Analysis on Fuel Properties of Pure Fuels and Diesel Blends with Ethanol and Acetone

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ABSTRACT

In current study, experimental analysis made on the fuel properties such as viscosity, acid value, surface tension, density of diesel and their blends with acetone and diethyl ether. The blends of petroleum fuel such as diesel were prepared with acetone and their viscosity, acid value, surface tension, density were determined. From the result obtained, it is found that viscosity, acid value, surface tension, density of diesel can be improved by blending with diethyl ether, ethanol and acetone.

Keywords *– Petroleum fuel, Blends, Acid value, Viscosity, Density*

1. INTRODUCTION

Fuel is a flammable material mainly composed of carbon, which releases a major amount of energy in the form of heat and light when properly burned in the presence of oxygen. There are different classifications of fuels, containing natural fuels like firewood and coal, and synthetic fuels such as petrol and diesel, which are used for various domestic and industrial purposes[1].

However, the use of fossil energies has major environmental concerns, such as air pollution and global warming, and they are convectional resources that take billions of years to form. As outcome, there is increasing trend towards alternative fuels, such as biofuels, and alternative energy sources, like solar power, to address these concerns[2,3]. Nuclear fuel, in definite, has the maximum energy mass of all practical fuel sources and can be used to discharge nuclear energy through nuclear reactions. The most reliable type of atomic fuel used by humans is heavy fissile elements, such as plutonium-239and uranium-235, which can undergo nuclear fission reactions[4,5].

Biofuels are prepared from biological sources, including vegetable and organic waste, and can be used as a renewable and alternative source of energy to fossil fuels[6,7]. Petroleum fuels, including petroleum, coal, and natural gas, have been the main source of energy for many decades, offering benefits such as well-known organization, high energy mass, and cost-effectiveness. However, they also come with important drawbacks, including ecological pollution, fitness risks, and soil degradation[5]. Unconventional fuels, such as biodiesel, deal a range of benefits, including renewable sources, low emissions, and energy freedom, providing a possible solution to the disadvantages of petroleum fuels[8,9]. In conclusion, the improvement and use of diverse types of

fuel have played a vital role in determining human past, and the movement towards renewable energy sources is expected to stay in the future[10,11].

Biodiesel means any kind of similarity between diesel and bio-fuel usually prepared from fats or vegetable oils[12,13]. Specially, it can be engaged as fuel of some machines, or mixed with gasoline in diesel engines with no or a few adjustments. Biodiesel has established into a wide range of applications for the environmental benefits[14, 15]. The biodiesel cost is usually the main problem for marketable trade. Waste cooking oils are recycled as a staple, the chance of a nonstop transesterification method and the finest glycerol quality regaining as a production of primary choices of biodiesel[16, 17, 18].

The main purposes of current research work is to carry out studies on fuel properties of renewable fuel such as ethanol, diethyl ether and acetone and their blends with petroleum fuels[19,20].

2. Materials and Methodology

Materials

1. Material taken for experimental work such as Ethanol, Acetone, Ether, Diesel, and Petrol.

2. Blends of above materials were prepared in the ratio of 75:25, 50:50 and 25:75.

Methodology

1. Acid Value Measurement

Acid Values of above samples were measured by using ASTM D974 Method.

2. Measurement of Viscosity

Viscosity of above samples were measured by ASTM D445 Method.

3. Measurement of Surface Tension

Surface Tension of above samples were measured by ASTM D1331Method.

4. Measurement of Density

Density of above samples were measured by ASTM D1298 Method.

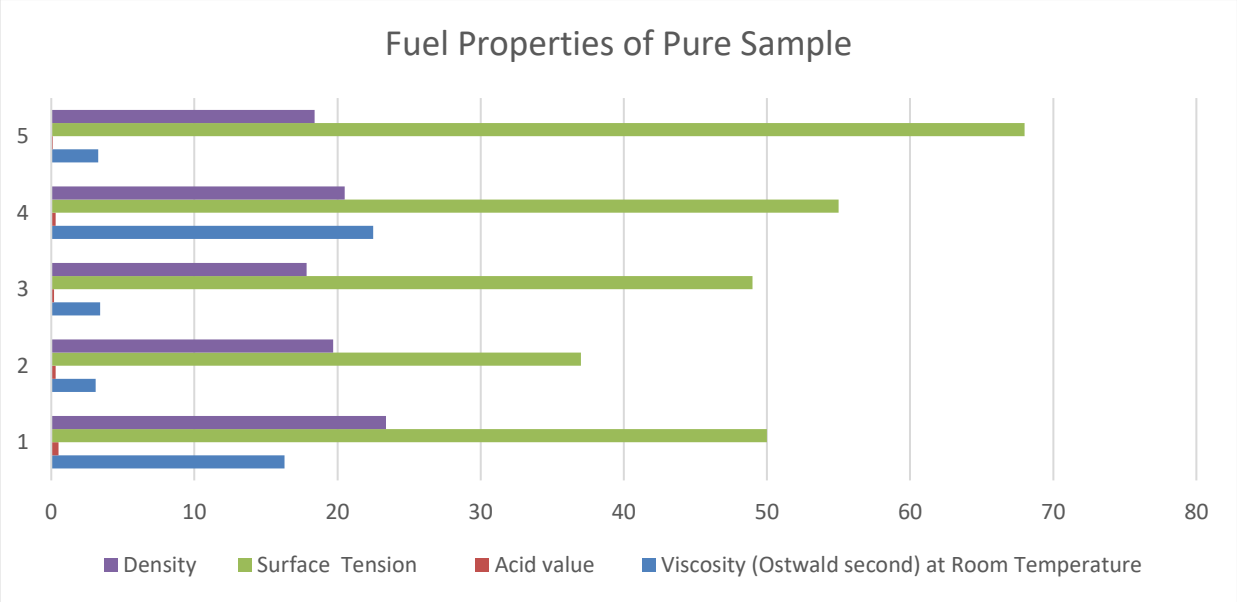
3. Result and Discussion

Table 1: Fuel Properties of Pure Sample

Parameters	Ethanol	Acetone	Diethyl Ether	Diesel	Petrol
Viscosity (Ostwald second) at Room Temperature	16.30	3.09	3.42	22.50	3.27
Acid value (mg/liter)	0.5	0.3	0.2	0.3	0.1
Surface Tension (dyn/cm)	50	37	49	55	68

Density (gm/cm^3)	23.382	19.7008	17.83	20.49	18.40

Graph 1: Fuel Properties of Pure Sample



From above table it is observed that viscosity of diesel is highest and petrol is lowest as compare to all fuel. High viscosity also decreases flow properties of fuel at lower temperature. Low viscosity of diesel is due to weak intermolecular force of attraction in between the molecules.

Acid value of petrol is lowest while ethanol is highest. Acid value indicates the presence of acidic impurities in fuel. High acidic content in fuel increases corrosion of metallic parts of diesel engine.

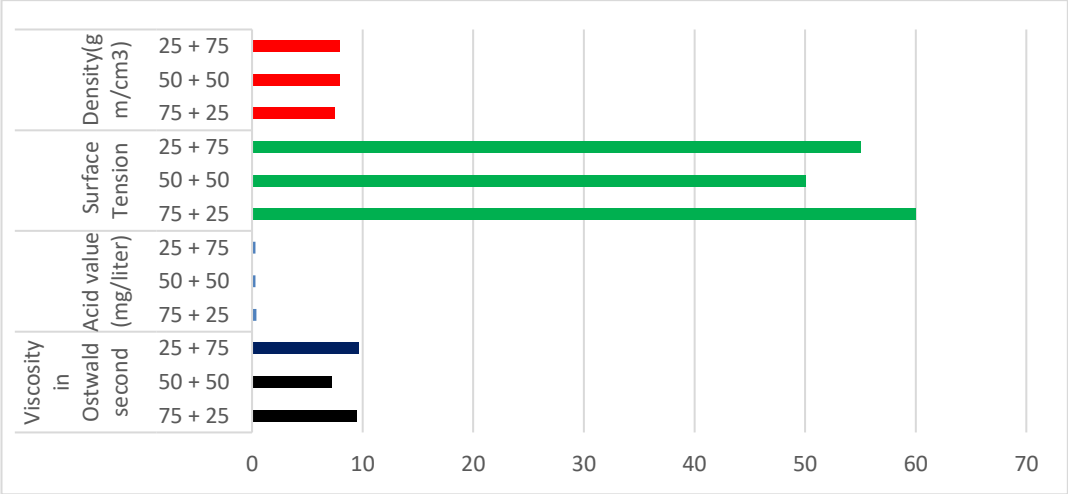
Surface tension of petrol is highest and acetone is lowest. Higher is the surface tension lower is fuel value and vice versa. Density of ethanol is highest while diethyl ether is lowest. High density fuels indicates higher mass per unit of volume compared to low-density fuels. This higher density means more molecules are packed into the same space, which can impact several aspects of the fuel's behavior and performance. Higher is the density lower is the fuel value.

Table 2: Fuel Properties of Ethanol - Diesel Blends at various proportions

Parameter	Percentage	Measured Values
Viscosity in Ostwald second	75 + 25	9.44
	50 + 50	7.23
	25 + 75	9.66
Acid value (mg/liter)	75 + 25	0.4
	50 + 50	0.3
	25 + 75	0.2
Surface Tension(dyn/cm)	75 + 25	60
	50 + 50	50

	25 + 75	55
Density(gm/cm^3)	75 + 25	7.5
	50 + 50	7.9
	25 + 75	8.9

Graph 2: Viscosity of Ethanol - Diesel Blends at various proportions

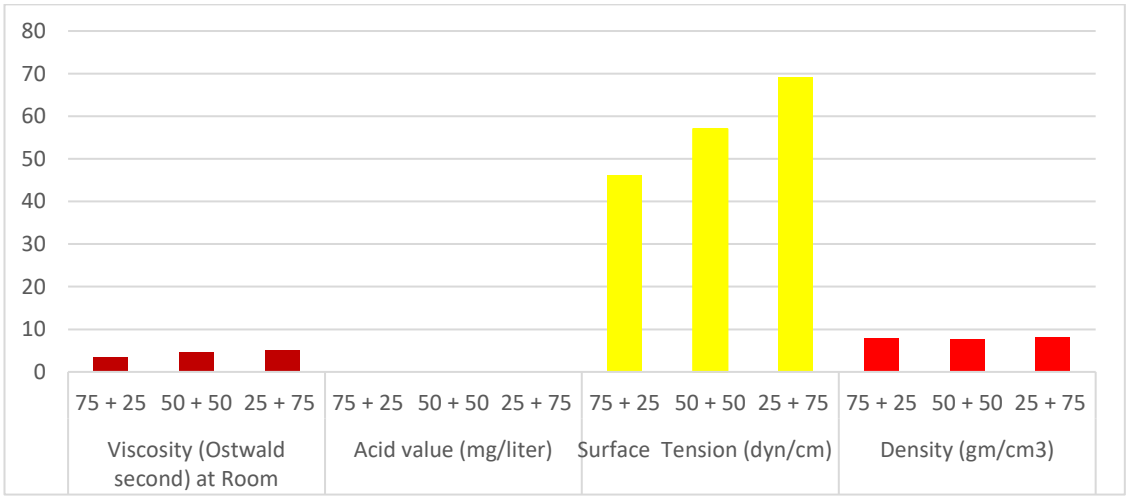


From above table it is observed that viscosity of 75% Ethanol + 25% Diesel is highest and 50% Ethanol + 50% Diesel is lowest. High viscosity of 75% Ethanol + 25% Diesel is due to strong intermolecular force of attraction in between the molecules. High viscosity also decreases flow properties of fuel at lower temperature. Low viscosity of 50% Ethanol + 50% Diesel is due to weak intermolecular force of attraction in between the molecules. Acid value of 25% Ethanol + 75% Diesel is lowest while 75% Ethanol + 25% Diesel is highest. Acid value of 25% Ethanol + 75% Diesel indicates the presence of lower acidic impurities as compare to 75% Ethanol + 25% Diesel. High acidic content in75% Ethanol + 25% Diesel shows lower corrosion resistance. Surface tension of 75% Ethanol + 25% Diesel is highest and 50% Ethanol + 50% Diesel is lowest. High surface tension means a liquid's surface resists external forces and has a strong tendency to minimize its surface area. Higher surface tension of 75% Ethanol + 25% Diesel minimizes their fuel value. Density of 25% Ethanol + 75% Diesel is highest while 25% Ethanol + 75% Diesel is lowest. High density fuels indicates higher mass per unit of volume compared to low-density fuels. This higher density means more molecules are packed into the same space, which can impact several aspects of the fuel's behavior and performance. Highest density of 25% Ethanol + 75% Diesel indicate lower fuel value.

Table 3: Fuel Properties Acetone - Diesel Blends at various proportions

Parameter	Percentage	Measured Value
Viscosity (Ostwald second) at Room Temperature	75 + 25 50 + 50 25 + 75	3.29 4.64 4.96
Acid value (mg/liter)	75 + 25 50 + 50 25 + 75	0.2 0.1 0.3
Surface Tension (dyn/cm)	75 + 25 50 + 50 25 + 75	46 57 69
Density (gm/cm^3)	75 + 25 50 + 50 25 + 75	7.8 7.7 8.02

Graph 3: Fuel Properties Acetone - Diesel Blends at various proportions



From above table it is observed that viscosity of 25% Acetone + 75% Diesel is highest and 75% Acetone + 25% Diesel is lowest. High viscosity of 25% Acetone + 75% Diesel is due to strong intermolecular force of attraction in between the molecules. High viscosity also decreases flow properties of fuel at lower temperature. Low viscosity of 75% Acetone + 25% Diesel is due to weak intermolecular force of attraction in between the molecules. Acid value of 50% Acetone + 50% Diesel is lowest while 25% Acetone+ 75% Diesel is highest. Acid value of 50% Acetone + 50% Diesel indicates the presence of lower acidic impurities as compare to 25% Acetone+ 75% Diesel.

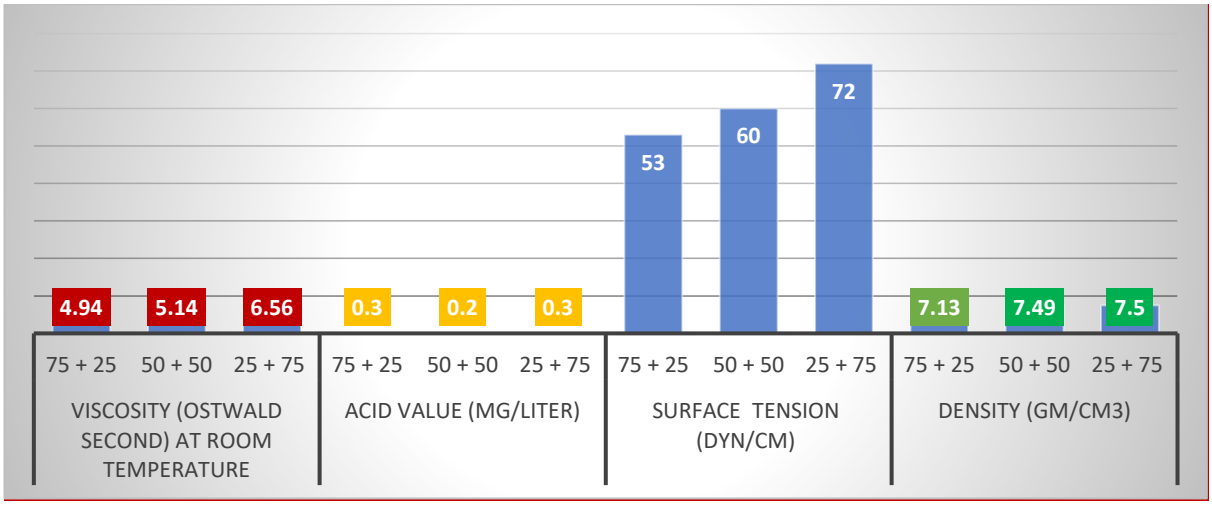
Surface tension of 25% Acetone+ 75% Diesel is highest and 75% Acetone+ 25% Diesel is lowest. High surface tension means a liquid's surface resists external forces and has a strong tendency to minimize its surface area. Higher surface tension of 25% Acetone+ 75% Diesel minimizes their fuel value. Density of 25% Acetone+ 75% Diesel is highest while 50% Acetone+ 50% Diesel is lowest.

High density fuels indicates higher mass per unit of volume compared to low-density fuels. This higher density means more molecules are packed into the same space, which can impact several aspects of the fuel's behavior and performance.

Table 4: Fuel Properties Ether + Diesel Blends at various proportions

Parameter	Percentage	Measured Values
Viscosity (Ostwald second) at Room Temperature	75 + 25 50 + 50 25 + 75	4.94 5.14 6.56
Acid value (mg/liter)	75 + 25 50 + 50 25 + 75	0.3 0.2 0.3
Surface Tension (dyn/cm)	75 + 25 50 + 50 25 + 75	53 60 72
Density (gm/cm^3)	75 + 25 50 + 50 25 + 75	7.13 7.49 7.50

Graph 4: Fuel Properties Ether + Diesel Blends at various proportions



From above table it is observed that viscosity of 50% Acetone+ 50% Diesel is highest and 75% Acetone+ 25% Diesel is lowest. High viscosity of 50% Acetone+ 50%Diesel is due to strong intermolecular force of attraction in between the molecules. High viscosity also decreases flow properties of fuel at lower temperature. Low viscosity of 75% Acetone+ 25% Diesel is due to weak intermolecular force of attraction in between the molecules. Acid value of 50% Acetone+ 50% Diesel is lowest while 75% Acetone + 25% Diesel is highest. Acid value of 50% Acetone+ 50% Diesel indicates the presence of lower acidic impurities as compare to 75% Acetone + 25% Diesel. Surface tension of 25% Acetone + 75% Diesel is highest and 75% Acetone + 25% Diesel is lowest. High surface tension means a liquid's surface resists external forces and 75% Diesel minimizes their fuel value. Density of 25% Acetone + 75% Diesel is highest while 75% Acetone + 25% Diesel is lowest. High density fuels indicates higher mass per unit of volume compared to low-density fuels. This higher density means more molecules are packed into the same space, which can impact several aspects of the fuel's behavior and performance.

4. CONCLUSION

1. Surface tension, acid value, viscosity and density of 50% Acetone and 50% ethanol are in acceptable range and it may be used as good fuel alterative to pure diesel.
2. Surface tension, acid value, viscosity and density of 50% Acetone and 50% Diethyl ether are in acceptable range and it may be used as good fuel alterative to pure diesel.

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