

Biodiesel Production via Transesterification

Cloud Point

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BIOFUELS ME481

INTRODUCTION

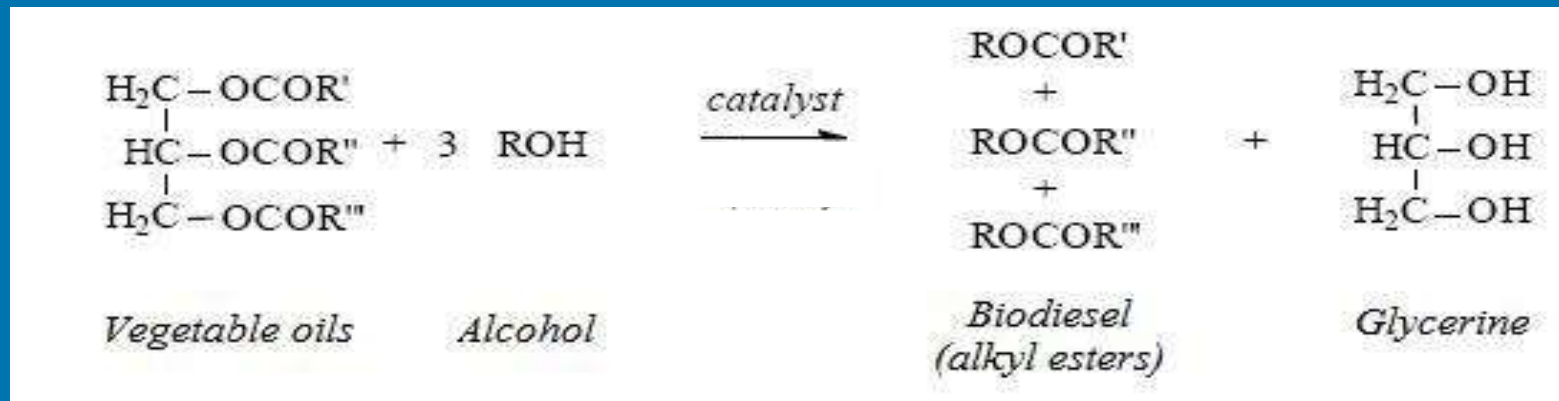
- * **Biodiesel Renewable , friend of the environment, and good alternative.**
- * **Transesterification is most common method to produce biodiesel.**
- * **Acid-catalyst transesterification.**
- * **Cloud point.**

Catalytic Transesterification



is the process of heating a mixture of oil and alcohol (methanol or ethanol) in the presence of a catalyst .

The products are methyl or ethyl esters and glycerin ($C_3H_8O_3$)



Acid-catalyst transesterification

- Transesterification process is catalyzed by acids like Sulfuric acid and Hydrochloric acid
- Advantages and disadvantages of acid catalysts transesterification.

Advantages	disadvantages
Esterification and transesterification occur at the same time	Low reaction rate
Suitable for oil that has higher FFAs	Can lead to equipment corrosion
Produce high yield of biodiesel	Harder separation of catalyst from product

Comparisons of reactions conditions for various types of acid catalysts.

Catalyst	Reaction conditions					Biodiesel yield	Remarks
	Temp, °C	Type of alcohol (alcohol to oil molar ratio)	Catalyst loading, wt %	Reaction time, h	Mixing, rpm		
Homogeneous acid catalyst							
Hydrochloric acid (HCl)	100	Methanol	1.85	1	-	Sunflower oil, 95.2%	-
Sulfuric acid (H ₂ SO ₄)	120	Methanol (40:1)	0.5	3	-	<i>Chlorella pyrenoidosa</i> , 92.5%	-
Sulfuric acid (H ₂ SO ₄)	50	Methanol (6:1)	3	1	-	Vegetable oil by product, >90%	Reflux condenser reactor

CLOUD POINT (CP)

What is the cloud point ? the cloud point is defined as the temperature at which crystals first start to form in the fuel.

- The CP is the most commonly used measure of low-temperature operability of the fuel.
- Fuels are generally expected to operate at temperatures as low as their cloud point.
- The biodiesel cloud point is typically higher than the cloud point of conventional diesel.
- The cloud point of biodiesel depends on the nature of the feedstock.
- According to (ASTM D 2500) there is No established limits .

Cloud point

Biodiesel made from different feedstocks may have different cloud point (ASTM D6751)

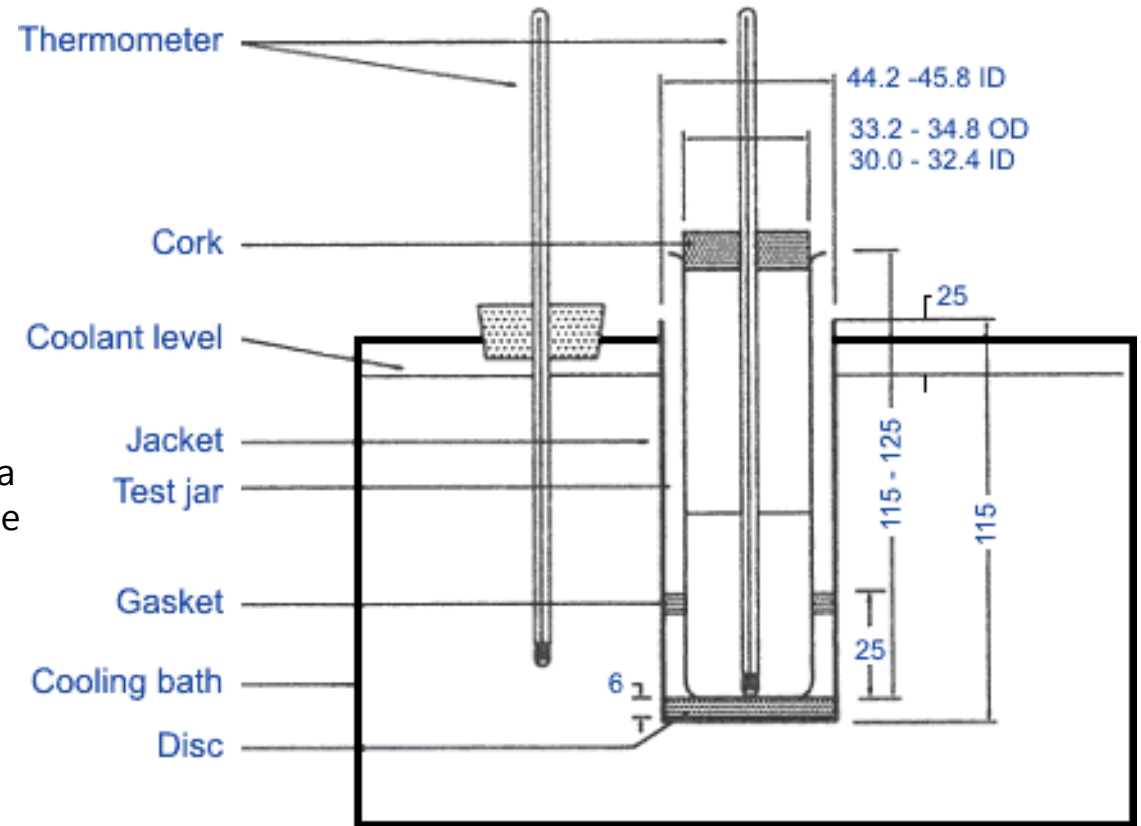
Biodiesel Feedstock	Cloud Point (degrees Celsius)
Soybean oil	1
Canola oil	0
Palm oil	17
Jatropha oil	8
Tallow	12-17

How can we measure cloud point ?

Laboratory method

Cloud point can be measured by a laboratory test (Standard test method for cloud point) index (**ASTM D 2500**) .

Summary of Test Method : The specimen is cooled at a specified rate and examined periodically. The temperature at which a cloud is first observed at the bottom of the test jar is recorded as the cloud point.



Fig(1)Apparatus for Cloud Point Test

- Thermometers in the method index in (ASTM D2500) having ranges:

Thermometer	Temperature Range	Thermometer Number	
		ASTM	IP
High cloud and pour	-38 to +50°C	5C	1C
Low cloud and pour	-80 to +20°C	6C	2C

- **Cloud point measurements**

Bath and Sample Temperature Ranges

Bath	Bath Temperature Setting, °C	Sample Temperature Range, °C
1	0 ± 1.5	Start to 9
2	-18 ± 1.5	9 to -6
3	-33 ± 1.5	-6 to -24
4	-51 ± 1.5	-24 to -42
5	-69 ± 1.5	-42 to -60

Automatic Method

The automatic method to measure cloud point called **Koehler KLA-3TS/2** index (ASTM D5773)

Temperature Range: +80°C to -80°C
Accuracy: ±0.1°C

The **D5773** test method determines the cloud point in a shorter period of time than manual method **D2500**.



Fig(2) Koehler KLA-3TS/2



Cloud point effect on engine performance

- When the temperature is low, crystals first starts to form in the fuel (biodiesel)
- The viscosity of the biodiesel is going to be very high, hence affecting its performance badly , make rough operation (noise and vibration) and engine can be stop .

Conclusion

- Biodiesel is a renewable and alternative fuel.
- Acid-catalyst transesterification is slower than base catalyst.
- The cloud point of biodiesel is typically higher than the cloud point of conventional diesel
- In the cold countries we should choose biodiesel with lower cloud point

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Thank you for your attention

THANK YOU