THE EFFECT OF GASOLINE-LIKE FUEL PRODUCED FROM WASTE AUTOMOBILE TIRES ON EMISSIONS IN SPARK-IGNITION ENGINES

H. F. ÖZTOP [a,*], Y.VAROL[b], ķ. ALTUN[c], M. FIRAT[d]

[a] *Department of Mechanical Engineering, Fırat University, 23119 Elazığ, TURKEY*
[b] *Department of Automotive Engineering, Fırat University, 23119 Elazığ, TURKEY*
[c] *Department of Mechanical Education, Batman University, 23119 Batman, TURKEY*
[d] *Department of Mechanical Education, Fırat University, 23119 Elazığ, TURKEY*

Abstract

In the present paper, the effect of Gasoline-Like Fuel (GLF) on emissions was investigated for direct injection spark-ignited engine. The GLF was obtained from waste automobile tires by using the pyrolysis. The tires are installed to oven without any procedure such as cutting, melding etc. Obtained GLF was then used in a four-cylinder, four-stroke, water-cooled and direct injection spark-ignited engine as blended with unleaded gasoline from 0% to 60% with an increment of 10%. Engine tests results showed that CO and HC emissions concentrations in the engine exhaust decrease, while the CO_2 concentration increases for blending gasoline-like fuel with unleaded gasoline.

Keywords: Gasoline-like fuel, waste automobile tires, pyrolysis, alternative fuel.
* Corresponding author. Tel.:+90424 2370000/4222; Fax: +90 424 2367064
E-mail address: *hfoztop4@gmail.com*

1. Introduction

The major part of all energy consumed worldwide comes from fossil fuel sources, which are petroleum, coal and natural gas. They are important energy resources in heating, transportation, power generation, and agricultural and industrial sector (Arpa and Yumrutaк, 2010). It is predicted that fossil sources will be depleted in the near future. Furthermore, environmental impacts have triggered off the examination of alternative energy sources (Utlu and Koçak, 2008). A lot of research is carried out throughout the world to evaluate the performance, exhaust emission and combustion characteristics of the existing engines using several alternative fuels such as hydrogen, compressed natural gas, alcohols (methanol and ethanol), liquefied petroleum gas, biogas, producer gas, bio-diesels developed from vegetable oils and a host of others (Bose and Maji, 2009). Alternative fuels include liquefied petroleum gas (LPG), compressed natural gas (CNG), hydrogen, and electricity for operation of gasoline-type vehicles (Demirbas, 2009). Many studies have been examined the utilization of alternative fuels in spark-ignited engines, and to determine the effects of these fuels on the performance and exhaust emissions (Murugan et al., 2008; Murugan et al.,2008; Arpa et al., 2010). In this study, performance and emission characteristics of the engine were analyzed and compared with unleaded gasoline operation. In this study using system, an automobile tire without any cutting procedure is subjected to pyrolysis process. the methods for the assessment of waste tires at Europe Union in 2003 are shown in Figure1.

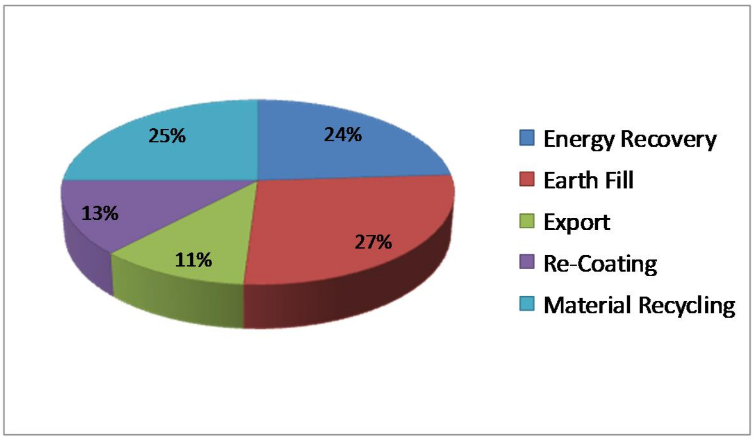

Fig. 1. Evaluation of completed the life of the tires in Europe

2. Experimental setup and testing procedure

The experimental set-up was installed in the Automotive Laboratory of Department of Mechanical Education in Fırat University, Elazığ, Turkey. The engine tests were conducted on engine test bed which consists of a hydraulic brake, test engine, measurement instruments and a control and monitoring panel. The engine used in this experiment is a gasoline engine with a cylinder bore of 89 mm, a stroke of 95 mm and a compression ratio of 11.1. Engine tests were performed at different engine speeds as 1000, 2000, 3000 and 4000 rpm at same torque output. The required load was obtained through the dynamometer control. The concentrations of the exhaust emissions (CO, CO_2 and HC) were measured using a Sun Gas Analyzer MGA 1500.

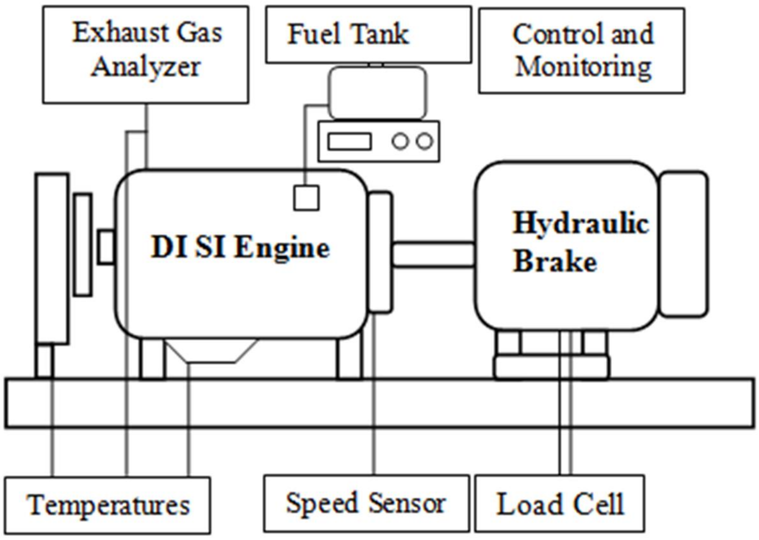

Fig. 2. Experimental set-up

The distillation curves of unleaded gasoline and gasoline-like fuel are shown in the Fig. 4. Initial boiling point of the GLF is 65 °C, final boiling point is 303 °C, and it is higher than the final boiling point for unleaded gasoline (~195 °C). The gasoline-like fuel's boiling point is closer to that of the gasoline, but the distilled temperature of each droplet is higher than that of the gasoline samples. Higher distillation temperature will give higher combustion efficiency, which will increase engine performance.

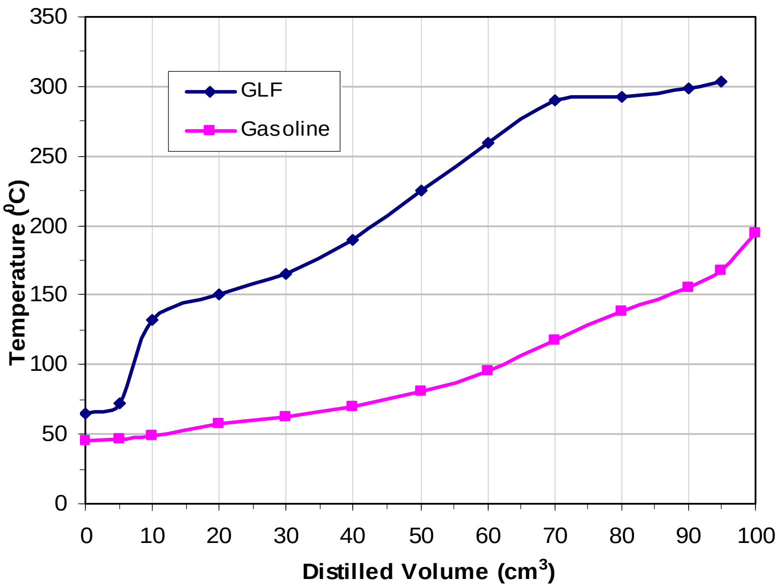

Fig. 3. The distillation curves of unleaded gasoline and gasoline-like fuel

3. Results and Discussions

The effect of gasoline-like fuel blending with unleaded gasoline on fuel consumption of the engine is shown in Fig. 4-6. Fig. 4 shows the variation of carbon monoxide (CO) emissions at different engine speeds. As observed from the results, they show the decreasing trends of CO with increased engine speeds while the content of unleaded gasoline in the fuel decreases. The increased engine speed causes to increase air movements in the engine cylinder which lead to more homogeneous air-fuel charge and thus results in an improved combustion and consequently lowered CO emissions.

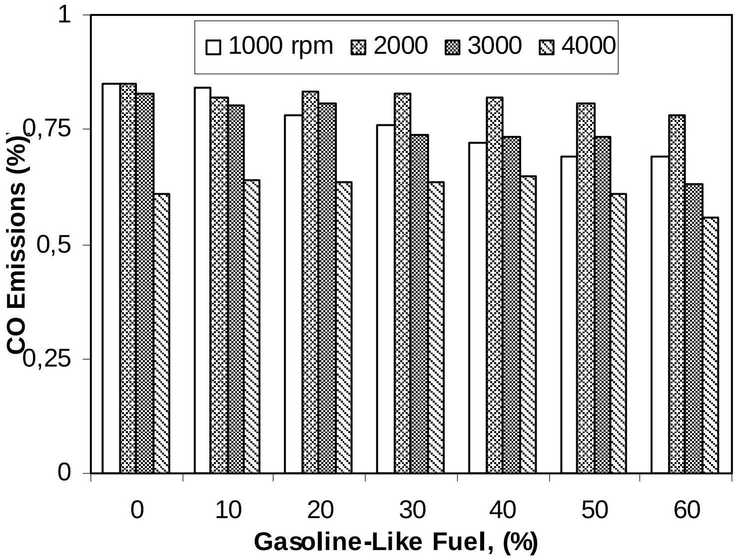

Fig.4. Carbon monoxide emissions (CO) for test fuels

Fig. 5 shows the variation of hydrocarbon (HC) emissions for the tested fuels at different engine speeds. HC emissions for blended fuels are higher than gasoline at low engine speeds. Higher HC emissions are probably due to higher viscosity, density and poor volatility at low engine speeds. Besides, the higher distillation temperatures of gasoline-like fuel might increase HC emissions. All these reasons lead to incomplete combustion and hence higher HC emissions.

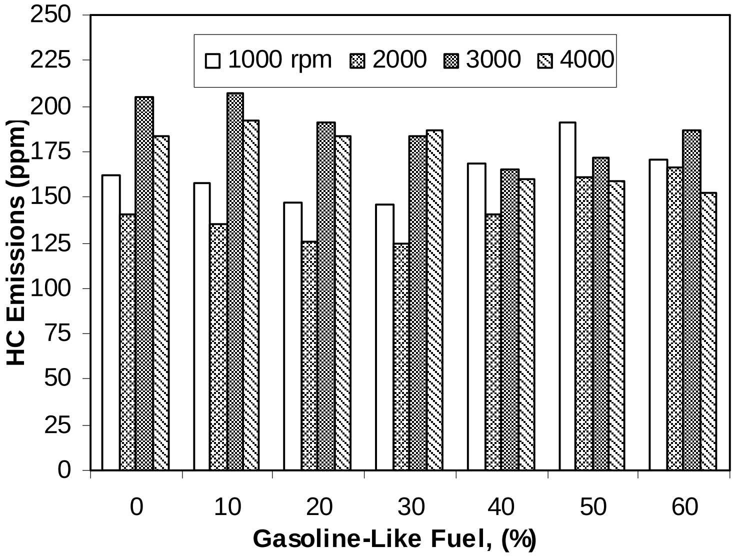

Fig.5 Hydrocarbon (HC) for test fuels

Fig. 6 shows the variation of CO_2 emissions for the tested fuels at different engine speeds. One can observe that all the blended fuels of the gasoline-like fuel and unleaded gasoline presented very similar CO_2 emissions.

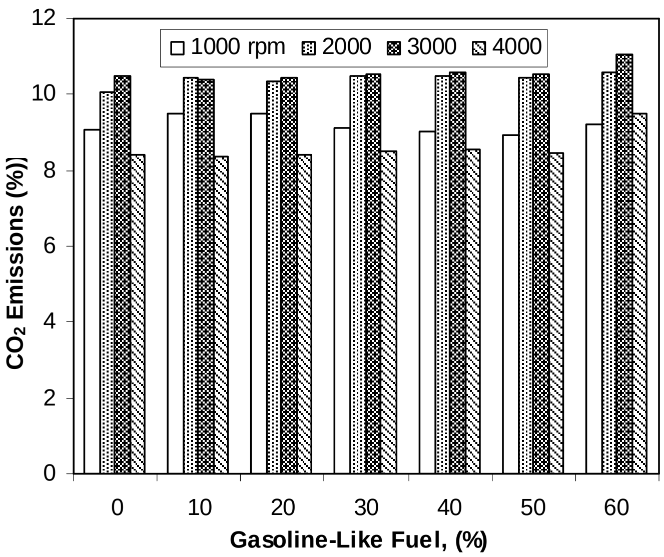

Fig.6 CO_2 emissions for test fuels

4. Conclusions

This study was performed to analyse experimentally gasoline like fuel on the emissions concentration in the direct injection spark ignition engine. Results are showed that gasoline-like fuel obtained from waste automotive tires can be partially substituted for the gasoline fuel up to 60% in blended form in terms of performance parameters and emissions without any engine modification. The CO and HC emissions were reduced with the use of the gasoline-like fuel-unleaded gasoline blends with respect to those of the unleaded gasoline.

Acknowledgment

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