Changing The Lube Environment Solves Problems

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Moisture and particle contamination in bearing lubricants is bad. Indeed, there are data suggesting that bearing failures account for typically 40% of all rotating equipment failures, by plant. Furthermore, particle contamination and corrosion account for over 50% of the bearing failures.

Fig 1.1

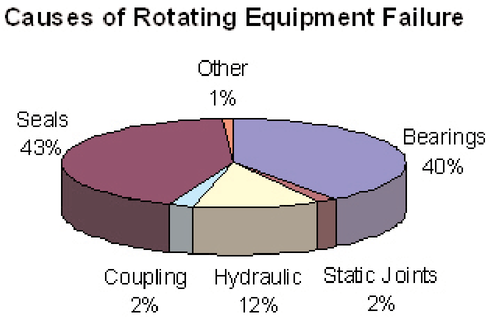
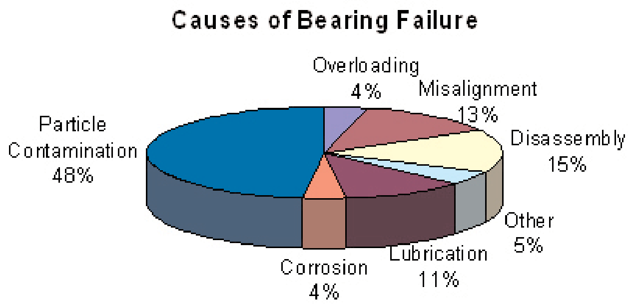


Fig. 2.1



These statistics form the basis for several important findings: fitting proper bearing seals is a fast and sure way to maximize rotating equipment effectiveness and reduce up to 20% of the total plant failures. But do not think that the benefits stop there.

Clearly, with proper bearing seals fitted, the bearing lubrication could be further enhanced by, say, Synthetic Oil, providing proven increased equipment operational characteristics.

Once correct bearing seals are installed, changing the bearing lubrication makes perfect sense…. or does it?

Uptime benefits can be truly realised when ALL the possible sources of bearing chamber moisture contamination are sealed and the challenge for plant engineers is to cover all such sources.

Since 1981, the premium rotating centrifugal pump standard, API 610 has stated that *"Lip Seals shall not be used"* to seal pump bearing chambers in rotating equipment [1]. Yet, many popular centrifugal pumps found in Chemical plants across Europe still incorporate lip seals, since this is the standard supply furnished by the OEM.

Lip seals are a major source of contamination entry and plant engineers are becoming increasingly aware of the fact that replacing lip seals with proper bearing seals can greatly improve their equipment downtime statistics.

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Furthermore, bearing seals which have been designed for installation on equipment previously equipped with lip seals can eliminate the need to replace or re-machine the equipment shaft, as shown in Fig 2.2. The point is that equipment refurbishment costs can be saved and used to pay for proper bearing seals – a win/win upgrade scenario.

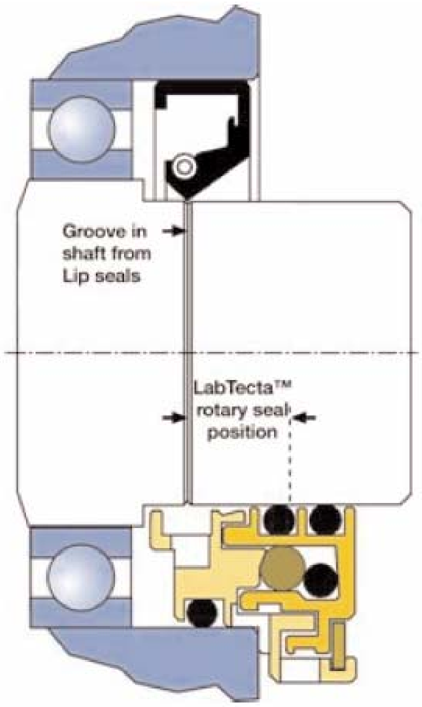

Fig. 2-2: Relative location of lip seal (upper view) v. advanced, field-repairable rotating labyrinth seal (lower view)

Research done by a major academic institution indicates that water contamination as low as 0.002% (20 parts per million) can reduce bearing life in some oils by as much as 48%-- that's a single a drop of water in a typical bearing chamber. Now imagine what a tablespoon of water will do!

At the same time as addressing the lip seal issue, the diligent engineer is encouraged to look around the entire bearing chamber. Experience shows that it is the engineers who address all the sources of moisture ingress who achieve the optimum uptime results.

On a typical bearing chamber design, there are only a handful of areas to review and investigate. Wherever it is possible for bearing lubricant to leak out of the bearing chamber, it will be possible for moisture to enter. The simple rule is to seal all such entry points.

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For many years, plant engineers have fitted unbalanced oil lubricators to accommodate losses in oil lubricant during equipment operation, as shown in Fig 2.3. Lubricant losses are typical when the equipment uses lip seals. However, if the losses are curtailed by simply using modern bearing seals, the need to top up the oil is greatly reduced or even eliminated.

Fig 2.3 - Bearing lubricant leakage from an unbalanced lubricator.

As unbalanced oil lubricators are vented to the atmosphere, moisture ingress is highly probable. Plant engineers may therefore replace the unbalanced lubricator with a balanced design or a suitable slight glass as shown in Fig 3. This action will remove the moisture ingress possibility.

Fig 3- Typical bearing chamber slight glass

The second place to review is the bearing plate static sealing means. It is not uncommon for some pumps, specifically those found in European Chemical plants, to employ paper bearing plate gaskets. Figure 4 illustrates a potential lubricant leak path if the gasket does not form a suitable seal to the bearing chamber.

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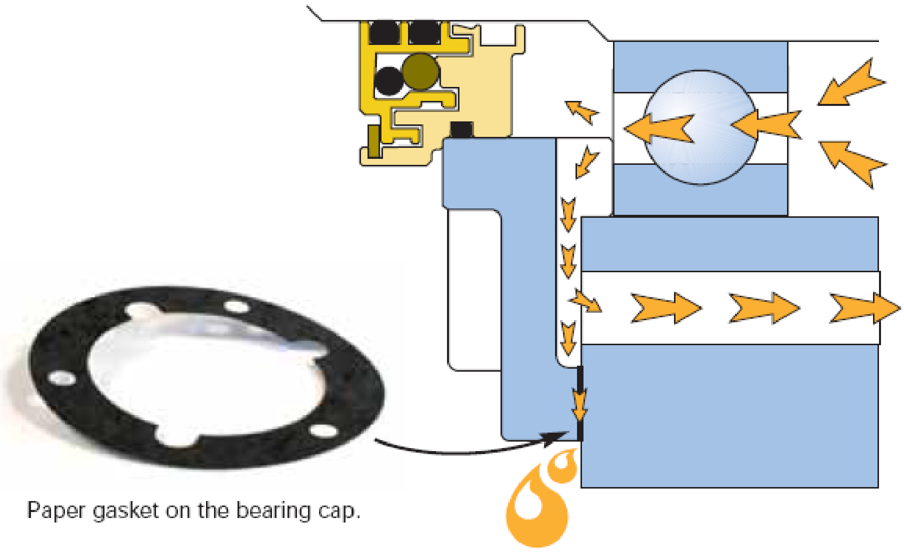
Fig 4 – Typical Bearing lube leakage through the paper gasket on the bearing cap



The paper gasket, in such applications, is typically 0.010" (0.25 mm) thick. Experience suggests that in some applications bearing lubricant drips past the gasket, even in bearing housings at ambient pressure conditions. Again, a diligent best practice plant engineer may be encouraged to view this as a moisture ingress possibility and look to correctly seal the bearing plate with an elastomeric device.

Fig 5.1 - 5.3 illustrates such an elastomeric sealing means, whereby an innovate elastomer design, supplied by AESSEAL plc, is employed to seal the bearing chamber of the KSB-CPK P02 to P05 range of process pumps.

Fig 5.1 –
Bearing Caps with bearing seal installed

Fig 5.2 -
Bearing cap with elastomer sealing means

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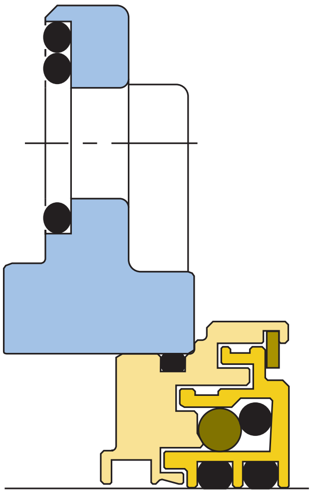
Fig 5.3 – Cross section of bearing cap and bearing seal assembly with elastomer sealing means



A third area to review is the perceived requirement of applying additional cooling means to the bearing chamber.

Figure 6.1 below illustrates a bearing chamber casing that is designed to dissipate heat. Figure 6.2 shows a cooling coil installed to directly cool the bearing lubricant. This presentation suggests that this cooling coil practice must be avoided. Experience suggests that such cooling promotes moisture condensation and water directly entering the bearing lubricant, reducing bearing life.

Figure 6.1
Bearing Housing designed to dissipate heat

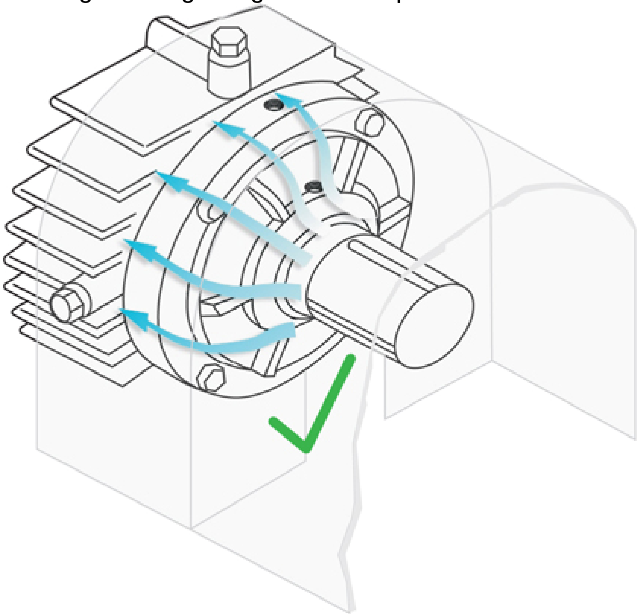
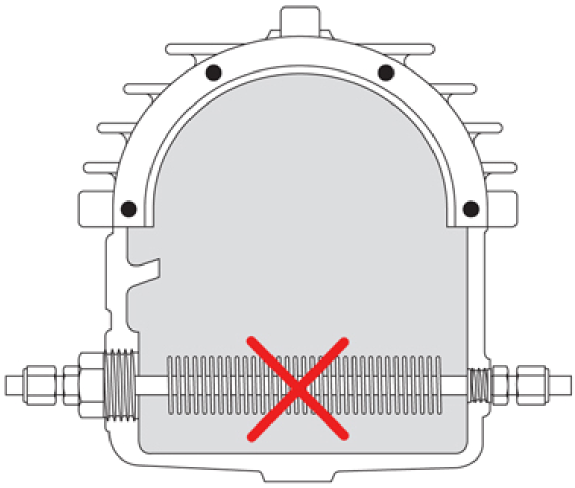


Figure 6.2 –
Cooling Coil installed in bearing housing



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An alternative method of dissipating the heat from the bearing chamber is to employ in a forced lubrication circulation system as shown in Figure 7 below.

Fig 7 – Bearing Lube circulation system

SD System
(Forced Lubrication System)

From Figure 7, bearing lubricant is circulated via a forced circulation system using a patented belt-drive mechanism from the equipment shaft. This lubrication means has no additional electrical supply and has the advantage of a vastly greater surface area compared to a conventional bearing chamber, so as to improve the heat dissipation for the bearing lubricant.

In summary, it is possible to gain considerable equipment uptime advantages by correctly sealing bearing chambers.

Plant engineers should seek to adopt best practice standards, as indicated in API 610. Life extensions will result from replacing lip seals with premium bearing protectors.

Furthermore, reliability focused practitioners such take the opportunity to eliminate all moisture ingress sources and address the shortcomings of unbalanced lubricators and/or paper bearing chamber gaskets.

References

[1] API 610 Ed10 standard, (Section 5.10.2.7)

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