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The Interaction of Piston-Ring-Cylinder on Flex Fueled Engines

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ABSTRACT

Modern SI engines focusing on CO_2 emission reduction has been applying flex fuel technology to enable burning biomass fuels. The prime route is the use of ethanol fuel on these engines. The action of designing an engine run with Ethanol and Gasoline (Flex Fueled Engines) affects powercell components in different ways. The mechanical loads are higher to Ethanol fuel. The combustion pressure can be increased without the risk of knocking for Ethanol while for Gasoline the compression rate of the Piston is limited due to knocking occurrence. The spark time also occurs earlier which impacts components lubrication once the maximum load happens near the top dead center (TDC) where the sliding speed is lower and consequently there is lower oil film thickness. Such combination of spark time and sliding speed may also affect dynamics which can affect inertia and load composition of engine components. The power density of engines running with Ethanol is also higher, which can impact on temperature, which also influences the tribology of engine components. Another subject on Ethanol is its high corrosive characteristic, which is presenting flaking mechanisms on components, rings for example, not existent on gasoline engines.

In this way, this paper compares the effects of such different engine characteristics given by Ethanol fuel on engine components. These effects are presented in a powercell approach evaluating the interactions between piston, ring and cylinder. Microwelding and/or abnormal groove wear on being dependant on the gas pressure, top land height and ring material is also discussed. Ring and cylinder wear are also affected by the gas pressure but even more on lubrication effects. It is also evaluated the low friction trends on powercell and its adaptions needed on Flex Fueled Engines. And it is discussed the harsher environmental effects given by Ethanol.

In this paper also presents the main recommendations on powercell to best fit on current and future Flex Fueled Engines based on numerical simulations, bench tests and engine tests.