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REDUCING HC EMISSIONS WITH ETHANOL USE IN AN INTERNAL COMBUSTION ENGINE

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Abstract - In this study, 1-D numerical analysis model of a spark ignition engine has been created. So, an engine test system has been modeled with using analysis program. Results of the HC emissions analysis which has been used gasoline and ethanol have been obtained for a total of five different engine speeds ranging from 1000 rpm to 5000 rpm with an increment of 1000 rpm. Effects of both gasoline and ethanol on HC emissions of the spark ignition engine based on engine speed have been revealed. Emission value also in terms of HC has been commented. Results of 1-D numerical analysis model have been shown with graphics.

Keywords - Spark ignition engine, Emissions, 1-D engine modeling, Ethanol

I. INTRODUCTION

That alternative fuels increasing the importance of every day in terms of natural balance and minimizing of emissions has been an inevitable item on the agenda in the automotive world. Developed in many studies is desirable more efficient use of alternative fuels and giving less damage to the natural balance with liquid fuels such as gasoline and diesel fuels inclusion different additions. Today, performed fuel supplements: For gasoline engines ; ethanol, methanol, kerosene hydrogen, LPG, CNG and LNG (use less). All alternative fuels which can be used for all type of engine are added in experimental and numerical studies. These additions results are investigated emissions values of engine. Same time, due to experimental studies require both highly cost and extensive time, alternative fuels studies tended analysis program which can be taken faster and near accurate results. In this study, it was aimed to compare the use of pure ethanol in terms of HC emissions by modeling a gasoline engine. The use of alternative fuels in the literature has mostly been experimentally studied. Through this numerical study, it has been tried to create original value in the literature. The workstation and the computational fluid dynamics (CFD) program helped to avoid costly and faster data throughput. In the literature dealing with this issue, there are numerical and experimental studies with various content and approach. Ors and Ciniviz [1], have investigated the effects of the gasoline-bioethanol blend on the vehicle. Gasoline and bioethanol were blended as E50, E85 and E100 on vehicle performance and emissions of vehicle with spark ignition engine. The wheel power decreased and fuel consumption increased for performance and CO, CO_2, NO_x emissions are decreased, HC emission is increased at using bioethanol-gasoline blends. Cay et al. [2], have compared engine energy distribution and efficiency for use of methanol in gasoline engine. As a result theoretically, indicated and organic efficiencies increased in the use of gasoline. Mechanical and effective efficiencies dropped by use of gasoline.

II. 1-D MODELING

In this digital-based work, an internal combustion engine with 4-stroke and sequential ignition was modeled from the intake air environment to the exhaust air environment through the 1-D Modeling Program. All the elements that make up the engine are modeled and all the elements from the intake manifolds to the exhaust manifolds are connected to each other in real scale. The geometric and physical conditions of all components of this spark ignition engine have already been determined. The characteristics of all the components belonging to the spark ignition engine are entered in this program. The 1D model is solved faster and less costly than experimental ones. The properties of the modeled motor are shown in Table I.

Engine Type	Spark Ignition
No. of Cylinders	4
No. of Valves	2
Compression Ratio	10.0:1
Bore	78.1 mm
Stroke	82.0 mm

Table 1. Specifications of 1-D Modeling Engine.

The engine was modeled with all parts and simulated after defining the initial and boundary conditionsIn the case of using 100% ethanol in full throttle.(Also, convergence criteria: 0.01, the number of cycles: 300,time step size: 0.5).

The 1-D spark ignition engine model is shown in figure 1.

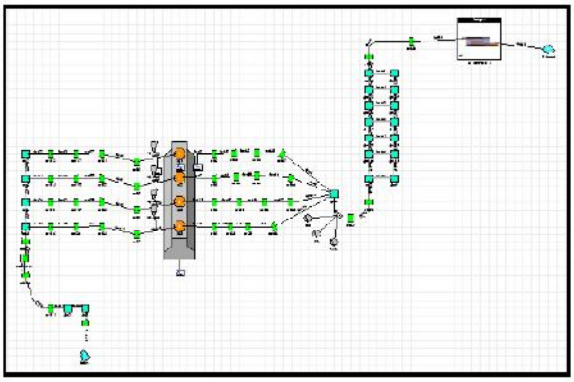

Fig.1.1-D Modelling of The System

As a result of the analysis, gasoline engine HC emissions levels obtained by the numerical model have been examined and evaluated. This results are shown in the following section.

III. COMPARISON OF RESULTS OF THE IDEAL SYSTEM AND 1D MODEL

The graphic is shown in figures as overlapped to observe more clearly the difference between ethanol and gasoline. It is given that use of gasoline in terms of HC emissions in gasoline engine modeling on Figure 2.

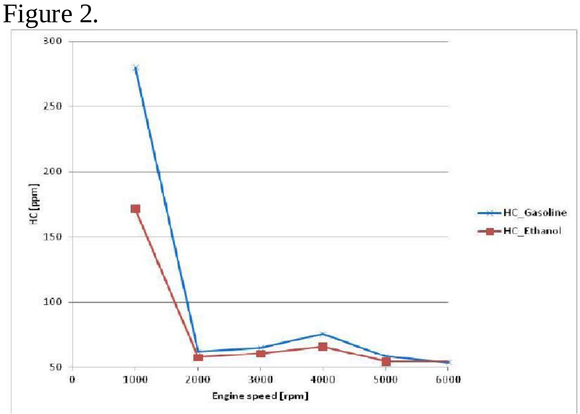

Fig.2.Engine speed – HCemissions and comparison of different fuel types.

HC emissions are compared engine speed, according to using ethanol on Figure 2. The HC emissions are significantly lower at a noticeable rate than ethanol use compared to gasoline use.

CONCLUSIONS

The results of the ethanol-gasoline comparison for HC emissions are shown in Figure 2. HC emissions, which tend to decrease in general due to many influences, show similar behavior with respect to use of ethanol in ethanol use, but HC release is reduced by ethanol addition. The reason for this is that the higher the evaporation of ethanol compared to the gasoline, the lower the ambient temperature due to heat. Particularly close to the cylinder walls, flame extinguishes due to the low temperature and HC emission increases. Along with the increase in vehicle power output, there has been a decline in HC emissions [3].

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