Tribology, the tool for an efficient implementation of Materials for tomorrow

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Europe is strongly committed to reduce carbon footprint by 2050. One of the ways to achieve this goal, involves the increase of energy efficiency and materials durability. The tribology is an excellent tool to quantify them. Materials for tomorrow should consider circularity to assure future materials availability. Materials coming from recycling (secondary materials) and biobased materials have lower carbon footprint than primary and fossil fuel derived materials. The main challenge of materials for tomorrow is to achieve the performance of primary or fossil fuel materials by using recyclable and biobased materials. Innovative coatings and nanotechnologies can be used to generate competitive tribological solutions by design.

Keywords: tribology, materials by design, coatings, biobased materials, low carbon footprint.

1. Introduction

The paper intends to highlight the potential of tribology as a tool that can help to reach European Green Deal objectives[1]. Durable and energy efficient materials and products are needed that are re-usable and repairable, with extended lifetime and functionality. Recycled materials can be upgraded for re-use as secondary materials, enhancing their performance by using suitable coatings. Materials design to be used in demanding situations can be achieved with specific tribological, mechanical and corrosion studies. Technology exists to simulate, at a laboratory level (field to lab), the working conditions of the different components in tribological-systems, and to reproduce potential failure mechanisms. This allows for a laboratory determination of the estimated lifetime of an unused component, or the remaining life of an ex-service part, which can be extrapolated (lab to field) to predict the behaviour of the materials in the real applications.

Green materials should be durable and energy efficient with a low carbon footprint during material processing and consider recycling as a circular approach to preserve raw materials. New technologies should be developed by research institutions and Universities, with subsequent implementation by SMEs and industry, to achieve the right impact of a sustainable European society.

2.-Results:

In the paper, several examples[2] on how tribology might serve to achieve green deal objectives is shown:

- Implementation of biodegradable lubricants for different industrial applications (SUNOIL, BIOGREASE, IBIOLAB, VOSOLUB EU Projects)
- Clean alternatives to replace Cr(VI) in tribological coatings (EFCAP, HVOF EU Projects[3]
- Replacement of Lead in common bearings electrochemical coatings (BELEADFREE EU Project, ECOBEARING Meranet Poject).
- Implementation of biofuels (biodiesel, bioethanol) and biolubricants in engines.

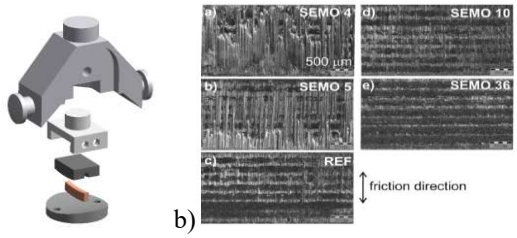

Figure 1.- *a) Piston ring/cylinder liner configuration developed by TEKNIKER. b) Selection of 2 stroke oil to avoid scuffing of bioethanol/biolubricant mixture, in piston ring/cylinder liner tests.*

In order to quantify the environmental impact of the tribological solutions, it is highly recommended to perform the lifecycle environmental assessment (LCA) of the solutions proposed. Examples of the combination of tribological studies and LCA studies are welcome.[3]

2. Discussion

Some of the recommendations[4] from the materials community European materials platform (EUMAT) and Alliance for Materials (A4M) to the EU Commission for Horizon Europe funding program are tribology related:

- Materials should be durable and energy efficient with a low carbon footprint during material processing, use, recycling, reuse and by materials-saving products "by design" during their complete lifecycle.
- Investment in materials for decarbonized and renewable energy is needed without forgetting the need for alternative fuels, efficiency of mixtures and emission's reduction.

3. References

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