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Effect of fuel oil - gasoline fusel blends on the performance and emission characteristics of spark ignition engine: A review

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Abstract: Alcohol-based as alternative fuels attract the attention of many researchers. Many kinds of research have been conducted on performance, combustion and emission characteristics of alcohol utilized in spark ignition engines. Fusel oil is an alcohol based fuel obtained as a by-product of alcohol fermentation from agricultural such as beet, cone, potatoes, rice, etc. The calorific value, higher evaporation heat and octane number of fuel oil close to other alternative fuels. Despite that, there is limited number of studies refer on the usage of fusel oil as fuel in spark ignition engines. This paper reviews the works done 'effects of fusel oil as a fuel blends on performance (brake torque, brake power, BSFC, effective efficiency, EGT) and emissions (CO, NOx, HC) characteristics in spark ignition engine. It was seen that when fusel oil – gasoline blend used at almost the engine torque and specific fuel consumption increased, Also HC and CO emissions averagely increased. Furthermore knocking and nitrogen oxides NOx were decreased .Moreover volumetric efficiency and octane number increases with the increase in percentage of fusel oil in blend tests. In other hand the negative effects that happened in engine performance caused by the higher water content in fusel oil.

Key words: Fusel oil; Alternative fuels; Spark ignition engine; Exhaust emissions

1. Introduction

A huge part of fuel used in the engine cars is fossil fuels. However researchers have studied on the alternative fuels owing to both damage on the environment and depletion of fossil fuels (Uyumaz et al., 2014). Alternative fuels should be environmental, renewable and easily obtained energy source. Alcohols have been recommended as an alternative engine fuel almost since automobile was invented (Wagner et al., 1979). Several researchers have achieved on using of alcohols directly as an alternative fuel or fuel additives in IC engines. Due the chemical properties of alcohol such as the heat value the fuel consumption usually increases when alcohol is used as an alternative fuel (Chen et al., 2010; Gravalos et al., 2013; Scragg, 2009). Gasoline – alcohol blend can be used with or without water. Depending on the ambient temperature, the chemical structures of the components and purity of the chemical components, phase differentiation problems can be observed. As a result of phase differentiation, differences between each cycle and difficulties in combustion and initial movement problems can be observed

Alcoholic fuels, particularly the ethanol, can be gotten from renewable energy resources such as ammoniac, sugar cane, waste biomass products, barley and corn (Astbury, 2008; Moka et al., 2014). The ethanol that is manufactured in Brazil in 99.3% purity is added to gasoline in concentrations varying between 20 and 25% in order to increase the ant-knocking resistance. (Costa and Sodre, 2010; Icingur and Calam, 2012; Jehlik et al., 1999) Also the oxygen content(O2) of alcohol improves the combustion performance, and allows for reduction the emissions of carbon-monoxide (CO) and hydro-carbon (HC) (Cairns et al., 2009; Yeliana et al., 2008). It is known that the octane values of alcohol-based alternative fuels such as methanol and ethanol that can be used in IC engines are high. The alcohol-based combustibles having high octane values which allow to reduce the knocking in SI engines when increase the compression ratio. The increment in compression ratio leads to improvements engine performance, brake specific fuel consumption BSFC (Cerri et al., 2013; Goswami and Vashist, 2015; Koç et al., 2009; Mack et al., 2014; Rothamer and Jennings, 2012). On the other hand, when compared alcohol with gasoline fuel, many researchers have revealed that alcohols reduce the exhaust emissions. But the low energy values of alcohol may be lead to increase the specific in engine performance. For same engines the fuel consumption and output power, decreases when alcohol-based combustibles are used (Gravalos et al., 2013; Yüksel and Yüksel, 2004).

Fusel oil is a by-product of ethyl alcohol production with fermentation during the distillation process and is a natural source of amyl alcohols (Dörmő et al., 2004; Ferreira et al., 2013; Özgülsün et al., 2000). Fusel oil has a bad smell and dark brown color. It consists of about 390 g/L iso amyl alcohol, 158 g/L isobutyl alcohol, 28.4 g/L ethyl alcohol, 16.6

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