Longer lifetime for hydraulic oil

In many applications hydraulic oils and lubricating oils are exchanged with new oil after only some thousand hours of operation. Changing the oil causes high costs and waste for the operator. With targeted maintenance of the hydraulic oil, the electrostatic oil cleaning extends the lifetime of oil up to 100.000 hours and more.

In hydraulic systems the hydraulic fluid is supposed to transfer energy and to reduce friction between two sliding surfaces. As long as both sliding surfaces are completely separated by the hydraulic fluid, the surfaces of both parts will not be changed. But only a few applications reach this ideal condition. After a certain period of time, solid particles can be found in every hydraulic fluid. If the size of these particles conforms to the height of the lubrication gap, the solids are pressed inside and touch the surfaces of both sliding parts. This causes overcharge of some material peaks. If the overcharge is repeated several times, the material peaks will crack and new solid particles are produced. Due to the constant repeating of the abrasion process, it is only a matter of time that the hydraulic system is stopped. In order to avoid malfunctions and failures, as many dirt particles as possible have to be removed from the hydraulic oil. The particles will not only cause wear, but they are also able to damage the hydraulic fluid.

Dirt particles as catalyst

The hydraulic oil changes under the influence of temperature, oxygen and the catalyst. In hydraulic systems dirt particles work as a catalyst. The surface of a single particle is extremely small. The numerous dirt particles in the oil have a big surface that works as a catalyst. (Even in new oil you can find more than 100.000 particles per 100 ml.) The catalyst helps the oil to react with oxygen in the air which causes long-chained molecules. The molecules connect to each other and deposit as resins on the surfaces of hydraulic parts. Especially if the hydraulic oil is cold the resins or oxidation products become softer and the machine runs better. If more oxygen products are produced, even more resins will stick together and may block valves or pumps.

The formation of resins is caused by dirt particles of all sizes. The number of particles in the oil rises with smaller particles. Especially fine particles with a size of less than one micron are responsible for the acceleration of the oxygen in the hydraulic oil.

Oil change or maintenance

The easiest way to avoid malfunctioning and failure caused by dirty oil and oxidation in the oil is to change the oil in short intervals (6-12 months). New oil is never clean and uncontaminated with particles. For this reason the change of the oil is not a perfect solution. In addition to that, the change of oil is very expensive and causes lots of waste. In order to reduce costs and to avoid waste, the operators of hydraulic systems have to find new methods in order to keep the system clean and raise productivity.

Due to the new recycling law, operators of hydraulic systems are obligated to avoid waste products. The indicated preventive measures are the internal roundput of substances as much as the application of products low in waste and pollutants. In order to reduce operating costs and to meet environmental regulations, the lifetime of hydraulic oil has to be extended with appropriate measures.

Technical limits of filtration

Conventional filtration effects a certain increase in the durability of hydraulic oil. Especially micro particles of less than 5,7µm are often not removed by conventional filters. The lubrication gap in a valve is between 1 and 4 µm, which means that particles fitting into the gap have to be removed in order to avoid failures of the parts. As filtration removes only particles down to 5 µm from the oil, there are still uncontrollable failures of the machines and frequent oil changing intervals caused by oxidation in the oil. A new method to clean the oil was necessary.

Electrostatic oil cleaning

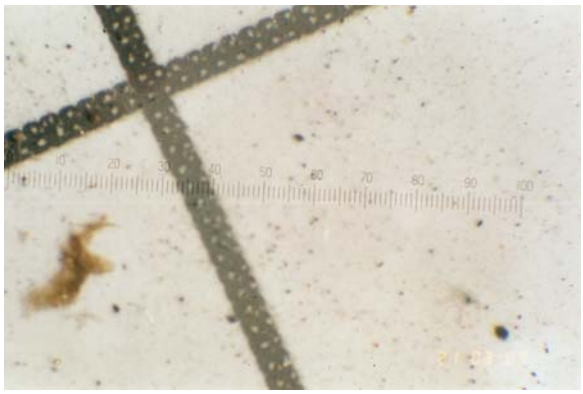
A very effective method to clean hydraulic oil is the electrostatic separation of particles. Particles in a fluid that come into an electric field are attracted by the electrodes, regardless of their size. This technology makes it possible to remove any kind of solid particle from non-conductive fluids. Even particles with a smaller size than the molecules of the hydraulic oil can be separated.
Electrostatic cleaning was already used in the dust removal technology. The electrostatic oil cleaning afforded new developments in order to clean hydraulic oil. Due to the viscosity of oil, the electrostatic oil cleaner has much higher resistance than gas when attracting particles. When cleaning hydraulic oil with electrostatic oil cleaners, voltage flashovers have to be avoided in order to prevent the oil parts from burning. The voltage between the electrodes has to be under a certain limit in order to avoid sparks. If the voltage between the electrodes is reduced, the power to attract the particles decreases as well. In order to improve the cleaning speed and capacity, Friess has developed special designed cleaning elements. The cleaning elements cause a higher power in order to attract the particles. In addition to that the cleaning elements have a bigger surface in order to collect the separated dirt particles.

Extreme cleanliness

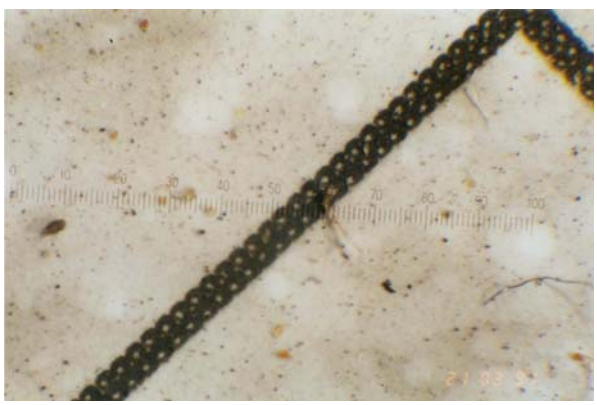
Because electrostatic oil cleaning achieves an extreme cleanliness of oil and removes micro particles from the oil, the particles in the oil are prevented from settling in the hydraulic systems. Particles which have settled on the bottom or at the wall of the tank or in hydraulic components, will be solved by the extremely clean oil. Together with the oil, these particles will be pumped into the electrostatic cleaner and are than removed by electrostatic.
This special method removes particles of all sizes. The number of particles in the oil is reduced by more than 90 %. Hydraulic failure or down time caused by dirt in the oil, for example in servo valves, is reduced by more than 70 %. Oxidation products, resins and sludge which may block the lubrication gap between piston and cylinder are removed.

Bypass-cleaning

Electrostatic cleaners are mobile bypass systems. The electrostatic cleaner is connected via two hoses with the hydraulic system and runs parallel to it. Due to the newly developed PLC, the control of the electrostatic cleaner is fully automatic. Because of the high saving of costs the amortization time takes less than 12 months which makes the retrofitting of systems especially economic.



Sticky resins in the oil may block valves



Resins in hydraulic oil

FRIESS GmbH

Date:	06.12.2005	Type of system:	USED CASTROL OIL
Rapport No.:	AR0512016		
Lab.No.:	12.016	Operating hours :	33788
		Type of oil :	CASTROL HYSPIN SP 46
Client:	FRIESS	Operating hours after oil change :	
System No.:		Date of test :	NOV 2005
		Sampling point:	

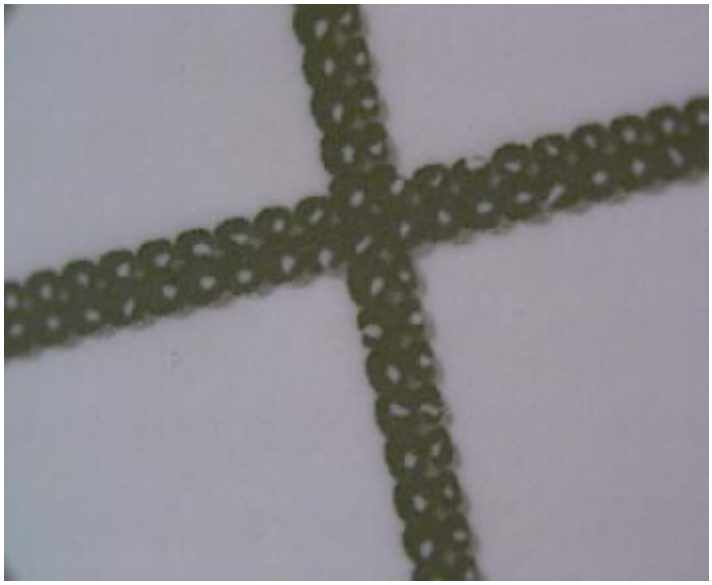
OIL IS CLEAN.
OXIDATION RESISTANCE IS SATISFACTORY.
LESS PHOSPHORUS BUT NO DEPOSITS ON THE MEMBRANE.
PLEASE SEND AN OIL SAMPLE FROM THE BARREL OF CASTROL HYSPIN SP 46.
OIL IS CHEMICALLY SPECIFIED.
OIL CAN FURTHER BE USED.

AR Nr.	Operating hours	Operating hours after oil change	ISO	NAS	Rust/ Sludge	Visc 40°C	Visc 100°C	TAN	TBN	Fuel	Water ppm
AR0512016			11/ 8	2		46.93		0.17			18

ADDITIVES (ppm) ABRASION ELEMENTS AND SILICON (ppm)

AR. Nr.	Na	B	Zn	P	Ca	Mg		Si	Fe	Cr	Mo	Al	Cu	Pb	Sn
AR0512016	5	4	4	33	0	0		0	2	0	0	0	0	0	0

Normal	Verfolgen	Gefahr



> 2	5160
> 5	1460
> 10	450
> 15	160
> 25	60
> 50	5
> 75	0
> 100	0

Oil analysis of electrostatic cleaned oil after 33.788 operating hours

GmbH
FRIESS

Date:	31.05.2004	Type of system:	MACHINE G6
Rapport No.:	AR0405468		
Lab.No.:	05.468	Operating hours :	85588
		Type of oil :	HLP 46
Client:	FRIESS	Operating hours after oil change :	
System No.:		Date of test:	18.05.2004
		Sampling point:	HY 1.1 / D2 STAT

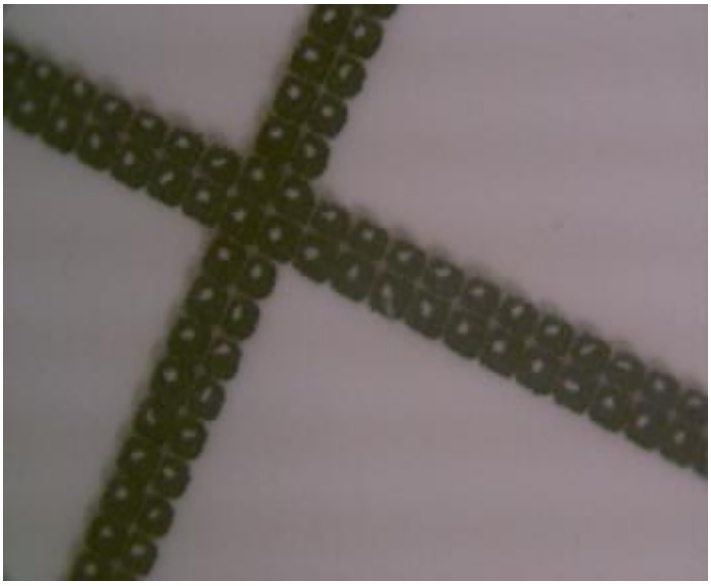
Bemerkungen : NAS 3: 5 - 15 MICRON.
OIL IS CLEAN.
OIL IS CHEMICALLY SPECIFIED.
OIL CAN FURTHER BE USED.

AR Nr.	Operating hours	Operating hours after oil change	ISO	NAS	Rust / Sludge	Visc 40°C	Visc 100°C	TAN	TBN	Fuel	Water ppm
AR0405468			12/ 7	3		46.18		0.25			95

ADDITIVES (ppm) ABRASION ELEMENTS AND SILICON (ppm)

AR. Nr.	Na	B	Zn	P	Ca	Mg		Si	Fe	Cr	Mo	Al	Cu	Pb	Sn
AR0405468	16	8	7	119	6	0		0	1	0	0	0	1	0	1

Normal	Verfolgen	Gefahr



> 2	6790
> 5	2320
> 10	560
> 15	100
> 25	15
> 50	5
> 75	0
> 100	0

Analysis of electrostatic cleaned hydraulic oil after 85.000 operating hours

Situation

A paint shop uses 12 pumps in order to provide paint for painting big sheet metal parts. The pumps for the paint are driven by hydraulic motors. In order to drive the hydraulic motors, a central system with an oil volume of 3500 l of hydraulic oil HLP 46 is installed.

Because of the continuous production, the maintenance team was not able to change the oil as planned. In order to change the oil and clean the tank the system had to be stopped for minimum 24 h.

The raising contamination of the hydraulic oil caused more and more down time. Almost weakly a hydraulic motor was stopped because of dirt particles in the hydraulic system. In order to reduce downtime, the maintenance team connected the hydraulic motors with quick couplers so that they were able to change the hydraulic motor in short time. The costs for overhauling of one hydraulic motor were approximately 500 €.

In order to reduce the costs for the repair, the maintenance manager checked several possibilities:
1) Changing the oil during production
2) Cleaning of the oil

Solution

The maintenance manager decided to use electrostatic oil cleaner in order to clean the hydraulic oil. The hydraulic oil cleaner model D16 was connected during production to the system. Without interruption of production process, the oil was cleaned during 6 weeks with electrostatic. Within the first week after connecting the electrostatic oil cleaner, another motor stopped because of failure and had to be overhauled. During the following 5 weeks of cleaning time the maintenance team reported no further failure of hydraulic motor.

The amount of dirt particles in the hydraulic oil could be reduced by more than 90 %. The electrostatic oil cleaner D16 removed not only particles, but also oxidation products and sludge. Oil samples after the cleaning process showed that the oil condition was perfect for further use.

Electrostatic oil cleaner model D16