FRIESS GmbH

Preventive maintenance
for
lubrication- and hydraulic systems

a. the effects of dirt in the oil

b. methods to check contaminants in the oil

c. different process to clean the oil

d. conclusion

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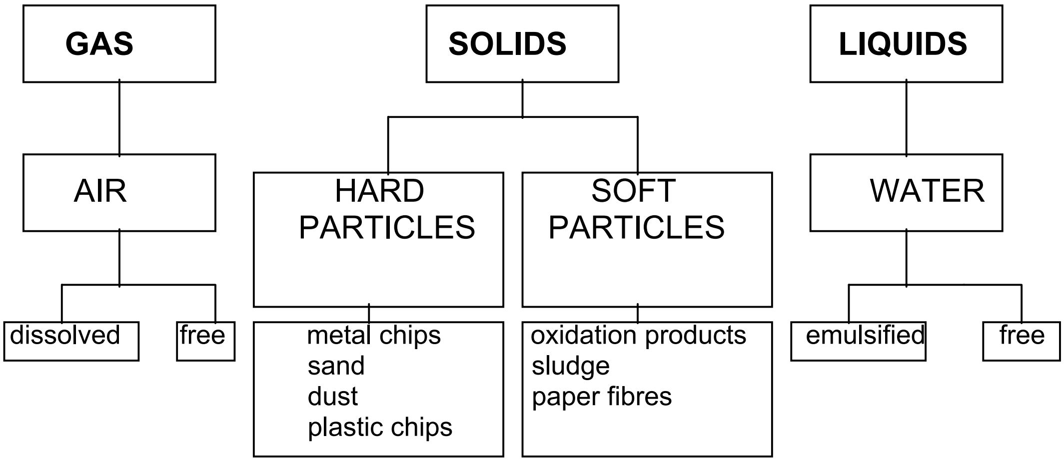
a. the effects of dirt in the oil

General

Following the most research results in the hydraulic fields more than 80 % of all hydraulic troubles are caused by contamination in the oil.

Contaminations are:



The effects of contamination

- **Hard particles**

  - cause wear by friction between moving parts.

  - wear causes new particles.

  - particles will be pulverized. The microparticles accelerate the oxidation of the oil. (microparticles are a good catalyst)

- **Soft particles**

  - the oxidation of the oil causes the production of fat-acids. The acid value of the oil rises. Resins and other sticky particles are formed in the oil. The resins and sticky particles block servo- and proportional valves. Especially these contaminants cause the most serious problems in hydraulic systems.

- **Water**

  - accelerates the oxidation of the oil and rises the acid value.

  - causes corrosion in the system if water content is higher than 200 ppm

Difference between piston and cylinder in hydraulic equipment in accordance with CETOP RP 92 H

hydraulic component	part	difference µm
gear pump (under pressure)	gear wheel / pump housing axial	0,5 - 5
	cog peak / pump housing	0,5 - 5
vane pump	vane / deplacementring (radial)	0,5 - 1
	vane / pump housing (axial)	5 - 13
piston pump	piston / cylinder (radial)	5 - 40
	valve plate / cylinder	0,5 - 5
servo valve	piston / cylinder (radial)	1 - 4
	valve piston / cylinder (radial)	1 - 23
hydro cylinder	piston / cylinder	50 - 250
hydrostatic bearing		1- 25
plain bearing		0,5

b. methods to check contaminants in the oil

b.1. counting of the particles in the oil
(NAS 1638, ISO 4406, ISO 11218)

The particles in an oil sample of 100 ml are counted with an automatic particle counter. The result is a list with the number of particles in different sizes. (unit: pcs/ml)

Following the standards, particles down to 5 µm / 2µm, can be detected.

b.2. Gravimetric method

A sample of 100 ml oil is drawn by vacuum through a membrane (47 mm diameter) with known weight and an a pore size of 0,8 µm.

The membrane with the particles has to be washed, dried and weighted.

The result is the weight of the particles in the oil.
(unit: mg/l)

c. different process to clean the oil

General

There are four different methods to remove dirt particles from the oil

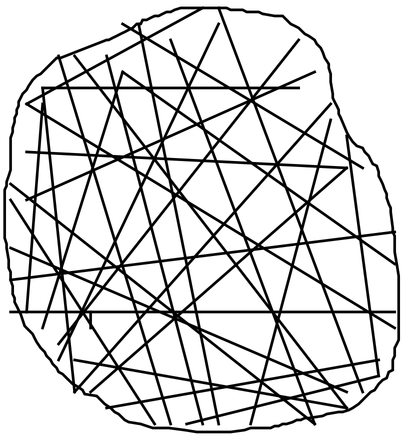
- filter
- centrifuge
- magnet strainer*
- electrostatic oil cleaner

***magnet strainer**

Magnet strainer only remove particles which can be magnetized. For this reason these units can be used only together with other cleaning equipment or for some special applications.

to 1. Filter

Bulk-filters are made of glass-fibre-fleece. The pores have different sizes and different forms.



enlarged filtersurface

A 5 µ filter element has a lot of pores, which have a size of more than 5 µ ! The pores become bigger while the system is in operation, because

- a part of the filter surface is blocked because of collected dirt particles. This means the pressure difference becomes bigger.
- The floating oil pulsates and the filter has to withstand pressure shocks.

In most of the technical data for filter elements these circumstances are not mentioned.

<u>ß-value for filtration elements</u>

To judge the efficiency of filter element most of the manufacturers test the ß-value of the filter element. The ß-value is estimated as follows:

$ß_x = P_i / P_o$

P_i = total number of particles bigger than x before filtration
P_o = total number of particles bigger than x after filtration

For example: in the technical data for a 5 µ filter element a value $ß_{10}$ is given. This value shows how many particles bigger than 10 µ will be hold back by the filter element.

to 2. Centrifuge

The efficiency of a centrifuge depends on the specific weight of the oil, the specific weight of the particle and the size of the particle.

$$\mathbf{Ab = Dp^2 * (\rho p - \rho ö)}$$

Ab = Efficiency
Dp = size of particles
ρp = density of particle
ρö = density of oil

Centrifuges are able to separate big and heavy particles from the oil. It is also possible to remove water from the oil. Small particles and particles with a density near the oil will not be removed by centrifuges.

Centrifuges cannot remove emulsified water. Oxydation products will not be removed from the oil by centrifuge. The viscosity of the oil has a big influence to the efficiency of the centrifuge. The higher the viscosity the worse is the result. If the oil is heated, so that viscosity is lower, the efficiency of the centrifuge is much better.

to 4. electrostatic oil cleaning

Electrostatic oil cleaning removes particles from the oil by electrostatic fieldforce, that means particle in the oil will be removed independent from

their size
their form
their material
their hardness and
their specific weight

and depending from

their electric charge and
the strength of the electrostatic field.

This means, that fluid addivites in the oil will not be removed or influenced by electrostatic. Every single molecule of the fluid has no electric charge and will not be removed by electrostatic. Particles, consisting of more than 1 molecule, may have an electric charge because of friction and other effects and will be removed by the electric field.

Cleaning elements

In order to reach a higher fieldforce at a given voltage special cleaning elements are amounted between the electrodes. The cleaning elements have sharp corners which deform the electric field. The cleaning elements in the **FRIESS** EFC – Electrostatic Oil Cleaner have four tasks.

1. The sharp corners deform the electric field and cause a higher fieldforce for higher efficiency.

2. The big surface is used to collect and store the dirt particles.

2. The special form cause a turbulence in the dirty oil and guides the particles towards the part with higher fieldforce.

3. The rough surface makes sure that particles, which are collected by electrostatic will not fall off from the cleaning element.

Application
for
FRIESS -EFC Electrostatic Fluid Cleaner

FRIESS EFC model D2/D4/D8/D16

FRIESS EFC – Electrostatic Oil Cleaners may be used for all kinds of non-conductive liquids. They are special designed for cleaning of mineral oils.

type of oil	**use**
gear oil	precision gears
spindle oil	spindle drives
turbine oil	powerturbines
lubricaction oil	central lubrication system in paper machines
high pressure oil	warm gears
Bettbahnöl	*Werkzeugmaschinen*
hydraulic oil	injection molding machines

other products

preservation agence	manufacturing of ball bearing
petroleum	cleaning
synthetic lubrication and hydraulic oils based PAO	central lubrication system on paper machines

CONCLUSION

To avoid production stop and machine breakdown you have to keep the lubrication and hydraulic oil system as clean as possible. It’s absolutely neccessary to remove microparticles down 0.05 µ, smaller particles (smaller than 5 µ) in the oil are the main reason for break-down and wear in the system and the main reason for oxydation in the oil. The only method which removes all kind of particles in all sizes is the

electrostatic oil cleaning.

When cleaning the oil constant by electrostatic oil cleaning you reach following benefits:

90 % less cost for oil

80 % less cost for filter elements

less cost for spare parts and service

higher productivity

cleaner and better work conditions

environment protection because of less oil consumption