

DES-CASE Europe sarl

23 allée VALENTIN

33470 GUJAN-MESTRAS

☎ Tel. 33 (0)5 57 73 04 08 Fax. 33 (0)5 57 73 04 09

WEB: www.descase-europe.com E. Mail : descase.europe@wanadoo.fr

PREDICTIVE & PREVENTIVE MAINTENANCE IN LUBRICATING

SYSTEMS by J.C. Bernard, dated June 2004

Presentation

Each year, industry spends billions of Euro to treat the negative effects of oil contamination in gearboxes and hydraulic systems. This is especially important in the emerging wind turbine market and in all kind of gearboxes, hydraulic systems and lubricated systems. It costs far more to treat these negative effects than it does to prevent them. It stands to reason, therefore, that there are billions in unrealized profits to be gained by preventing the root causes of contamination.

The purpose of this presentation is not to dispute the efficiency of in-line or off-line filtration, but rather to help industry optimize the use of filtration to improve efficiency and maximize profitability.

Scientific Data and Background

The “Ball Bearing Journal Special”, dated 1989, presented the following results on the relationship between pollution and bearings:

- “1969 and 1968, studies by Felsen and Schatzeberg showed that a presence of 100 ppm (0.01%) of dissolved water in the squalane lubricant decreased the bearing life by 32-48%.”
- “Finally, it not well understood why water can decrease bearing life as much as it does but a concentration of water as small as 0.01% is enough to decrease bearing life to half its original value,...., it is worst with sea water ambience.”
- Bearing life will be divided by 3 with only 250 ppm of water.
- This report provided advice to remove water and solid contaminants equal to or greater than 3 microns.
- Increasing water concentration by 100ppm will generate the loss of additive efficiency and will cause “system generated” contaminants.

Most industry experts today agree that the presence of a small amount of water in lubricating systems that use filtration will:

- Create chemical reactions with various types of additives,
- Increase the oxidations rate by ten times or more,
- Generate a loss in additive performance,
- And, cause premature filter clogging.

Regarding condensation in a reservoir, Rhone Poulenc’s engineers established:

- “It should be noted that this phenomenon (concentration of humidity in a reservoir) is not completely reversible as moisture escapes the reservoir much less easily than it seeps in”
- “It is enough to maintain a RH of the enclosed air of less than 30% to avoid all risk of condensation.”
- “The relative humidity (RH) of the imprisoned air gradually reaches a point at which the slightest fall in temperature causes condensation.”

Henry’s law states that the mass (weight) of a gas (vapor) dissolved by a liquid is proportional to the pressure of the gas (vapor) upon the liquid (lubricant). For example, in a closed (or minimally vented gearbox or reservoir) container, the mass of water vapor in a lubricant and its associated vapor pressure will reach equilibrium with the mass and vapor pressure of the water vapor in the air surrounding the lubricant.

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J.C. Fitch and Simeon Jaggernauth stated: “A contaminant that is excluded is one that never enters the machine housing and makes no contact with the lubricant. Moisture can be excluded by effective use of seals and breathers in bearing applications. Flapper-valve style desiccant breathers are especially effective for vented systems where humid air intake and condensation/absorption is a possibility.”

Exxon Mobil states: “Contamination is the greatest single source of lubricant malfunction and subsequent excessive wear of parts.”

NORIA, a world-wide leader in tribology and machinery reliability states: “The cost of excluding a gram of dirt is probably only 10% of what it will cost you once it gets into your oil.”

Eaton Vickers, a very well respected producer of hydraulic systems and components states: “hydraulic reservoir vents are a common source for water and particulate contamination which cause: corrosion – increased equipment wear – reduced fluid performance and fluid life.”

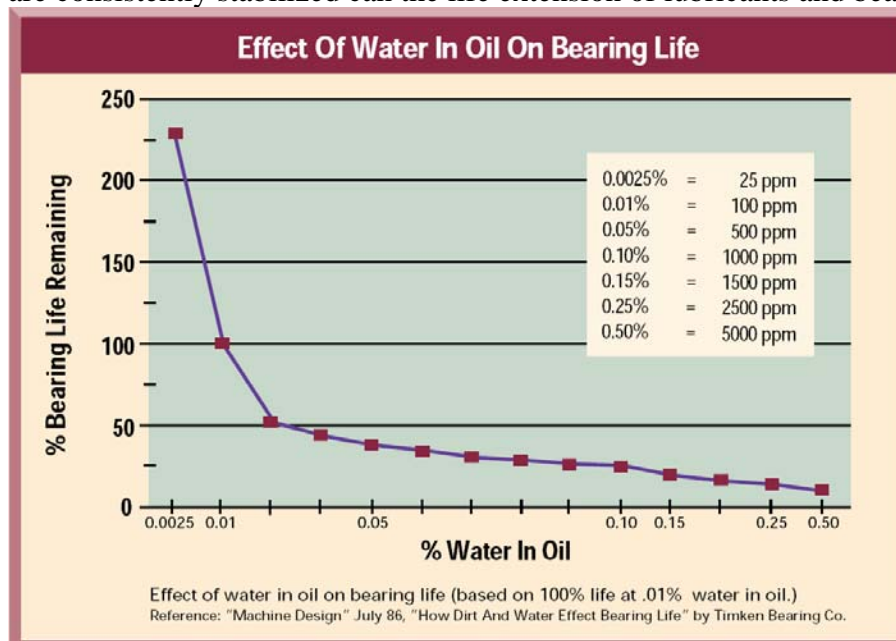
A large lubricant filtration company, who presents itself as a world-wide leader, states:

- “Particulate contamination and water can have serious adverse effects on the physical and chemical properties of hydraulic and lubricant fluid. They include accelerated oxidation of the fluid base stock and premature depletion of additives due to additive precipitation or chemical reaction involving additives. The importance of the removal of particulate contamination and water in fluid service life extension has been confirmed in laboratory studies and through experience in the field where factors of 4-6 in fluid service life extension are realized”.
- “Water is a much less effective lubricant and can result in decreased viscosity, load carrying ability and dynamic film thickness when present in the fluid. This can lead to greater surface-to-surface contact at sliding, rolling dynamic clearances and hence, increased component wear.”
- “The presence of water can also lead to the agglomeration or precipitation of particles to produce viscous sludges or solids. This induces excessive stress on system components, especially in pumps, and the clogging of orifices, nozzles, and jets.”
- “In addition, particulate contamination and water can promote chemical reactions involving the base stock and additives resulting in reaction products that adversely affect viscosity and other properties of the fluid. Typical reactions include the oxidation of the base stock, producing corrosive organic acids, gums, and sludges.”

This company goes on to recommend: “the incorporation of vent dryers to prevent ingress of moisture into the fluid system from the environment.”

It is very common for oil analysis to show large quantities of particulates on a membrane of silicium and silicate.

Moisture is know to enter lubricated bearing systems in several different ways, resulting in dissolved, suspended or free water. Both dissolved and suspended water can promote rapid oxidation of the lubricant’s additives and base stock resulting in diminished lubricant performance. Only when lower moisture levels are consistently stabilized can the life extension of lubricants and bearings be effectively achieved.



What about solid particle oil filtration?

Today, OEM's invest large sums of money for in-line and/or off-line filtration to remove particles that are 3 micron and larger in size. Yet, these same OEM's allow equipment to be fitted with a simple vent cap that removes particles that are 50 micron and larger, and which are ineffective against moisture ingress.



This can be compared to spending a large sum of money on a heating and cooling system for your house and leaving all of the doors and windows open. Likewise, diabetes is a disease that can be controlled with insulin; however, it is, in many cases, preventable with proper diet and exercise.

Similarly, in-line and off-line filtration are very good at controlling contamination (the disease). Controlling the "disease" is important, but, if you want to maximize the return on investment in equipment, you must work to prevent the "disease" by closing the door (the standard vent on a system) on contamination.

Determination of contamination sources effects & consequences.

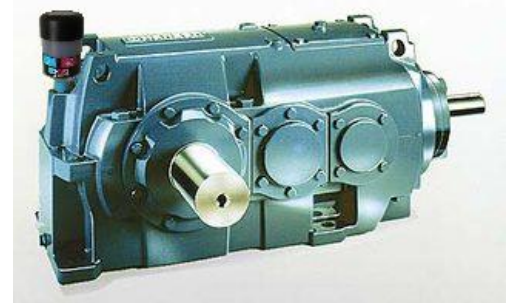
In fact many people make confusion between sources, causes and consequences.

Solution 1	The realistic approach	The most efficiency solution is to use of DES-CASE Desiccant Breathers in concert with in-line or off-line filtration.
Sources	External pollution particulate (silicate & silicium) and humidity represents 30-50% of the contaminants found on membrane.	Using a DES-CASE desiccant breather with a filtration efficiency of 3 microns will stop 95% of the total pollution (externally ingressed and "self-generated") and will optimize the life of the lubricant and filters elements.
Causes	Breakdown of lubricant additives and generation of "self pollution" of the system.	Because DES-CASE Breathers reduce ingress by 95%. Lubricant additives perform better, film thicknesses are consistent, mechanical components performance is optimized.
Effects	Pollution of the lubricant. - Equipment failures. - Unplanned down-time - Increased costs - Decreased profitability.	Use of a DES-CASE desiccant breather, to exclude the introduction of contaminants, maximizes the life of in-line or off-line filters. These filters become an insurance policy against contaminants. Remember NORIA: "The cost of excluding a gram of dirt is probably only about 10% of what it will cost you once it gets into your lubricant."
Conclusion		Attack the root cause of contamination. Eliminating contamination at the source provides the best return on investment.

Solution 2	Short-sighted Approach.	Using in-line or off-line filtration with simple cap or vent.
Sources	External pollution particulate and humidity represents 30-50% of the contaminants found on membrane.	Acceptable to allow so much contamination to enter the system.
Effects	Breakdown of lubricant additives and generation of "self pollution" of the system.	Accepted as a cost of business.
consequence	Pollution of the lubricant. - Equipment failures. - Unplanned down-time - Increased costs - Decreased profitability.	Using in line or of line filtration will remove contaminants, but at a cost of nearly 10 times those associated with solution one. Before removal, though, these contaminants have opportunity to damage components and lubricants.

Why using a DES-CASE desiccant breathers?

- Des-Case Corporation pioneered the manufacture and use of desiccant breathers more than 20 years ago.
- Des-Case has strong, world-wide distribution; with offices in the US, Europe, and Asia.
- Des-Case continues to lead the world in desiccant breather production and enjoys more than a 99% customer satisfaction rating.
- Des-Case Breathers are, at this time, the only products on the European Market to meet all of the following:
 - To be in accordance with European regulations in the field of health or worker protection and environmental regulations.
 - Having the technical agreement of the largest European gearboxes manufacturers (we can supply copies of agreement).
 - Designed in accordance with fluidic law regarding air flow.
 - Designed to work with Newton's law.
 - To make efficient use of filter media to ensure that only clean air contacts the silica gel.
 - Use silica gel that is the most effective and which uses a colour indicator (blue) that has been regarded as the standard for colour indication of moisture content for more than 50 years, and which still represents the best all-around solution.



Conclusion:

Engineers, scientists, tribologists, and industry experts agree that:

1. Contamination is harmful to lubricants and equipment.
2. Many harmful contaminants, particulate and moisture enter a system through the standard vent cap.
3. In-line and off-line filtration helps control the problem, but cannot prevent it.
4. Attacking the root cause of problems is most effective in solving them.

Des-Case Desiccant Breathers attack the root cause of fluid contamination which:

- Protects lubricating systems
- Improves efficiency, durability of lubricants, lubricant additives, and lubricant filter elements
- Increases return on investment in equipment and lubricants
- Decreases operating costs
- **Increases profitability**



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