26 de NOVIEMBRE de 2021

12.00 h
Aula, Edificio I+D,
Campus Río Ebro

INMA Impulso

Water-based lubricants for a green tribology transition

Prof. Nuria Espallargas
Norwegian University of Science and Technology (NTNU), Trondheim, Norway

In order to build a safe and sustainable industry for the future, environmentally friendly technologies need to be developed with a focus on the future of our society. In the field of lubrication and lubricants, the main challenges are related to poor recycling (only 50% of lubricants are recycled in Europe and the rest are burned up) and spillages of mineral oils. The latter have unfortunately increased in the last years and therefore are putting our ecosystems at risk. Many of the machineries operating offshore suffer wear due to the harsh operating conditions. The continuous pursuit for improving the performance of the lubricated systems operating in offshore conditions together with the increase in the environmental restrictions set by regulators pushes lubricant formulators to shift to safer lubricant formulations.

Lubricants consist of a base fluid and 5-30% of an additive package (AP), which provides functionalities to the base fluid. The AP is a complex mixture of chemical compounds having a direct impact on the environment due to leakages and poor recycling methods. Every function of a lubricant additive is fulfilled by single chemicals carefully designed to avoid competition with each other. This makes it difficult to develop recycling strategies and limits finding and developing greener alternatives with the same functionality.

Environmentally acceptable lubricants are typically more polar than classical mineral oils or synthetic oils used in machine elements. This directly influences the selection of additives responsible for frictional reduction, corrosion protection, pour point depression or viscosity. Many approaches are taken in industry to tackle this challenge, in our group we believe the best technology for a greener lubricant industry is water-based lubricants since water is readily available and any formulation based in water is potentially easier to recycle. Unfortunately, water has never been considered a good lubricant due to its low viscosity, poor corrosion and frictional properties. The performance of water-based lubricants must be therefore improved by carefully selecting the additive package to best match the operational conditions.

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