

PRESENTATION:

The Importance of Lube Oil Cleaning

How to improve operational
costs and equipment lifetime

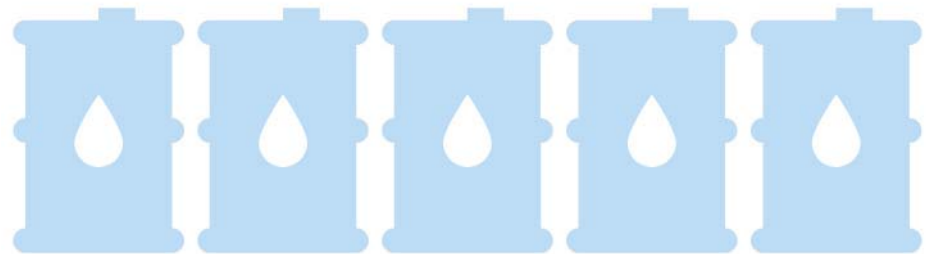
Clean lube oil is key to an effective process

- With clean lube oil the production process
 - can operate at normal performance
- However, the lube oil is often contaminated with
 - solid particles
 - water



Risks connected to poor lube oil quality

- Contamination means exposure to several risks:
 - Chemical degradation
 - Corrosion
 - High oil consumption
 - Friction: wear and noise
 - Efficiency losses
 - Clogging



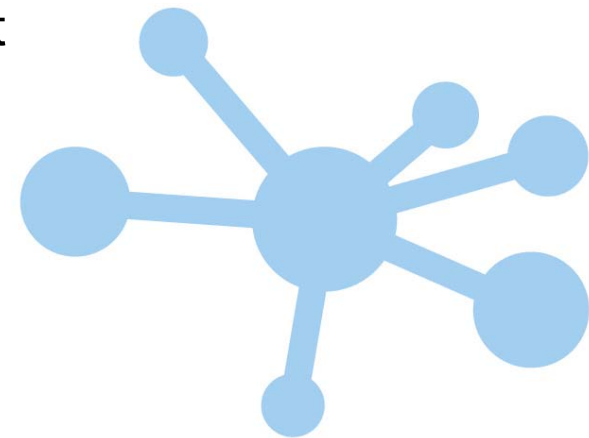
Consequences of poor lube oil quality

- Contamination can lead to costly consequences:
 - Unplanned production stops
 - Lower productivity
 - Disposal/replacement of lube oil
 - Machine wear / shorter lifetime



Particle contamination

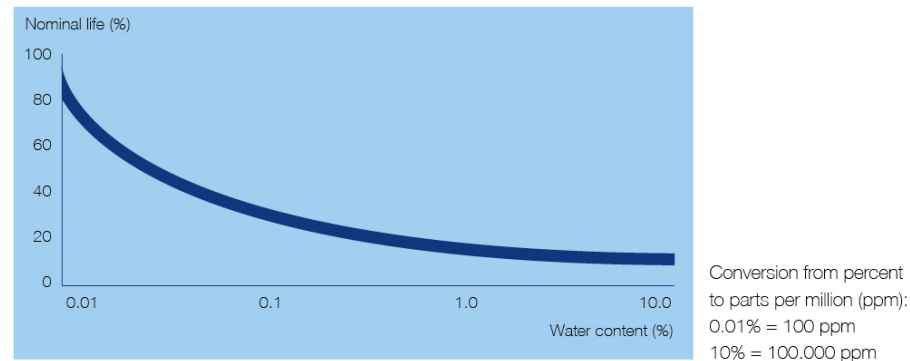
- Particle contamination comes from several sources:
 - Wear from metal
 - Plastic and rubber components
 - Paint flakes
 - Dust
- Particles in the lube oil impair system functionality
 - Can be trapped in fine clearances, like bearings
 - Can cause micro cracks on the surface
 - Degrades the metal until it falls apart
 - Changes the lube oil properties



Water contamination

- Water contamination comes from sources like:
 - Leakage
 - Condensation
- Water in the lube oil impair system functionality
 - Creating emulsions damaging valves and pumps
 - Oxidation of oils and additives
 - Reduction of oil viscosity and lubricity
 - Corrosion

Life time of bearing as function of the water content in the oil





Methods for cleaning lube oil



Filter for cleaning lube oil

- Removes solid particles from lube oil
 - Catches particles larger than selected mesh size
- + Advantages
- + Low initial cost
- Disadvantages
- Does not remove water
 - Cleaning efficiency degrades over time
 - High maintenance costs (change of filter cartridges)



Coalescer for cleaning lube oil

- Removes water from lube oil
- Often used in combination with a filter
- + Advantages
 - + Low sound emission, due to no moving parts
- Disadvantages
 - Functions best with low-viscosity fluids
 - No solids handling
 - Cannot be used if surfactants are present



Centrifugal separator for cleaning lube oil

- Removes both particles and water
- Contaminants separated by the use of gravity
- + Advantages
 - + High and consistent cleaning performance
 - + Continuous contamination removal
 - + Minimal maintenance and attendance
 - + Easy integration in production process
- Disadvantages
 - Soluble particles and solids with a density below 2000 kg/m^3 are not removed
 - Sound levels typically 64-75 db(A)*

*for solid retaining separators

Performance & Cost



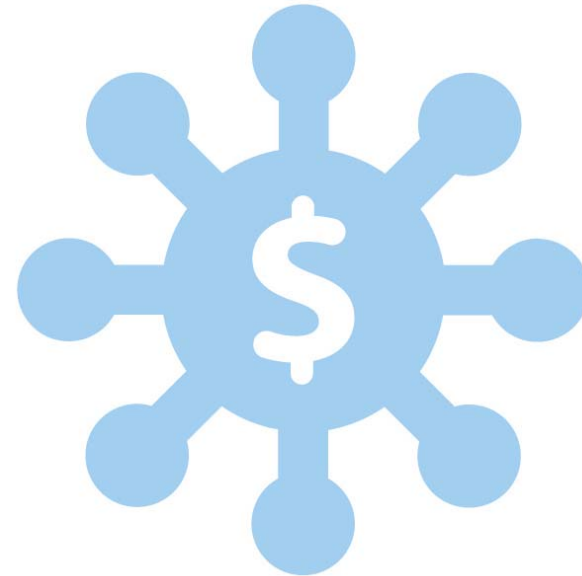
Total cost of ownership

- Considerations when choosing cleaning method
 - Performance
 - Cost
- At the bottom line, different technologies come with different Total Cost of Ownership (TCO)



Investment

- Filter technology comes with lower initial costs
- A Centrifugal Separator module has a comparably higher initial cost



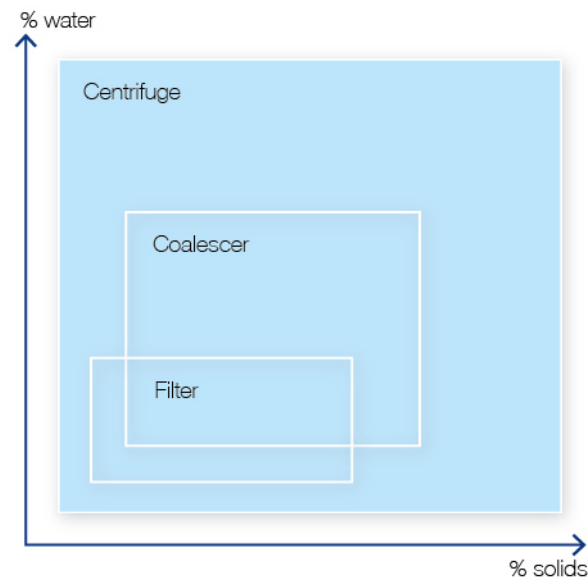
Maintenance costs

- Centrifugal separators require minimal maintenance and spare parts, which means lower costs for maintenance
- A filter solution requires manual service, filter element replacement and disposal of used filter cartridges



Operating performance

- Filter, Coalescer and Centrifugal Separators operate at different ranges
- Cleaner lube oil means more uptime and longer equipment life



Particles effect on machine life

- Expected machinery lifetime is directly connected to the cleanliness of the lube oil

Solids particles effect on machine life

Amount of solid particles (ISO 4406)	Expected cleanliness level (ISO 4406)									
	21/19/16	20/18/15	19/17/14	18/16/13	17/15/12	16/14/11	15/13/10	14/12/9	13/11/8	12/10/7
24/22/19	2 1,6 1,8 1,3	3 2 2,3 1,7	4 2,5 3 2	6 3 3,5 2,5	7 3,5 4,5 3	8 4 5,5 3,5	>10 5 7 4	>10 6 8 5	>10 7 10 5,5	>10 >10 >10 8,5
23/21/18	1,5 1,5 1,5 1,3	2 1,7 1,8 1,4	3 2 2,2 1,6	4 2,5 3 2	5 3 3,5 2,5	7 3,5 4,5 3	9 4 5 3,5	>10 5 7 4	>10 7 9 5,5	>10 10 10 8
22/20/17	1,3 1,2 1,2 1,05	1,6 1,5 1,5 1,3	2 1,7 1,8 1,4	3 2 2,3 1,7	4 2,5 3 2	5 3 3,5 2,5	7 4 5 3	9 5 6 4	>10 7 8 5,5	>10 9 10 7
21/19/16		1,3 1,2 1,2 1,1	1,6 1,5 1,5 1,3	2 1,7 1,8 1,5	3 2 2,2 1,7	4 2,5 3 2	5 2,5 3,5 2,5	7 4 5 3,5	9 6 7 4,5	>10 8 9 6
20/18/15			1,3 1,2 1,2 1,1	1,6 1,5 1,5 1,3	2 1,7 1,8 1,5	3 2 2,3 1,7	4 2,5 3 2	5 3 3,5 2,5	7 4,6 5,5 3,7	>10 6 9 5
19/18/17				1,3 1,2 1,2 1,1	1,6 1,5 1,5 1,3	2 1,7 1,8 1,5	3 2 2,3 1,7	4 2,5 3 2	6 3 4 2,5	>10 5 8 3,5
18/17/16					1,3 1,2 1,2 1,1	1,6 1,5 1,5 1,3	2 1,7 1,8 1,5	3 2 2,3 1,8	4 3,5 3,7 2	8 4 6 3,5
17/16/15		Hydraulics and Diesel Engines	Rolling Element Bearings			1,3 1,2 1,2 1,1	1,6 1,5 1,5 1,4	2 1,7 1,8 1,5	3 2 2,3 1,8	6 2,5 4,5 2,2
16/15/14		Journal Bearings and Turbo Machinery	Gear Boxes and others				1,3 1,3 1,2 1,1	1,6 1,6 1,6 1,4	2 1,8 1,9 1,5	4 2 3 1,8
15/13/10								1,4 1,2 1,2 1,1	1,8 1,5 1,6 1,3	2,5 1,8 2 1,6

EXAMPLE:

Suppose oil with following particles count:

No. of particles > 4 µm: 9 800 (=> range 20)

No. of particles > 6 µm: 470 (=> range 16)

No. of particles > 14 µm: 34 (=> range 12)

Hence contamination level 20/16/12

For centrifuges below can be taken to calculate the solid reduction:

100% of particles removed with size 10 µm and above

90% of particles removed with size 5 µm to 10 µm

70% of particles removed with size 3 µm to 5 µm

(Valid for non-oil soluble particles and solids with a density ≥ 2000 kg/m³)

This chart is an estimate of prolonged lifetime of machinery as an effect of clean oil.

Source: Noria Corporation

Water level effect on machine life

- Expected machinery lifetime is directly connected to the cleanliness of the lube oil

Moisture level effect on machine life

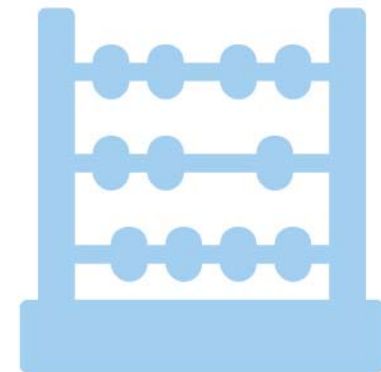
Current level of moisture, ppm	Machine life extension by factor								
	2	3	4	5	6	7	8	9	10
50 000	12 500	6 500	4 500	3 125	2 500	2 000	1 500	1 000	782
25 000	6 250	3 250	2 250	1 563	1 250	1 000	750	500	391
10 000	2 500	1 300	900	625	500	400	300	200	
5 000	1 250	650	450	313	250	200			
2 500	625	325	225						
1 000	250								

This chart is an estimate of the prolonged lifetime of machinery as an effect of clean oil.

Source: Noria Corporation

Centrifugal Separators: Best Total Cost of Ownership (TCO)

- Excellent and continuous performance
- Smooth and hassle-free operations
- Low maintenance costs
- Prolonged equipment lifetime

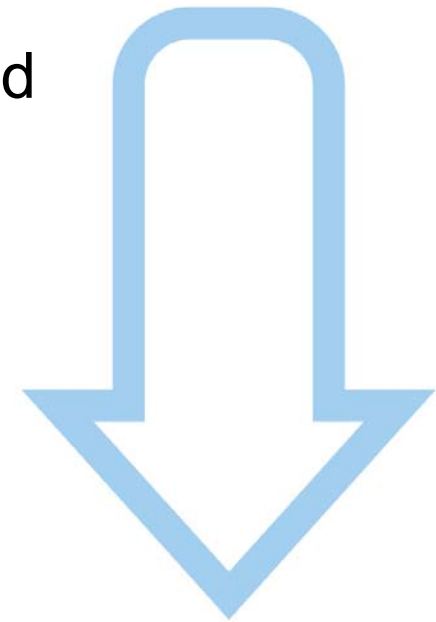


Side by side comparison

	Disc stack centrifuge	Filter	Coalescer
Particles & water separation?	yes	no	no
Particle removal	yes	yes	no
Free water removed	yes	no	yes
Emulsified water removed	limited	no	limited
Dissolved water removed	no	no	no
Capital cost	high	low	low
Operating cost	low	high	high
Total cost of ownership	low	high	high

Centrifugal Separator reduced downtime with 90%

- Weyerhaeuser Flint River switched to centrifugal separators
- Compared to the previous filter solution they recorded reduced downtime by 90%
- Worst case scenario downtime dropped from 14h/month to 3 h/month
- Repair costs were reduced by 74%





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