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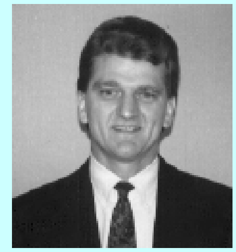

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FOAMING AND AERATION OF LUBRICATING OILS

In training sessions and seminars, I like to accent the serious nature of the presence of foam or aeration in a circulating oil system by stating, “Foam does not make a very-good lubricant”. Of course, the point being that bubbles of foam between moving metal parts can create metal-to-metal contact, increased wear, and shorter component life since insufficient lubrication can result.

The foaming of a lubricant in a circulating oil system is a serious problem; however, it does not necessarily mean there is a problem with the lubricant or that the lubricant is no longer suitable for continued use. In fact, by carefully evaluating the problem, and considering all factors which can cause the entrapment of air in the oil which results in foam, in many cases mechanical problems are found to be the culprit.

Here are a few suggestions to follow when investigating a foam problem:

1. Make sure the proper viscosity oil is being used. The higher the oil viscosity, the more likely the foaming tendency.

2. Make sure oil suction line is not near oil return line in sump tank. This gives air in return line a chance to release. This is a design problem.

3. Check for possibility of outside contaminants, such as dust, grease or moisture. Contaminants retard air release from bubbles.

4. Make certain there is no air leak on the suction side of the circulating pump through which air can be drawn into the oil.

5. Verify system oil return is below the oil surface in the tank. Otherwise return oil splashing into the reservoir will put air into the system … another design problem.

6. Check the residence time of the oil in the sump tank to allow air release.

In most cases, foaming problems can usually be traced down to one of the six items shown above. If the problem does not go away, a used oil sample should be drawn and sent for laboratory analysis.

Background History

Oil surface foam - This is a mixture of air in oil. When lubricating oils are churned or agitated in the presence of air, this mixing results in the formation of air bubbles, each surrounded by an oil film. Some of the bubbles break; the bubbles which don't break build up on the surface, forming foam. This can cause false reading of oil content, or if the foam rises so high that it reaches the overflow vent of the oil reservoir, it's possible for the entire oil charge to be lost through the vent, resulting in a lubrication failure.

Foaming can increase if the oil is contaminated by water in the system and by particulate matter. Examples of such matter are dust, detergents, soaps and salts; but many other finely divided, oil insoluble solids or liquids can also cause problems. What happens is that the foam is stabilized by these materials … it can't just dissipate and disappear. Another cause of foam is excess air, which may be pulled in through leaking pump glands or through poorly designed reservoir return lines, and mixed into the oil by high speed pumps. If so much foam forms in an oil distribution system that the pump is delivering a mixture of oil and air to the bearings, insufficient lubrication may result, leading to bearing failure.

Aeration - This occurs when tiny air bubbles accumulate in the oil below the surface. Air is trapped and forms bubbles when the oil is thrashed around by bearings, coupling, gears, or an oil return stream. In a properly functioning system, this air is quickly released by the oil. The rate at which air is released is affected by oil viscosity, temperature (because of its effect on viscosity), system pressure, what contaminates (if any) are present, and by the additives used in the oil. Rapid release of air is an important property of hydraulic and circulating oils. Slow release can cause excessive aeration and reduces a lubricant's lubricity.

The problem with aeration becomes especially critical in hydraulic systems. The reason is that the oil-air mixture is compressible and hydraulic controls may become "spongy" or "springy" and unreliable. This results in improper or erratic operation of the device. In a circulating system such as a large turbine system, pumps (especially the centrifugal type) can lose pressure, or even lose suction altogether. Excessive aeration has also been implicated in turbine thrust bearing failures.

Foam Inhibitors - A large number of foam-reducing compounds, often called anti-foaming additives or inhibitors are blended into lubricants at the time of manufacturing to hasten the breakdown of surface foam. Since these materials do not prevent the formation of foam, but cause it to dissipate quickly after being formed, they are referred to as "de-foaming" additives or inhibitors. Unfortunately, some de-foaming additives evaporate or change chemically under the effects of heat and oxygen. Others are incompatible with certain oils or with other de-foaming additives. Some of the best de-foaming agents are silicones. Because they are insoluble in mineral oil and have very low surface tensions, they are attracted to a bubbles air/oil interface. When foam is first foamed, bubbles rise to the surface and bunch together, and the film separating the individual bubbles thins out. Silicones work because they cause these thin films to rupture.

In addition to extending component life by reducing wear caused by excessive foaming, the correct concentration and quality of foam inhibitors can also greatly reduce operating temperatures. As an example, the highly active foam inhibitors found in SWEPCO lubricants have documented up to 25 degrees F. lower operating temperatures by dispersing the foam and releasing the trapped heat.