Lubricant-surface system mitigating in-cylinder friction

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1. Introduction

There is a global challenge to reduce environmental pollution and increase the efficiency of automotive powertrain systems. Existing research indicates that 7-8% of energy loss within an internal combustion engine is attributable to parasitic friction at the piston-ring-liner interface [1] and provides the greatest opportunity for improvement [2]. Therefore, it is critical to design systems to optimise friction losses in this conjunction [3].
There is typically, 50-62% thermodynamic heat loss from exhaust gasses and cooling system of the engine in a typical light duty automotive vehicle. Total engine frictional losses account for almost 16.5% [4] of the fuel used and hence gaseous emissions, but it can increase to 20-30% under urban driving cycle [5]. Breakdown of the efficiency for a typical light duty vehicle is shown in Figure 1.

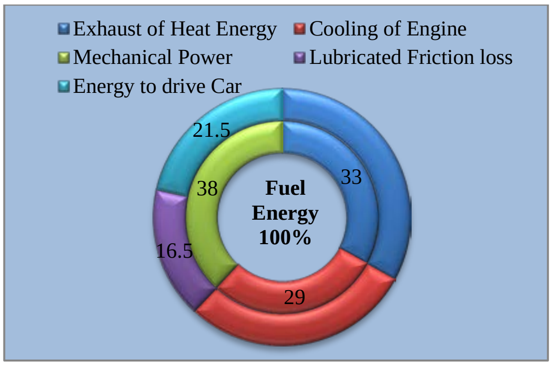

Figure 1: A breakdown of IC engine energy consumption [4]

There is significant publication of friction reduction techniques for lubricants and surfaces. However, there is a dearth of integrated modelling and experimentation for lubricant-surface system together, particularly for practical applications. This integrated research in lubricants and surfaces will open a new horizon for lubricant and surface manufacturers, to provide better products and provide a competitive advantage for both engine and lubricant manufacturers.
There are more than 1300 lubricant manufacturers worldwide, collectively producing in excess of 37 million tons of lubricants per annum in 2004[6]. The current research is intended to formulate an improved lubricant-surface system.

2. Methodology/Results/Discussion

The experimental research plan is shown in *Figure 2*. The rheological and physical-chemical properties of lubricants are investigated through Rheometers and spectrometers respectively. The surface topographical and lubricant-surface (L-S) interaction is analyzed through the use of atomic force microscopy in lateral force mode. Both experiments run simultaneously, by continuously tracking the lubricant's additives and their respective interaction and impact on surfaces.

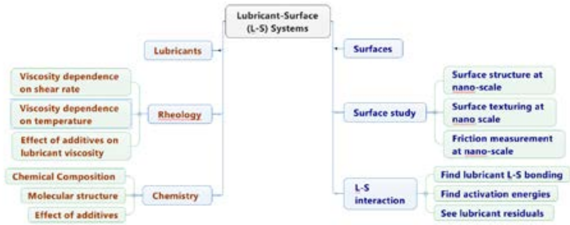

Figure 2: Experimental procedure for Lubricant-surface system

The lubricant-surface system would enable optimization of their combination for enhanced load carrying capacity and reduced friction. In order to validate the result, initial wide ranging combinatorial experiments will be carried out using a number of tribometers. Engine testing will then be conducted for selected lubricants and surface combinations. The Dynamics Research Group has an in-house engine based rig for the measurement of in-cylinder friction, using a floating liner [5].
The supports of EPSRC, Castrol, Capricorn Automotive and UET Lahore are acknowledged.

3. References

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