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Water & Particulate Contamination in Oil & Lubricated Systems

Author: Tony Arenas, Y2K Fluid Power, Tony.Arenas@y2kfluidpower.com

Abstract or Executive Summary

Every major sustainable market in the world from Power Generation, AG, and Mining to Pulp and Paper, Industrial and many more, all face some form of contamination in their Oil or Lubricated Systems. The challenge is, first understanding the cleanliness requirements with specific focus on the most critical wear components and second, applying the correct filtration system for the application that reduces contamination and stress on these components extending the normal life cycle up to 5 times.

How to control the effects with the most cost effective solution?

Introduction

The vast majority of resources utilized by people all over the world are possible because of some form of Hydraulic or Lubricated equipment. Contamination in various forms (Water, Particulate, and Air) are among the highest contributors to failures in these systems and can account for as much as 75-85% of the wear that leads to mechanical failure and loss of usefulness (See Figure 1). Although this is an improvement in the recent years as the awareness of proper oil conditioning proves to be effective at extending of the useful life of the machine or equipment and increasing productivity to meet current and growing demands, it still requires more dedicated focus, education and a planned approach.

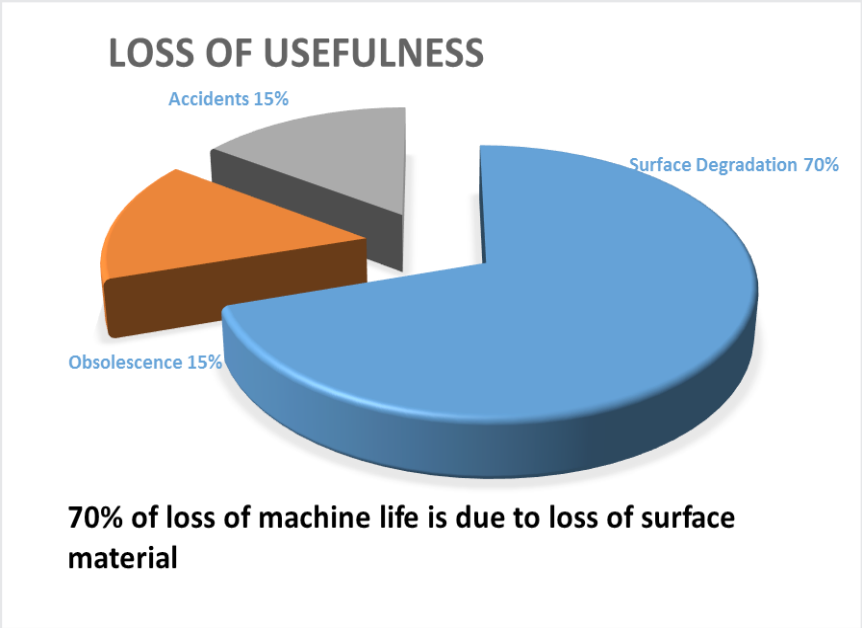

FIGURE 1:
SOURCE: Rabinowicz, Ernest MIT: Friction And Wear of Materials

"Compared to 40-micron filtration... wear was reduced 70% with 15-micron filtration." - General Motors through SAE, cited *www.kleenoil.ca/pdf/casestudy_gm.pdf 11/14/2016*

"Bearings can have an infinite life when particles larger than the lubricant film are removed." - SKF

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(937) 432-9292 or info@lubrisource.com

Background/Problem Statement

Whether you live in the United States or outside the country one thing remains, the ingression of moisture and particulate contamination is unavoidable in any type of equipment or machine that utilizes hydraulic or lube oil. It is significantly easier and at a lower cost to prevent contamination than it is to remove it from a contaminated system. Different applications, conditions and environments pose a challenge in choosing the correct filtration system for the application, there is no one solution that fits all applications. Water and particulate contamination can cause great strains on these systems including physical and chemical changes in the oil that decreases the effective lubricity and additives properties. This causes pre-mature wear on moving components, lower productivity and early or consecutive failures. Focus on contamination control can be a powerful and important part of a proactive maintenance strategy.

What is Contamination?

- Dirt & Other Particles
- Water
- Air
- Wear Debris
- Fuel
- Other Lubricants
- Coolant
- Detergents & Other Chemicals

Sources of Contamination:

- New Oil
- Built In Contamination from OEM equipment
- Hoses and Pipes
- System maintenance
- Condensation
- Reservoir Design
- Moving Components

Solutions: How to Control

1 Set Cleanliness Targets

- Target Cleanliness Level should reflect reliability goals and application specific requirements.

2 Take Specific Actions to Achieve Targets

- Reduce Ingression
- Secondary Filtration (Permanent, Mobile, Offline or Online)

3 Monitor Oil Cleanliness Levels Consistently

- Oil Analysis
- Particle Monitor
- Fluid Patch Test Kit

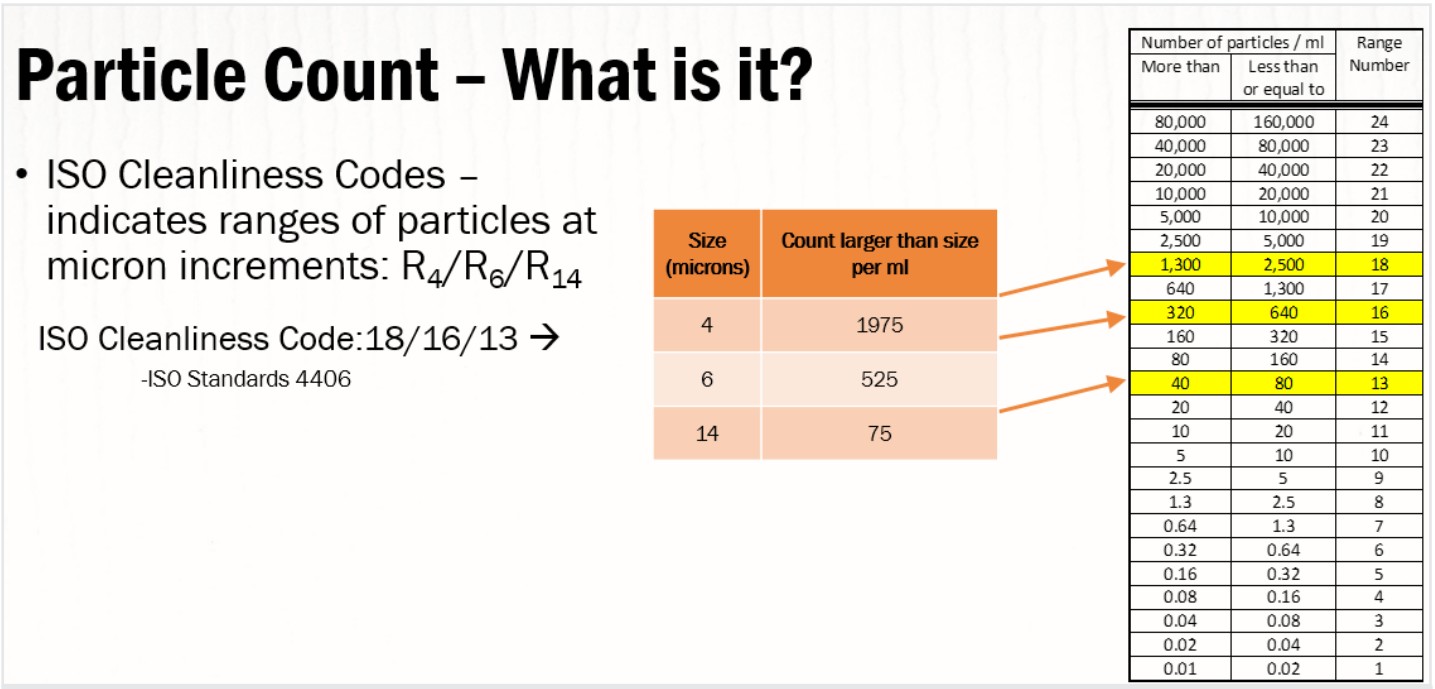

FIGURE 2: Particle Count - What is it?

Solutions: Methods to Control

Contamination Exclusion

- Filter new oil
- Use good quality breathers
- Use sound application methods
- Upgrade seals
- Use hydraulic cylinder rod boots
- Utilize non-invasive inspection / sampling methods
- Use sound flushing practice for new or recently serviced equipment
- Practice good parts management

Contamination Removal

- Upgrade system filters
- Permanent off-line filtration
- Portable off-line filtration
- Vacuum dehydration
- Centrifugal separators
- Water absorbing filters
- Air stripping
- Electrostatic / BCA filters
- System flushing

Solutions: Selecting the Appropriate Filtration System

Things to Consider:

- Avoid cross-contamination
- Filter element selection
- Quick connects
- Sample ports, options for verification of fluid cleanliness
- Safety features; filter bypass and pressure relief valve
- Flow rate vs. efficiency

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Solutions: Spin-On Type Filters

Mobile two-wheel filter cart or stationary system, the elements on these carts can have varying levels of beta efficiency ratios from Beta 200 to Beta 2000 the higher the Beta number the higher the efficiency or effective removal the element can capture during a pass. This is important when sizing, not only the correct level of cleanliness the system requires but also how fast or efficient it has to be to keep up with the ingression rates. Keeping the system running at peak performance while extending oil changes and maintenance intervals is the greatest advantage to a great oil cleanliness program.

Key points to keep in mind when selecting a filter cart:

- Reservoir or Sump Volume:
- Desired or Required ISO Cleanliness Level?
- Type of Oil or Lube?
- Time: How long do you have to clean it to the desired level?
- Power Source: Air, Electric (Electric: What Voltages are available)?

D Series Filter Cart

M Series Filter Cart

D Series Tandem Filter Cart

M Series Tandem Filter Cart

Solutions: Depth Type Filtration Systems

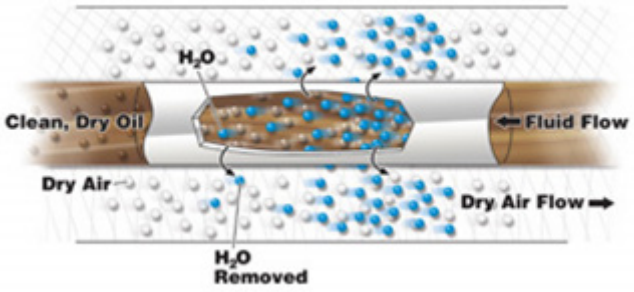
Depth media can come in many forms from point of use inline solutions with or without pressure and flow regulating valves to mobile and stationary plug and play systems. The benefit of using this type of system is the low cost high dirt and water absorption capabilities of the tightly wrapped large surface cellulose media. The dirt holding and water absorbing capacity of the element provide specific benefits to certain applications where the oil sump is severely contaminated or an ingression of free water is an issue. Where typical spin on elements don't have the capability and are not from a cost point of view economically feasible this would be the next step up.

CCECO Gold Filter Cart Series

Solutions: Membrane Technology (Water Removal)

Membrane water removal technology is very new to the market and will slowly be introduced to more applications in the coming years. The concept behind membrane technology is an oil impermeable membrane inside an opposing directional dry/clean air path to which there is a less populated cluster of dry air molecules causing the air molecules to permeate through the membrane and attached to the dry clean air. This is exhausted out as a pure invisible air/water mist. This type of unit is unique in the fact that it can act like a vacuum dehydrator and remove free, emulsified and dissolved water and gasses from the oil, this differs from spin on and depth media because these absorbent types are only designed to capture mainly free water molecules.

When the membrane technology is coupled with high efficiency filters the ability to clean the particulate in addition to moisture from the system provides an extension of the wear components and overall useful life of the equipment.



Portable Membrane Dehydration System

Solutions: Vacuum Dehydration

Vacuum Dehydration is by far the most effective at rapid water removal these systems also typically contain some form of particulate removal before returning the oil back to the sump. Vacuum Dehydration is used in critical high cost components or systems that cannot be easily shut down for maintenance or where the cost of breakdowns exceeds the presumable cost to prevent an unexpected shut down. Some markets include Power Generation, Pulp and Paper and mining industries. The concept behind operation is to use a vacuum pump to lower the effective boiling point of water from the 212 Deg. to a much lower temperature between 130-150 Deg. Which allows under vacuum and heat the transition of the liquid free water, emulsions, Dissolved water and gasses to be exhausted out of the dehydration system as pure gas or steam. The goal of this process is to eliminate or lower the water (PPM) and contamination (ISO Cleanliness Level) in the oil to an acceptable level so that the characteristics of the oil maintain their lubricity properties and allow for an extension of useful life of the machine or equipment.

FD-5

FD-15

Conclusion

Use of secondary filtration is no longer an option that can be put on the back burner when budgets are tight, additionally making good decisions on applying the right product for the application can save a lot of wasted time, frustration and resources. Filtration systems allow for higher efficiency and better utilization of time and productivity but also has an impact in lowering operating costs by reclaiming and extending the useful life of the oil and components and lowering yearly waste oil handling. Simply changing the oil when it is dirty to "New Oil" which often is not within acceptable ISO cleanliness requirements is not enough, although the oil may appear to be translucent and clean the fact is when this fluid is tested by a certified oil analysis lab, it turns it's not very clean at all and can significantly contribute to the degradation of the system. In cases where reliability is critical to the operation there must be a direct and conscious effort to a good oil management and cleanliness program.

M Series Panel Unit

M Series Platform Cart

D Series T-3 Tote