Green Tribology as an Indispensable Part of Sustainable Future and Associated Knowledge Challenges

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Environmental awareness and especially the legislation that requires the reduction of polluting emissions are strong driving forces toward more sustainable engineering and greener solutions in the design, use and overall life span of machinery. However, providing novel concepts that will exclude non-environmentally adapted, but over many years developed and optimized solutions, is not an easy task. It clearly requires time if the same level of technical performance is to be maintained. Green tribology is one of the fields that has been closely involved in these actives in the past two decades. The talk is about what we really systematically do about green tribology, how do we very-differently consider it, and how much do we know about it, as well as where to study about it. Accordingly this work provides the discussion on many questions that are still to be defined and answered but are essential for sustainable engineering, and green energy transformation.

Keywords (from 3 to 5 max): green tribology, sustainability, knowledge

1. Introduction

It is becoming very clear, with overwhelming evidence from researchers worldwide, that the use of fossil-based fuels is the key source of climate change. Therefore, we need to act immediately to reduce these energy-consumption levels as well as pollution in many forms, such as limitations on CO_2 and particle emissions in internal combustion engines, by, for example, EURO regulations, [1] (Fig. 1). What is more, through the 2015 United Nations Climate Change Conference [2] held in Paris in 2015, 170 countries are now legally bound to reduce the amounts of energy they use from conventional fuel resources. In order to meet these obligations, lowering friction and reducing wear will play a critical role. Moreover, the wear-related replacement of parts and machinery and vehicles lead to increased demands for more production, and thus more energy consumption and so more pollution [3].

2. Green tribology challenges

Thus, the challenge for green tribology is to reduce both friction and wear and improve lubrication in a sustainable way. However, in today's extremely advanced state of technology it is not sufficient to merely design a new, green lubricant or additive, adapt novel bulk materials or produce advanced low-friction surface coatings. The compatibility between these various components is complex and current solutions have taken years of development and optimization. If any new engineering contact is to result in substantially lower friction and wear, it needs to be sensitively tailored into an innovative combination of substrate, coatings, lubricant and additive, adapted to an optimized joint performance with low friction and wear, typically through the formation of particular nm-scale interface layers in these contacts.

3. Discussion

Creating a sustainable engineering future will require a more comprehensive understanding of green tribology as a concept that encompasses the complete engineering life-cycle and the skills, knowledge and expertise to provide environmentally sustainable solutions and more general green tribological contacts and solutions, applicable in many engineering mechanical systems. To ensure that green tribology becomes central to engineering design, researchers will need information and knowledge covering these topics in the public domain. In fact, this is also the focus of a recent European-wide research activity to develop general and green tribology concepts within the framework of the GreenTRIBOS initiative [4], which is also discussed in this work.

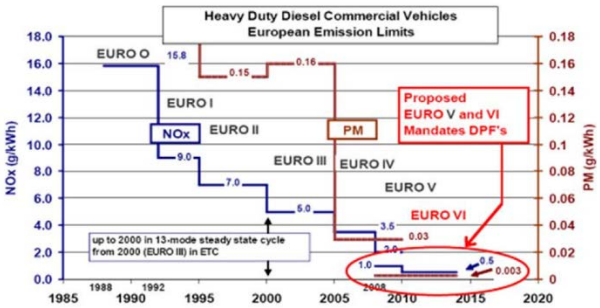

Figure 1: Increase in demands of the EURO standards for the emission limits of internal combustion engines.

4. References

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