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RESEARCH

Tribological Principles of Constructing the Reciprocating Machines

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A B S T R A C T

Reducing vehicle weight contributes to reducing fuel consumption and exhaust emissions. In practice, this is achieved by application of lightweight materials and through optimization of tribo-systems on the vehicle. The benefit of using aluminium is evident due to the reduced mass of the parts, but in parallel there is a problem due to the low strength of this metal. This is especially evident during overheating when can form cracks. The wear resistance and tribo-properties of aluminium are the problem, too. To achieve the strength and tribo-properties of aluminium alloys similar to grey cast iron, we applied eco-tribological knowledge during construction of reciprocating machines. The result of researches is patented prototype of aluminium piston and cylinder whose contact surfaces are coated or modified with inserts based on the tribo-materials.

1. INTRODUCTION

The EU has set out an ambitious strategy to reduce CO_2 emissions from road vehicles. According to European Commission Directive 93/116/EC, total CO_2 output in Europe must aim to reach an average of 130 $g \cdot km^{-1}$ for all new passenger cars by 2015 and 95 $g \cdot km^{-1}$ by 2020 [1]. At the same time, the use of lower viscosity lubrication oil and other measures for the reduction of fuel consumption such as start/stop systems, downsizing of engines and engine components as well as high-pressure turbo injection technologies, are leading to higher loads and increased wear. As a result, by modifying the surface of components in the powertrain by reducing friction and increasing wear resistance, engine coatings look set to play an increasingly important role in improving fuel economy, reducing CO_2 emissions and meeting those tough legislative targets.

In passenger cars, one-third of the fuel energy is used to overcome friction in the engine, transmission, tires, and brakes. The direct frictional losses, with braking friction excluded, are 28 % of the fuel energy. In total, 21.5 % of the fuel energy is used to move the car. By taking advantage of new technology for friction reduction in passenger cars, friction losses could be reduced by 18 % in the short term (5–10 years) and by 61 % in the long term (15–25 years). This would equal worldwide economic savings of 174,000 million euros and 576,000