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Research Article

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Modification of Fuel Properties of Biodiesels by using Acetone Additive

Kailas M Talkit[1*], DT Mahajan[2] and VH Masand[2]

[1]Department of Engineering Chemistry, DESS COET Dhamangaon Rly, India
[2]Departmentof Chemistry, V.B.M.V. Amravati, India

ABSTRACT

In present research work, biodiesels of soybean, cottonseed, sesame, mustard and sunflower oils were prepared. The fuel properties such as saponification value, iodine value, cetane number and heat of combustion of pure biodiesels and blends of biodiesel with acetone in varying percentage were investigated. From the obtained results shows that, the fuel properties such as saponification value, iodine value, cetane number and heat of combustion of pure biodiesels were improved by acetone additive. Hence, from the present research work it is concluded that acetone may be used as better alternative additive to improve the fuel properties of biodiesels.

Keywords: Biodiesels; Blends; Acetone; Alternative fuel

INTRODUCTION

The developing countries like India, China etc. and developed countries like America, England etc. have increases energy demands due to increasing rapid industrialization. But due to continue depletion of petroleum oil resources as well as increase in pollution by nonrenewable petroleum oil resources creates an interest in alternative and renewable energy. In recent days, biodiesel one of the most important prominent candidate as fuel and it is also derived from natural renewable resources like vegetable oil by transesterification process. Many researchers were studied biodiesels as fuel to check their availability for diesel engine. Kandasamy et al. [1] have presented biodiesel synthesis from pongamia pinnata oil by acid and alkaline transesterification method. They provided information about saponification value of biodiesel produced from pongamia pinnata oil. Matola et al. [2] have proposed quality evolution of sunflower and groundnut oil produced by two co-operatives under the one village one product program in central Malawi. They determined saponification values of sunflower and groundnut cooking oil. Gadwal et al. [3] have proposed studies on physicochemical properties and fatty acid profile of seed oil from two hibiscus species. They extracted oil from the seeds and the leaves sample of two hibiscus species collected from Kadganchi, Tengli, Aland and supermarket of Gulbarga district, Karnataka, India and determined their saponification values. Nadeem et al. [4] have determined the effect of cold-pressing and soxhlet extraction on the physico-chemical attributes of sunflower (*Helianthus annuus* L.) oil. They determined iodine value of seed oil extracted from sunflower (*Helianthus annuus* L.) oil. Ahamad et al. [5] has proposed studies on acrylic acid modified poly (ester-amide) resins from melia azedarach seed oil – a renewable resource. They determined iodine value of melia azedarach seed oil. Yoon et al. [6] have presented studies on the effects of canola oil biodiesel fuel blends on combustion, performance, and emissions reduction in a common rail diesel engine. They determined iodine value of canola oil biodiesel blends. Uzoh et al. [7] have investigated kinetic study on the polyesterification and copolymerization process of unstyrenated and styrenated palm kernel oil based alkyd resin. They determined the iodine value of unstyrenated and styrenated palm kernel oil based alkyd resins. Issaka et al. [8] evaluated effect of 20% water content on the properties (cetane number, rheology and stability) of emulsion fuel in comparison to the commercial diesel. Sabah et al. [9] have studied effect of fuel cetane number on multi-cylinders direct injection diesel engine performance and exhaust emissions. They investigated cetane number of diesel mixture with 2-ethylhexyl nitrate.

Saleh et al. [10] have predicted cetane number of biodiesel fuel from fatty acid ethyl ester (FAEE) composition. They investigated cetane number of fatty acid ethyl ester according to weight percentage of fatty acids available in the fuel. Srikanth et al. [11] have investigated influence of injection timing on performance parameters and combustion characteristics of high grade semi adiabatic diesel engine with preheated cotton seed biodiesel. Kumar [12] has studied influence of linseed oil based biodiesel on exhaust emissions and combustion characteristics with fixed injection timing using ceramic coated diesel engine. Deshpande et al. [13] have investigated production of biodiesel fuel from waste soy bean cooking oil by alkali trans-esterification process. They calculated heat of combustion of waste soybean oil biodiesel. From above cited work, it is found that the fuel properties of biodiesels such as saponification value, iodine value, cetane number and heat of combustion are not close to diesel fuel. Hence the main objective of my research work is to carry out the study on, to improve the fuel properties of biodiesels by using highly flammable additive like acetone.

EXPERIMENTAL SECTION

Materials

Biodiesels:

The biodiesels of soybean oil, mustard oil, cottonseed oil, groundnut oil and sesame oil were prepared in laboratory.

Biodiesel blends:

Blends of biodiesel with acetone were prepared by mixing of biodiesel with acetone (w/w) in different mixing ratios.

Methodology

Measurement of saponification values:

Saponification values were measured by using ASTM D464 method.

Measurement of saponification values:

Iodine values were measured by using ASTM D 5768 – 02 method.

Measurement of cetane number and heat of combustion:

The simplest method based on saponification value and iodine value suggested by Krisnangkura [14].

RESULTS AND DISCUSSION

Table 1: Saponification value, iodine value, cetane number and heat of combustion of pure soybean, palm, mustard, cottonseed and canola oil biodiesels

S .No.	Name of biodiesel	SV (mg KOH/ gm oil)	IV (mg I_2/ gm oil)	Cetane Number	Heat of combustion(ΔH) in MJ/kg
1	Soybean oil biodiesel	166.53	72.17	62.84	41.52
2	Mustard oil biodiesel	113.34	69.96	77.49	43.92
3	Cottonseed oil biodiesel	130.95	71.33	71.94	43
4	Groundnut oil biodiesel	124.93	71.18	73.97	43.25
5	Sesame oil biodiesel	124.02	73.61	73.53	43.22

From the above Table 1 it is found that, soybean oil shows highest saponification value, due to presence of more percentage of impurities such as free fatty acids and lowest saponification value of mustard oil biodiesel, due to presence of low percentage of free fatty acid impurity. Sesame oil biodiesel shows highest iodine value, due to presence of more amounts of unsaturated fatty acid methyl esters and mustard oil biodiesel shows lowest iodine value, due to presence of lower amount of unsaturated fatty acid methyl esters. Mustard oil biodiesel shows highest cetane number, due to presence of long chain and saturated fatty acid methyl ester and soybean oil biodiesel shows lowest cetane number, due to presence of short chain and unsaturated fatty acid methyl esters. Mustard oil biodiesel shows highest heat of combustion, due to presence of long chain and saturated fatty acid methyl ester and cottonseed oil biodiesel shows lowest heat of combustion, due to presence of short chain and unsaturated fatty acid methyl esters.

Table 2: Saponification value, iodine value, cetane number and heat of combustion of pure soybean oil biodiesel blends with acetone

S No.	Composition of blends	SV (mg KOH/ gm oil)	IV (mg I_2/ gm oil)	Cetane Number	Heat of combustion(ΔH) in MJ/Kg
1	85%Soybean oil biodiesel +15% Acetone	103.19	70.92	83.24	44.14
2	75% Soybean oil biodiesel +25% Acetone	66.67	69.2	112.59	45.66
3	65%Soybean oil biodiesel +35% Acetone	87.53	66.68	93.61	44.84

From the above Table 2 it is found that, saponification value of soybean oil biodiesel decreased with addition of acetone, due to decreased in percentage of free fatty acids. Iodine value of soybean oil biodiesel decreased with addition of acetone, due to decreased in percentage of unsaturated fatty acid methyl esters. Cetane number of soybean oil biodiesel increased with addition of acetone, due to increased in flammability of soybean oil biodiesel with addition of acetone. Heat of combustion of soybean oil biodiesel increased with addition of acetone, due to increased in volatility of soybean oil biodiesel with addition of acetone.

Table 3: Saponification value, iodine value, cetane number and heat of combustion of pure mustard oil biodiesel blends with acetone

S No.	Composition of blends	SV (mg KOH/ gm oil)	IV (mg I_2/ gm oil)	Cetane Number	Heat of combustion(ΔH) in MJ/Kg
1	85% Mustard oil biodiesel +15% Acetone	85.41	72.03	94	44.85
2	75% Mustard oil biodiesel +25% Acetone	62.78	67.37	118.08	45.85
3	65% Mustard oil biodiesel +35% Acetone	71.05	67.77	107.87	45.51

From the above Table 3 it is found that, saponification value of mustard oil biodiesel decreased with addition of acetone, due to decreased in percentage of free fatty acids. Iodine value of mustard oil biodiesel decreased with addition of acetone, due to decreased in percentage of unsaturated fatty acid methyl esters. Cetane number of mustard oil biodiesel increased with addition of acetone, due to increased in flammability of soybean oil biodiesel with addition of acetone. Heat of combustion of mustard oil biodiesel increased with addition of acetone, due to increased in volatility of soybean oil biodiesel with addition of acetone.

Table 4: Saponification value, iodine value, cetane number and heat of combustion of pure cottonseed oil biodiesel blends with acetone

S No.	Composition of blends	SV (mg KOH/ gm oil)	IV (mg I_2/ gm oil)	Cetane Number	Heat of combustion(ΔH) in MJ/Kg
1	85% Cottonseed oil biodiesel +15% Acetone	141.26	69.26	69.35	42.6
2	75% Cottonseed oil biodiesel +25% Acetone	101.2	65.63	85.47	44.3
3	65% Cottonseed oil biodiesel +35% Acetone	72.43	69.69	105.97	45.42

From the above Table 4 it is found that, saponification value of cottonseed oil biodiesel decreased with addition of acetone, due to decreased in percentage of free fatty acids. Iodine value of cottonseed oil biodiesel decreased with addition of acetone, due to decreased in percentage of unsaturated fatty acid methyl esters. Cetane number of cottonseed oil biodiesel increased with addition of acetone, due to increased in flammability of soybean oil biodiesel with addition of acetone. Heat of combustion of cottonseed oil biodiesel increased with addition of acetone, due to increased in volatility of soybean oil biodiesel with addition of acetone.

Table 5: Saponification value, iodine value, cetane number and heat of combustion of pure groundnut oil biodiesel blends with acetone

S No.	Composition of blends	SV (mg KOH/ gm oil)	IV (mg I_2/ gm oil)	Cetane Number	Heat of combustion(ΔH) in MJ/kg
1	85% Groundnut oil biodiesel +15% Acetone	98.8	71.75	85.4	44.31
2	75% Groundnut oil biodiesel +25% Acetone	76.88	67.46	102.12	45.27
3	65% Groundnut oil biodiesel +35% Acetone	68.35	67.14	111.05	45.63

From the above Table 5 it is found that, saponification value of groundnut oil biodiesel decreased with addition of acetone, due to decreased in percentage of free fatty acids. Iodine value of groundnut oil biodiesel decreased with addition of acetone, due to decreased in percentage of unsaturated fatty acid methyl esters. Cetane number of groundnut oil biodiesel increased with addition of acetone, due to increased in flammability of soybean oil biodiesel with addition of acetone. Heat of combustion of groundnut oil biodiesel increased with addition of acetone, due to increased in volatility of soybean oil biodiesel with addition of acetone.

Table 6: Saponification value, iodine value, cetane number and heat of combustion of pure sesame oil biodiesel blends with acetone

S No.	Composition of blends	SV (mg KOH/ gm oil)	IV (mg I_2/ gm oil)	Cetane Number	Heat of combustion(ΔH) in MJ/Kg
1	85% Sesame oil biodiesel +15% Acetone	114.59	71.75	77.86	43.67
2	75% Sesame oil biodiesel +25% Acetone	80.68	68.06	98.63	45.11
3	65% Sesame oil biodiesel +35% Acetone	72.41	63.83	107.31	45.51

From the above Table 6 it is found that, saponification value of sesame oil biodiesel decreased with addition of acetone, due to decreased in percentage of free fatty acids. Iodine value of sesame oil biodiesel decreased with addition of acetone, due to decreased in percentage of unsaturated fatty acid methyl esters. Cetane number of sesame oil biodiesel increased with addition of acetone, due to increased in flammability of soybean oil biodiesel with addition of acetone. Heat of combustion of sesame oil biodiesel increased with addition of acetone, due to increased in volatility of soybean oil biodiesel with addition of acetone.

CONCLUSION

From the above results and discussion the following conclusions are drawn:

i) Saponification values of soybean oil, mustard oil, cottonseed oil, groundnut oil and sesame oil biodiesels decreased with addition of acetone. Hence it is concluded that acetone may be used as alternative additive to improve the quality of biodiesels.
ii) Iodine values of soybean oil, mustard oil, cottonseed oil, groundnut oil and sesame oil biodiesels decreased with addition of acetone. Hence it is concluded that acetone may be used as alternative additive to improve the oxidation stability of biodiesels.
iii) Cetane number of soybean oil, mustard oil, cottonseed oil, groundnut oil and sesame oil biodiesels decreased with addition of acetone. Hence it is concluded that acetone may be used as better alternative additive to improve the flammability of biodiesels.
iv) Heat of combustion of soybean oil, mustard oil, cottonseed oil, groundnut oil and sesame oil biodiesels increased with addition of acetone. Hence it is concluded that acetone may be used as better alternative additive to improve the heating value of biodiesels.

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