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ORIGINAL ARTICLE

Evaluating the Physical Properties of Biodiesel and Diesel Fuel Blends to Use In Compression Ignition Engines

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ABSTRACT
So far the most important and the most common fuel used in diesel engines has been diesel fuel in many countries. The use of diesel fuel in these engines leads to release harmful substances and pollutants with chemical compounds that causes environmental damages irreparably. In this direction, bio fuels have chemical and physical attributes of different fuel blends in 6 levels are compared biodiesel is produced with the residual oil in restaurants by trans-strification method. Examined fuel samples containing diesel fuel which is commonly used in Iran as a fuel source and compositions of produced biodiesel based on voluminal of 0, 5, 10, 15, 20, and 25% which are called respectively B0D100, B5D95, B10D90, B15D85, B20D80, B25D75 were considered. The results of the experiments show the increase of 1.89% density based B25 to B00. The results of the tests on viscosity of fuels indicates the increase of these attributes for B25 to B00 is about 34.96%. This increase toward the conventional diesel fuel with the amount of biodiesel percentage in composition was in relation directly.
Keywords: *alternative fuels, biodiesel, physical properties, blend fuels*

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INTRODUCTION

Reduction in fossil fuels and environmental considerations caused to use of renewable fuels like, ethanol, hydrogen and biodiesel. Today, most of these fuels are used with fossil fuels in vehicles. The main problem of fossil fuels is its pollution. Bioethanol is cleaner than petrol and it is renewable that most of the countries use it. Not only it is renewable, but also it has far less pollution for the environment than other fuels like petrol and diesel fuel.Today gasohol or E10 (a blend of 90% petrol and 10% ethanol) and E 85 are used as most of the vehicles fuel. Use of E10, without needing major changing in engine, causes reduction in petrol fuel consumption [3].

Currently, ethanol as a reliable source, can be used instead of other common fuels. Ethanol produce able according to each country resources. 98% of the produced ethanol in the world, by using of sugar fermentation, would achieve. The useable sugar can be obtained from different resources like starch, sugar agricultural products, industrial waste water, Ligno cellulose sources. Ethanol is produced in industrial scales from water increasing reaction to ethylene in the presence of sulfuric Acid catalysts. In 2007, the total amount of world production of this substances was about 45 to 50 billiard liter that Irans proportion of this mount was around 0.001%, while Iran with having rich oil sources has the ability to produces more than one percent [1].

Ethanol production expense, compared to the price of raw material, has a high sensitivity. So sources in ethanol production and its competition with other fuels concerns with the geographical situation of the region, climatic condition, production method, agricultural productions, attributes and types of their wastes. A system that is based on low cost row materials, easy accessibility to the row materials and use of its side products, has economical justification. The studies show that adding ethanol to diesel fuel has no effect on fuel flash point, even with adding biodiesel fuel, no change happen in it, but the blend flash point reduces in these three fuels [2].

It has a good advantage to add ethanol to diesel fuel than biodiesel because preparing ethanol and diesel fuel blend is simple and also cheaper. Ethanol can be produced from many different materials and is completely renewable. While ethanol has a long process to produce and is costly, despite its advantages and also its renewability is 89% [5].
The studies show, the amount of oxygen into alternative fuels, useable in diesel engines, is between 6.9 to 25.7 percent, if the amount of oxygen in fuel is 5.19% Aromatic Hydrocarbon density and emitted soot And is of emitted gassed will be minimal. And also emitted CO densing from exhaust depends on rev and has the minimal amount in 10.7 to 16.8 percent of oxygen [6].

MATERIALS AND METHODS

In this design, diesel fuel and bioethanol fuels, blend physical attributes are examined in different levels. The used bioethanol in Zanjan Kymia Alcohol company with the parity of 96% was produced. Table [1] shows the features of bioethanol fuel [4]. The features of the examined bioethanol fuel To evaluate the physical attributes of diesel fuel with bio ethanol blend, two fuels were mixed with clear amounts until the best kind of fuel identifies bioethanol in 6 levels consists of 0, 2, 4, 6, 8, 10, & 12 of final blend voluminous percentage, was blended with conventional diesel fuel in Iran. Each of the fuel samples was named by EXDY. E indicates bioethanol, D indicates diesel fuel, X indicates bioethanol voluminous percentage and Y indicates diesel fuel voluminous percentage. Preparing fuel blend samples, physical, combustion attributes were measured according to ASTM standard.

Density:

In this study, density determination was measured according to ASTM standard by a hydrometer and weighted method. Fuels sample put in to milliliter stings and was calculated by measuring the sample density in a digital scale with 0.01 accuracy, and dividing the sample density by sample volume, according to equation [1].

$$\rho = \frac{m}{v} \qquad (1)$$

Kinematic viscosity:

At the beginning, we turn on the set and adjust the bath temperature on 40°c. we choose a calibrated viscometer that surround the estimated kinematic viscosity so that the current time should not be less than 200 seconds. The sample was entered in the viscometer by pure and the viscometer was entered into the bath by keeper. We waited around 5 minutes until the sample temperature becomes the same as the bath. Then draw up the sample coke pure upper than the first signed line. Afterwards we calculated the time needed for flowing the liquid from the first singed line to the second one based on seconds. Then write down. Kinematic viscosing was computed by using fixed and measured current time of viscometer that is measured on it by equation (2):

$$\nu = C \times F \times t \qquad (2)$$

In this equation:

ν: Kinematic viscosing based on mm2/5

C: viscometer calibration castant (that is 0/03959 in experiment set)
t: Current time (s)
F: Current factor (F=1)
We use the equation (3) to determine dynamic viscosity.

$$\upsilon = \frac{\mu}{\rho} \qquad (3)$$

In this equation

μ: dynamic viscosity based on cp_z

An error that may happen in this experiment can be due to the temperature fluctuation. Another error can be related to sample passing recognition time from the line that can be removed by repeating the experiment.

Cloud point:

One of the major attributes of fuel using in cold climatic conditions is cloud point. This point is the temperature in which the first wax network creates to cloud into the cooling liquid. It is the lowest temperature that we can use the fuel in. Using fuel in lower temperatures of cloud causes fuel filter clogging because of forming wax network. Cloud point is determined according to the ASTM D5777 standard by observing fuel transparency at which is cold under the controlled conditions. Since the start of crystals, formation in biodiesel is done in upper temperatures than diesel fuel, so low biodiesel cloud point than diesel fuel is one of its important disadvantages. To determine, at the beginning, the samples will be cooled in a special cooling device in a fixed manner and than the sample would be measured by an optical detector constantly. The temperature at which the first wax network would appear to network, would be registered as a cloud point. This trait was measured by using a refrigerator according to the ASTM standard.

Pour point:

It is the lowest temperature at which the fuel can flow. The fuel changed to solid after this temperature and is not useable. This point is very important to transfer the fuels in cold conditions. The standard to determine this point is ASTM D97, In this method the fuel would be cold in a special manner and its liquidity would be evaluated in each 3 seconds. The lowest temperature at which the fuel can flow is pour point.

RESULTS AND DISCUSSION

Evaluation of blend fuel density and viscosity:

The density will increase around 2% with rising the bioethanol percentage in blend. This may be contrary to the expectation at first glance but the reality is that with increasing the amount of ethanol in blend with diesel fuel, the molecules, locating of two substances in their distances happen better and as a result with decreasing the empty spaces among molecules and approaching the molecules together causes compressing blend molecules and as a result in volume unit, due to the molecules, compression, it cause a more weight up. With further increase in ethanol in each level, density decreases. Thereby the maximum density reduction occur in ethanol 4% and 6% samples. Again in ethanol 2% blend, a great increase was in density. In figure (3) the effect of bioethanol different percentages on fuel blend samples density is shown.

Adding ethanol reduces diesel fuel viscosity to a great extent. We can use of this ethanol attribute to improve the high viscosity of biodiesel in which is one of its disadvantages. In 2% , 6% and 12% ethanol compared with the amounts 4%, 8% & 10% the viscosity reduction is considerable. In figure (4), the effect of different bioethanol percentages on samples, viscosity fuel blend is shown.

Evaluation of cloud and pour point blend fuel:

With the increase of ethanol in samples, cloud point decreases. We can relate this attribute to the cloud point of very low ethanol that adding it to blend even in low percentages, can decrease the points. In figure (5) cloud point changes are given in fuel blend samples. Also pour point decreases with increasing ethanol. In figure (6), pour point changes are given in blend samples. It is so clear in this graph that the samples include ethanol 2% & 8% than the other two levels, has caused the greatest decrease in pour point.

Table1. Characteristics of the test fuel bioethanol

Fuel Characteristics	ethanol
Chemical formula	C_2H_5OH
The molecular weight	46.7
Density (kg / Lit) at 15^{0}C	0.79
Welding point ^{0}C	78
Steam pressure(kPa) 38^{0}C	15.9
Viscosity (Pa.s)	1.19
Heating value (1000KJ/Lit)	21.1
Specific heat (KJ / Kg.K)	2.4
Ignition ^{0}C	423
Stoichiometric air-fuel ratio	9
Research Octane Number	108.6
Engine Octane Number	89.7

Table2. Experiment results concern with the viscosity and density

Blend Fuel	Device temperature(^{0}C)	Average (s)	Kinematic viscosity(mm^2/s)	Density(gr/cm^3)
E0D100	40	68	2.8305	0.8156
E2D98	40	70	2.7590	0.8184
E4D96	40	69	2.7193	0.8186
E6D94	40	70	2.5563	0.8154
E8D92	40	65	2.5148	0.8155
E10D90	40	68	2.5200	0.8143
E12D88	40	65	2.4358	0.8158

Table3. The results of the experiments related to the amounts of pour temperature, freezing temperature and cloud temperature

Blend Fuel	Cloud temperature (^{0}C)	Freezing temperatures (^{0}C)	Pour Point (^{0}C)
E0D100	-6.5	-12	-11.5
E2D98	-7.5	-13	-18
B4D96	-8	-19.5	-18.5
B6D94	-9	-48	-20
B8D92	-10	-50	-25
B10D90	-12	-51	-26
B12D88	-14	-51	-27

Figure1. The used viscometer for determine viscosity.

Figure2. The used device to determine the freezing and cloud point.

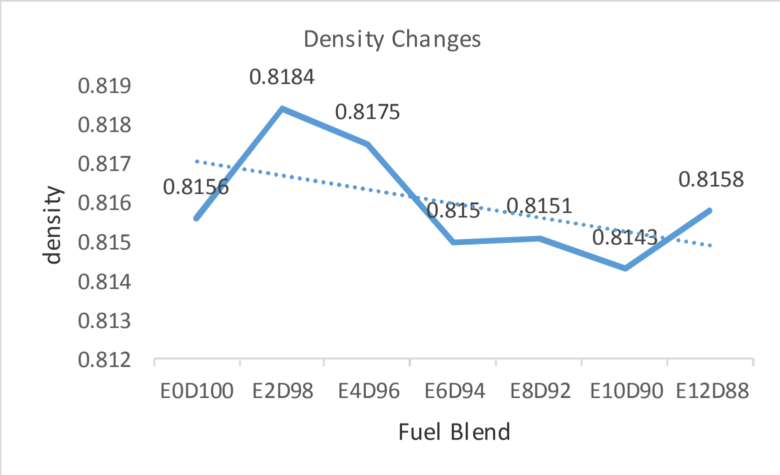

Figure3.The effect of bioethanol on density

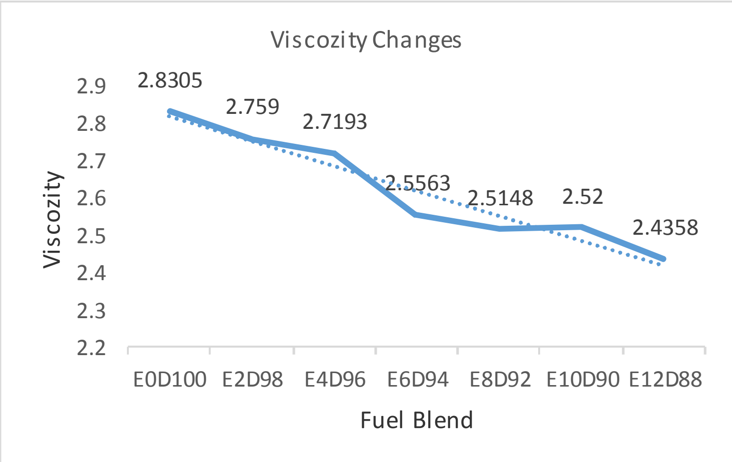

Figure4.The effect of bioethanol on viscosity.

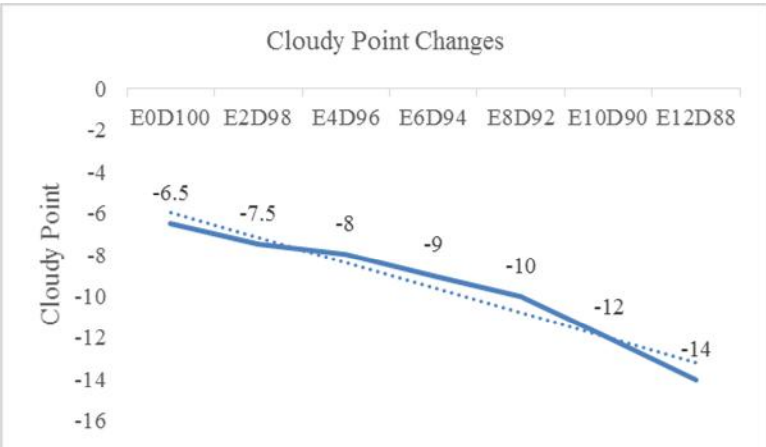

Figure5. The effect of bioethanol on cloud point.

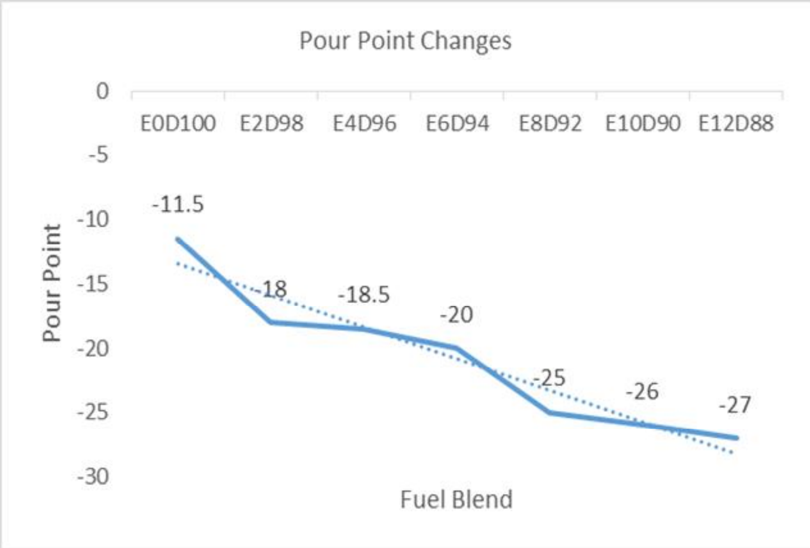

Figure 6.The effect of bioethanol on pour point.

CONCLUSION AND SUGGESTIONS

Adding ethanol to diesel fuel improves the diesel fuel cloud and pour point and prepare it to work in cold and winter conditions. By increasing the amount of ethanol in blend with diesel fuel, locating the molecules of two substances in their distances happen better and as a result by decreasing the empty spaces among molecules and approaching the molecules together, the molecules compress in blend and so in volume unit, because of the molecules, compression, it takes more weight up. Ethanol with higher percentages and diesel fuel are not soluble in each other. To achieve a homogeneous blend we can use a third fuel like biodiesel in blend that can cause solving these 3 fuels together.

REFERENCES

1. Cormick, M., Michaels, R., Tersal, G., Andrew, A., Herring, M., (2001). Impact of biodiesel source material and chemical structure on emission of criteria Pollutants from a heavy-duty engine. Environmental Science and Technology, 35: 1742-1747.
2. Fernando, S., Hanna, M. (2004). Development of an ovel biofuel blend using Ethanol- Biodiesel-Diesel micro emulsions: EB-Diesel. Energy and Fuels , 18 : 1695-1703.
3. Hansen, A.C., Zhang, Q., Lyne, P.W. (2005). Ethanol-diesel fuel blends. Bioresource Technology 96:277-285.
4. Li D, Zhen H, Xing-cai L, Wu-gao Z, Jian-guang Y. (2005). Physicochemical properties of ethanol–diesel blend fuel and its effect on performance and emissions of diesel engines. Renewable Energy;30: 967–76.
5. Sendzikiene, E., Makareviciene, V., Janulis, P. (2006). Influence of fuel oxygen content on diesel engine exhaust emissions. Renewable Energy, Renewable fuel, 31: 2505-2512.
6. Xiayan, S. (2006). Emission reduction potential of using ethanol-biodiesel-diesel fuel blend on a heavy-duty diesel engine. Atmospheric Environment, 49 : 2567-2568.
7. Stork, N. (1997). Measuring Global Biodiversity and its Decline (Eds. Reakakudla, M.L., Wilson, D.E. and Wilson, E.O.) Biodiversity II, Joseph Henry Press, Washington DC : 41-68.

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