THE FUTURE OF LUBRICANTS (1)

New applications by the use of NanoVit®

The generation of heat on frictional surfaces influences the flow characteristics of lubricants and the load capacity of the lubricating film. By restructuring the lubricants, a reduction of the heat generation on frictional surfaces can be achieved.

1 The hydrodynamics of lubricants on frictional surfaces

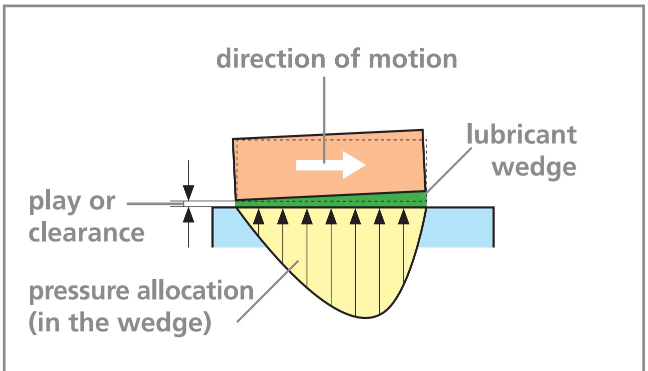
During the construction of machinery, the hydrodynamics of lubricants has the highest priority.
The starting phase of the motion of frictional surfaces starts with boundary friction.
In order to form an adequate lubricating layer between the frictional surfaces, a force is needed to compensate the pressure between the two surfaces.

In order to form this force, a relative motion between the two frictional surfaces, local viscosity of a lubricant and a satisfactory angular velocity are conditional.
This hydrodynamic force is proportional to the frictional surfaces:

$$P = k * B * C * S / T^2$$

P – Hydrodynamic force
B – Dynamic viscosity of the lubricant
S – Frictional surface
K – Material constant
C – Angular velocity
T – Relative Play

As the temperature rises, the dynamic viscosity of the lubricant decreases proportionally, the loading force decreases as well and the dynamic friction-area becomes smaller and limited. The heat-balance between the frictional-areas which, on their turn, determine the allowable inner and outer temperature sphere, are disturbed. Higher frictional losses and wear occur.



Picture 1: The formation of a lubricant wedge

Due to wear, the relative clearance or play increases (which only has a limited tolerance) and therefore the hydrodynamic force reduces. Consequentially this wear leads to small defects on the frictional surfaces causing additional loss of the hydrodynamic force. The lubricant film becomes smaller and, at lower loads, leads to a transition from hydrodynamic friction to boundary friction.

In order to reduce wear and tear, following issues should be resolved:

- Absence of the boundary friction in the starting phase.
- Wear – defects balancing and its influence on hydrodynamic friction.
- At higher oil temperatures, load and speeds, the viscosity of the oil should remain stable.

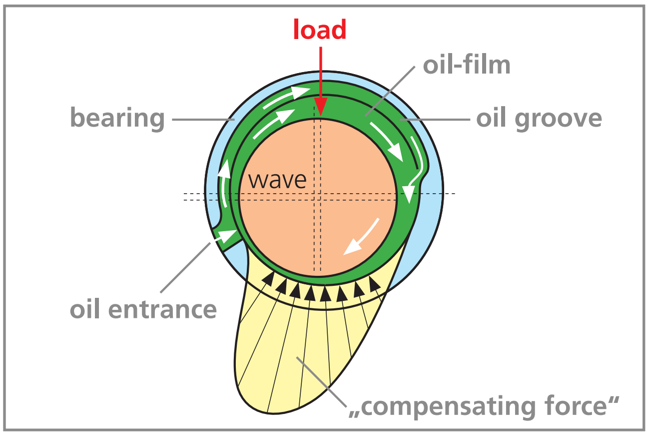
2 The market of additives

Additives are substances which should give additional properties to final products. Mostly these are vague claims and suggest an increase in performance in order to point out the new advantages of the product. On the market there are numerous products which can be added to the engine-oil. Their operation should build a layer on the frictional surfaces which compensates wear and covers the areas which display small defects of these surfaces. In order to do so, various materials are used like:

- fine-grain powder,
- ceramic-powder,
- substances which contain fluoride,
- compounds of soft-metals (copper, bronze, cadmium, tin),
- Teflon and polymer-preparations,
- chloride-paraffin,
- diamond-powder,
- wear-layer modifiers,
- sulphur combinations with molybdenum, wolfram, tantalum,
- etc.

All these preparations have their own shortcomings and aren't general applicable.
The build-up of the protection layer is unstable, for both the layer thickness as well as the heat-transfer capabilities. At higher temperatures their connection to the frictional surfaces is partially destroyed, the thickness of layer will vary in size and the heat-balance becomes unstable. E.g. in plain bearings, there are two parameters on which one could have an influence:

- the dynamic viscosity of the oil and the relative clearance of the bearing.



Picture 2: The load-spread in a plain bearing

During a temperature increase at the frictional area, the dynamic viscosity of the oil can reduce by a factor three, which leads to a substantial reduction of the hydrodynamic loading-force of the plain bearing. At high oil temperatures e.g. at high loads, speeds, balanced temperatures in the frictional area and a sufficient oil-viscosity, the hydrodynamic frictional surface increases and reduces the internal frictional losses and wear of the plain bearing.

3 Liquid Crystals in lubricants:

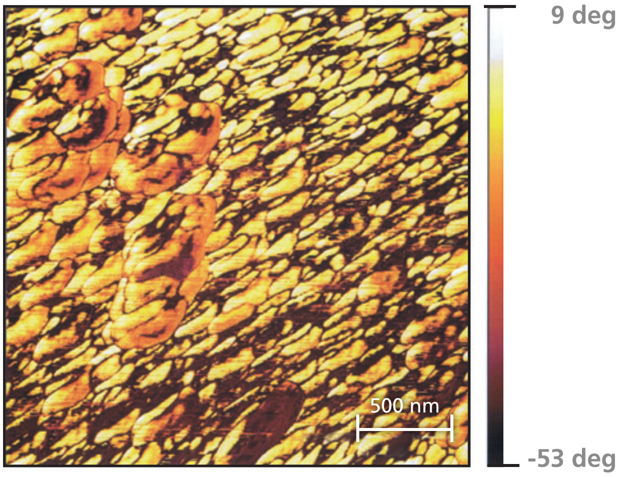
Supramolecular liquid crystals have many different properties. Mixed with structured fluids which hold electrical polarized dispersed materials, one could observe two effects: A non-linear change of the viscosity as well as an anomalous increase of the heat transfer capacity of the medium. This observation allowed us to assume that one could reach similar effects with lubricants, provided we could find a dispersed structure with corresponding parameters. When this structure remains stable and non-destructive, one gets an unbounded process in which dynamic balanced structures are built and remain to have a consistent and stable condition.

The company NanoVit® Research GmbH has taken up this challenge.

By testing several polarized nano-materials made from solids of metal-oxides in fluid hydrocarbon (e.g. oil) a high dispersed system should result.
Due to self-organisation, three-dimensional molecules are built in the oil, which consist of nano-parts and oil-molecules which hold on firmly to the nano-parts.
Macro-structures are formed (colloid active substances) which have a cleaning effect on the frictional surfaces.
Also non-linear effects were observed at the oil-viscosity as well as the increase of the oil's heat capacity.
Also an oil-regeneration process could be seen, by the building up of three dimensional oil-molecules which have the capability to connect the oil chains to each other again.

4 What is NanoVit®?

- NanoVit® is a universally applicable nano-technical product that by the self-organisation of the substance in oils, greases and pastes leads to the formation of various macro-molecular structures.
- NanoVit® has a specific operative application. It builds three-dimensional structures in various fluid hydro carbonates, greases and pastes.
- NanoVit® exists of three solid components: $SiO2$, $Al2O3$ and plasma-treated graphite. It holds sufficient properties which cause the build-up of structures in fluid hydro carbonates.
- By means of the self-organisation, NanoVit® ensures a permanent dynamic balancing process, which leads to the formation of macro-molecular structures.



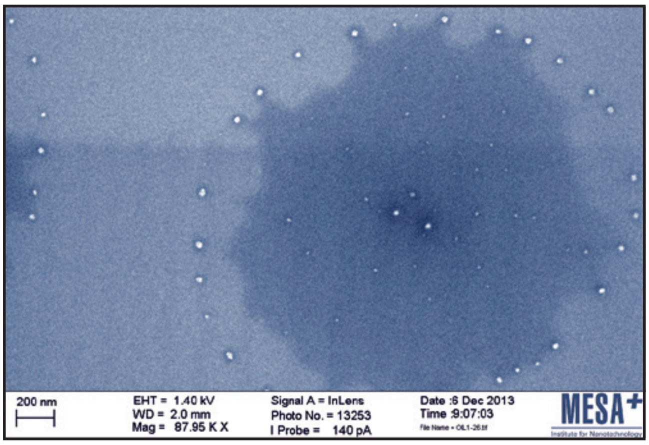
Picture 3: Electrical polarized nano-powder
Source: Radboud University Nijmegen (NL)

5 What is the effect of NanoVit®?

NanoVit® provides the lubricants new special and permanent properties:

- The frictional surfaces are cleaned thoroughly, independent of the actual condition of the lubricant.
- It improves the local viscosity in the frictional areas.
- It increases the heat capacity of the lubricant.
- It modifies the frictional surfaces, the surface tension and consequentially the wear reduces.
- It protects the frictional surface against electro-chemical corrosion.
- The oil consumption of the engine reduces dramatically and the life-span of the lubricant increases.
- It reduces emissions in combustion engines which leads to fuel-consumption reduction.

The application of NanoVit® in fluid hydro carbonates doesn't alter the chemical and physical properties of the lubricants. The certified specifications of the lubricants remain unchanged after the applications of NanoVit®.



Picture 4: the magnification of the oil density within the spatial oil-structure.
(more pictures: www.nanovit-research.de)
Source: MESA+ Institute for Nanotechnology.