified lubrication specialist (CLS) study guide that unfortunately does not reflect current technology. This prompts us to highlight the importance of staying abreast of technology advances, since companies that stick to inefficient ways of doing things, or are performing maintenance by anecdotal references, are like to suffer in the long run.

Oil mist is easily controlled and applied. Modern plants use oil mist as the lube application of choice. Plantwide piping distributes the mist to a wide variety of users. Oil mist is easily produced and its flow to bearings is not difficult to control. Flow, of course, is a function of reclassifier size and piping ("header") pressure. Unless plugged by an unsuitable (e.g., elevated pour point) lubricant, reclassifiers have a fixed flow area.

Depending on make and systems provider, header pressures range from 20 in. to 35 in. (500-890 mm) of H_2O. Modern units are provided with controls and instrumentation that will maintain these settings without difficulty. However, mixing ratios, typically 160,000-200,000 volumes of air per volume of oil, are frequently incorrect on old-style mist generators that incorporate gaskets and O-rings in the mixing head, unless these elastomers have been periodically replaced or properly serviced.

Comparing plants with nonoptimized mist entry to equipment bearing housings with their modern counterparts, consumption is about 40% less for plants that have implemented mist entry and vent locations per our October 1990 "HP In Reliability" column and API Standard 610 Eighth Edition (2000).

Forward-looking plants have used the API method since the mid-1970s. It was then already recognized that mist entering at locations far from the bearings could have difficulty overcoming bearing windage effects. If, near the bearing, the mist now existed at a pressure *below* that directly adjacent to the bearing, insufficient amounts of oil mist would reach the bearing rolling elements.

A larger quantity of oil mist or specially designed "directional" reclassifiers will be needed with certain bearing types *unless* the API method is used. This will overcome windage, the flow-induced slight pressure increase caused by the skewed cages found, for instance, in most types of angular contact bearings.

Environmental and health concerns addressed. For decades, these concerns have been addressed by using oil formulations that are neither toxic nor carcinogenic. Such formulations are available to responsible users. Appropriate lubricants have also been formulated for minimum stray mist emissions. These, too, are readily available to responsible users.

Stray mist emissions can be kept to very low values by installing suitable face-type bearing housing seals.[1] Unlike old-style labyrinth or other housing seals that allow highly undesirable communication between housing interior and ambient air, face-type devices seal off this contamination route.

Closed oil mist systems have been available since first being applied in the Swiss textile industry in the late 1950s. Today, closed systems are in use at several U.S. petrochemical plants. They allow an estimated 99% of the lube oil to be recovered and reused. Closed systems emit no oil mist into the environment and are available to responsible users.

Header temperature and size. Temperature has never been an issue for properly designed systems. Once a mist or aerosol of suitably low particle size has been produced—and particle size is influenced by the temperature constancy of both air and oil in mixing head—the oil mist will migrate in noninsulated headers at low velocity.

Ambient temperature has little influence on mist quality and effectiveness. Mist temperatures in headers have ranged from well below freezing in North America to over 122°F (50°C) in the Middle East. Regardless of geographic location, responsibly engineered systems will incorporate both oil and air heaters, since these are needed to maintain constant and optimized air/oil mixing ratios. The heaters must have low watt density (low power input per square in. of surface area) to prevent overheating the oil. Users that try to save money by money by omitting heaters or using undersized headers will not be able to achieve optimum life cycle cost of their assets.

Using undersized headers may increase flow velocity to the point where the small oil globules suspended in the carrier air experience too many collisions. They may thus agglomerate into droplets large enough to fall out of suspension, causing excessively lean mist to arrive at the point to be lubricated.

Dry-sump ("pure mist") vs. wet-sump ("purge mist") applications revisited. Applying dry-sump oil mist is advantageous for a number of reasons. However, on reason that is often overlooked involves oil rings—or rather the fact that no oil rings are used with this application method.

Oil rings represent 18th century technology; they were developed for slow-speed machinery during the Industrial Revolution. Deleting oil rings is one of the many keys to improved reliability of virtually *any* bearing type or style. Oil rings are known to have journal surface velocity limitations, sometimes as low as 2,000 fpm or 10 m/s. So as not to "run downhill", which might cause the rings to make frictional contact and slow down, ring-lubricated shaft systems must be installed with near-perfect horizontal orientation.

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Frictional contact often results in abrasive wear, and the wear products end up contaminating the oil. Oil rings will malfunction uless they are machined concentric within close tolerances. They suffer from limitations in allowable depth of immersion and, to operate as intended, need narrowly defined and controlled oil viscosity.

Experience with modern oil mist systems. Actual statistics from a world-scale facility convey and accurate picture of the value of properly applied oil mist technology. This petrochemical plant went onstream in 1978 and 17 oil mist systems providing dry-sump oil mist to virtually every one of the many hundreds of pumps and electric motors in the facility. With dry sump, the oil mist is introduced at a location that guarantees its flow through the bearings and to an appropriate vent location. There are neither oil rings nor any other provisions for the introduction of liquid oil on pumps and motors with rolling element bearings at the plant.

Over a period of 14 years, one qualified contract worker serviced these systems by visiting the plant one day each month. In this 14-yr period, there was only one single malfunction; it involved a defective float switch in one of the 17 systems. The incident caused a string of pumps to operate (and operate without inducing bearing failure!) for eight hours. Over a 14-yr period, the availability and reliability achieved by the oil mist systems at this U.S. Gulf Coast plant was calculated to be 99.99962%.

Concluding comments. Being aware of the relative unreliability of conventional lubricant application methods involving oil rings and constant level lubricators, knowledgeable reliability professionals can attest to the utility and overall advantages of properly engineered dry-sump oil mist systems. Certainly, the known advantages of properly engineered oil mist systems far outweigh the actual or perceived disadvantages. Unfortunately, much information to the contrary is either anecdotal or pertains to systems that were not correctly designed, installed, maintained or upgraded as new technology became available.

Only dry-sump applications will lubricate, preserve and protect both operating and stand-by rolling element bearings. At all times, only clean, fresh oil will reach the bearings. In many instances, bearing operating temperatures with dry-sump oil mist lubrication are 10° or even 20°F (6° or 12°C) lower than with wet-sump lubrication. Industry experience with dry-sump oil mist systems is well documented. Its superiority over both conventionally applied liquid oil and wet-sump oil mist lube applications has been solidly established.

Regrettably, entire plants still try to get by on wet-sump oil mist. Wet-sump lubrication makes economic sense on sleeve bearings only. Here, its only function is the exclusion of atmospheric contaminants. It does so by existing at a pressure slightly above that of the surrounding ambient air. Often, the wet-sump oil level is expected to be maintained by an externally mounted constant level lubricator. However, due to the slight pressurization, and on bearing housings equipped with traditional open-to-atmosphere constant level lubricators,[2] the oil level in the bearing housing will now be below the oil level in the lubricator. Arrangements of this type will always prove considerably less reliable than most alternative methods. **HP**

LITERATURE CITED

[1]Bloch, H. P., and A. Shammin, *Oil Mist Lubrication, Practical Applications,* 1998, The Fairmont Press, Inc., Lilburn, Georgia, ISBN 0-88173-256-7.

[2]Bloch, H. P., "Case study in reliability implementation," *Hydrocarbon Processing,* August 2002, p. 41.