Making the Case for Nano Technology Lubricants

CATEGORY OR KEYWORDS
Fluid Lubrication

AUTHORS AND INSTITUTIONS
Dr. Michael Hagemann
Evonik Resource Efficiency GmbH

Dr. Stephan Wieber
Evonik Resource Efficiency GmbH

Dr. Roland Wilkens
Evonik Resource Efficiency GmbH

Dr. Daniel Ness
Evonik Resource Efficiency GmbH

INTRODUCTION

Nanostructured materials are predicted to become an important lubricant additive class due to their extraordinary tribological properties.[1, 2] These include high load bearing capacities, very low friction (reaching even super lubricity) and anti-wear properties.

In spite of their advantages and intense academic research this additive class is still not well established nor widely used in industry.

Dispersion stability and filtration properties are seen as the main hurdles for industrial application of nanostructured materials as lubricating oil additives. This talk will analyze the hurdles that future product developments must overcome and propose respective solutions.

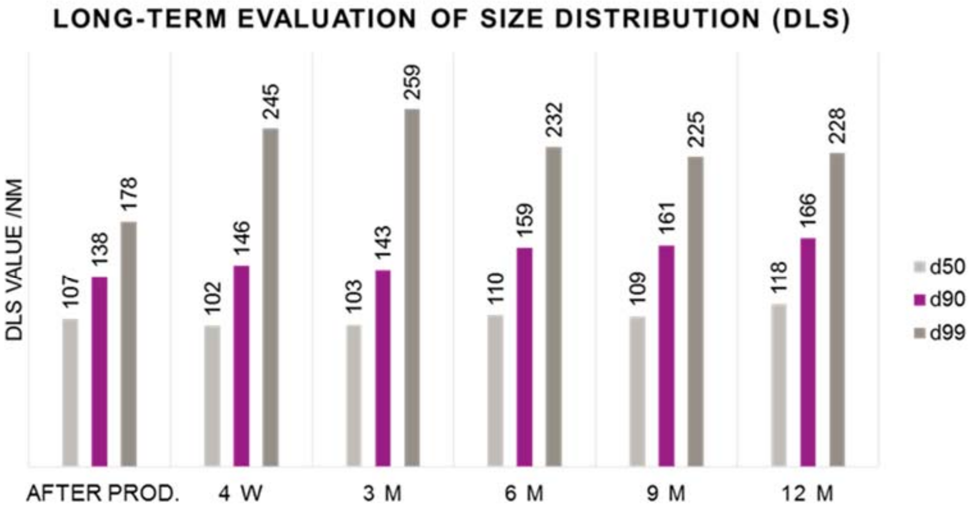
While most research work focusses on one solid material, this talk will consider particles of different chemical nature and compare respective properties. The talk will consider two different particle natures: materials that are solid lubricants by themselves, like the metal sulfides of Tungsten and Molybdenum, and materials that do not belong to this class, like the oxides of Silicon and Titanium.

DISCUSSION

In this study, the creation of stable nanoparticle dispersions in oil with polymers as dispersing aids is demonstrated.

It will be explained that besides the chemical nature of the particles and the chemical structure of the polymer, the dispersing process is of highest importance.

We compare dispersions created via ultra sound, jet mill, and agitator bead mill and show how these processes influence the dispersion stability. Optimizing chemistry and processes, the dispersion stability can easily exceed one year. Creating small particle size distributions allows for the creation of long term stable materials. Figure 1 gives the example of the particle size distribution analysis of a TiO_2-dispersion over the course of 1 year.



Results from SRV, MTM, 4B and FE8 tests will be discussed during the talk and the particle system properties will be compared.

We observe that thick TiO_2-containing tribo-layers are generated from stable TiO_2-dispersions, which reduce wear, but do not reduce the friction coefficient. In comparison, the WS_2-dispersion yields strong friction reduction as it might be expected from its chemical nature. An even lower friction coefficient is observed using nanostructured *h*BN.

Taking the leap from tribometer analysis to application related tests the talk will analyze how the dispersion quality, particle size and chemical nature of the particles influence the results in FE8 tests.

REFERENCES
[1] Spikes, H, (2015), “Friction Modifier Additives,” *Tribology Letters*, **60** (5).
[2] Dai, W., (2016), “Roles of Nanoparticles in Oil Lubrication,” *Tribology International*, **102**, pp. 88-98.