7th World Tribology Congress, WTC 2021
September 5-10, 2021, Lyon, France

Future Transport Priorities for Engineering Tribology

Martin Priest

Faculty of Engineering and Informatics, University of Bradford, UK
m.priest@bradford.ac.uk

Engineering tribologists have dedicated themselves throughout the last fifty years to minimising the lifecycle impact of internal combustion engines and other common energy conversion devices for transport. Massive improvements in energy efficiency, durability, reliability and environmental impact have resulted, and the machines of today are vastly superior to their predecessors. However, global and societal outlooks have accelerated at a faster rate in recent years and we now face new tribological challenges from engineering systems powered far more by electricity than traditional fossil fuels. Tribologists need to refocus their future research and development on making the most promising new solutions successful.

Keywords: tribology, transport, energy, efficiency, environmental impact.

1. Introduction

During the 1970s there was huge growth in the demand from industry and society for more energy efficient machines, and the automobile was a natural focus, as fossil fuel costs rose very markedly and visibly for the consumer. Over the following decades, the performance demands placed on the reciprocating internal combustion engine moved cyclically through reducing friction, controlling wear and minimising environmental impact [1]. With the passage of time, the scope expanded from road transport to rail, sea and air, with gas turbine engines facing similar scrutiny. The energy consumption and environmental impact of the power generation and manufacturing industries also grew in importance. It is no exaggeration to say that the performance improvements achieved over the last fifty years have been immense, and tribology has been crucial to that development.

However, increased globalisation of the challenges facing the world and the pressures from a growing global population are now pushing technological innovation faster than we can improve traditional energy conversion devices. At a time of such great change, tribologists need to show agility and refocus their efforts on the most promising engineering systems that are emerging to meet this step change in demand.

2. Approach

The review presented here considers the alternative technologies that are emerging for a range of energy conversion devices, in terms of the tribological challenges that they pose. All machines have interacting surfaces in relative motion, and so tribology will always have a vital role to play in controlling the lifecycle impact of any machine or larger system.

The compelling and undeniable trend is for the engineering systems used to provide motive energy for transport to be powered predominantly by electricity rather than fossil fuels. These technologies should be viewed not only in terms of their engineering but also with respect to their operation. Increasing autonomy, removing much of the variability of the human operator, presents an opportunity for enhanced energy efficiency and reliability. It is an old adage that the benefits of reducing the friction of an automobile engine is then lost in operation as the human driver simply uses the power capacity this creates to drive faster and more aggressively. In parallel, the growth in the ensemble sensor arrays of the internet of things and our ability to analyse huge data sets, increasingly in real time, presents an opportunity to monitor the health of a machine in service and change the way it operates to improve performance and reliability [2].

Of course, viewing the end use of energy for transport in isolation from the primary energy generation process is a flawed analysis. So, attention is also given to the tribology of electrical power generation and the devices emerging to supply low carbon electricity, with the timeline for their implementation and integration into energy supply networks an important consideration.

The aim of the analysis presented here is to guide engineering tribologists to aspects of these new technologies where their efforts can have the greatest industrial and societal impact across the globe.

3. References

[1] Priest, M. and Taylor, C.M., “Automobile Engine Tribology – Approaching the Surface”, Wear, Elsevier, 241, 2, 2000, 193-203.

[2] Doikin, A., Zadeha, E.H., Campean, F., Priest, M., Brown, A. and Sherratt, A., “Impact of Duty Cycle on Wear Progression in Variable-Displacement Vane Oil Pumps”, Procedia Manufacturing, Elsevier, 2018, 16, 115-122.