HERCULES SEALING PRODUCTS

Shop Talk

SEAL FAILURE ANALYSIS - DIESELING

Those customers who do low pressure repairs see many different types of seal failures while doing their repairs. Many of the failures are easily diagnosed and corrected.

For example, extrusion on the ID of a rod seal generally indicates excessive clearance between the rod and the throat of the gland. However, there are some types of seal failures which may be rarely seen and when encountered many not be understood.

As a way of helping our customers educate their employees I thought I would highlight a few of the lesser known types of seal failures, what causes them and what can be done to avoid a repeat occurrence.

So, periodically, in future newsletters I'll submit an article discussing a type of seal failure of which you may not be aware or not have previously seen.

For this first article I have chosen to discuss a failure mode which is rarely seen but is commonly referred to as DIESELING.

Basically the diesel effect in a hydraulic cylinder is the same as what happens in a diesel engine. A flammable liquid is vaporized in the presence of extreme heat and an "explosion" occurs.

All mineral oil contains molecularly dissolved air. At atmospheric pressure approximately 9% of the volume of hydraulic oil is comprised of dissolved air. In a "saturated" condition air molecules are mixed or attached to the oil molecules. In this situation the dissolved air has no effect on the performance of the hydraulic oil – not even on the compression modules.

However, the volume of saturated air rises directly in proportion to the pressure acting on the oil. This means that at high pressure large quantities of air will be dissolved in the oil. The percent of molecularly dissolved air increases in direct proportion to the increase in pressure.

If the pressure on the oil falls, the high volume of air molecules can no longer remain in solution and the air will separate and form bubbles. The presence of air bubbles in the hydraulic oil may now be evidenced by "spongy" operation of the system.

When this drop in pressure occurs very rapidly (i.e.: high pressure oil bypasses across a seal surface from extremely high pressure to the low pressure side of the seal) the change in energy will take the form of heat and in extreme conditions may actually cause an ignition of the vapors of the oil present in the air bubbles which will burn the seal. There are studies which have shown temperatures of 1000 degrees C being reached in the most extreme conditions.

Generally this condition may be exhibited more frequently in cylinders which are cycled very rapidly, but it is not exclusive to this type of operation.

Melted / burned seal material under expander.

Two piston u-seals exhibiting evidence of pressure trap, air entrapment in seal material and dieseling. Note the burned seal area on the lighter of the two u-seals.

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