**Abstract:-**

Biodiesel is a non-petroleum based fuel that generally consists of fatty acid methyl esters or fatty acid ethyl esters, respectively derived from the Tran esterification of oil, whose main components are triglycerides with methanol or ethanol.**(1)**

The objectives from this experiment are to make biodiesel, to show the tests on it(e.g. the differences between biodiesel and oil when we set them on fire, Combustion, and to show how biodiesel is more conservative for environment than petroleum fuel.

**Chemicals:-**

| Anhydrous sodium sulfate | Pure methanol | Anhydrous Sodium Hydroxide | Vegetable oil |
| --- | --- | --- | --- |
| Na2SO4 | CH3OH | NaOH | C31H~O~ |

 **Table 1: Chemicals Used**

**Glassware:-**

|  Erlenmeyer Flask | Beaker | Hot plate stirrer | Separatory Funnel  | Graduated Cylinder |
| --- | --- | --- | --- | --- |

 **Table 2: Tools Used**

**Reactions and Mechanisms:-**

**Experimental Procedure:-**

| Step | # |
| --- | --- |
| 15ml of pure methanol is measured into a 250ml Erlenmeyer Flask, this is your Reaction Flask. | 1 |
| 0.5g of finely ground anhydrous NaOH is measured and it transferred into the 250ml flask. | 2 |
| The flask containing methanol and NaOH is covered with aluminum foil. | 3 |
| A magnetic stirring bar is used to stir the solution until all NaOH dissolves.  | 4 |
| 50ml of Vegetable oil is measured, its mass is determined and it added to the Reaction Flask. | 5 |
| The Reaction Flask and its contents are heated in a hot plate stirrer to a temperature of 45-50o C for 30 minutes. The mixture should be stirred continuously, the mixture becomes cloudy at first, but it soon separates into two layers | 6 |
| While still warm, the mixture is poured into a separatory funnel and allowed to cool until two layers are distinctly observed. | 7 |
| The lower layer is drained into a 100ml beaker and it is discarded, this layer contains glycerin, unreacted methanol, unreacted NaOH, a trace of water and salts. | 8 |
| 10ml of water is added to the remaining layer (The Biodiesel). The separatory funnel is swirled gently for a couple of minutes. This wash should remove methanol, glycerin, NaOH, and any soap. | 9 |
| The lower layer is drained and it discarded. The Biodiesel is transferred into a small beaker and it placed on a hot plate(In the hood); to evaporate any methanol left | 10 |
| 0.5g of anhydrous Na2SO4 to remove any traces of water. | 11 |
| The dried Biodiesel is poured into a clean, dry, weighed 50ml beaker. The mass and the volume of the Biodiesel are determined. | 12 |

 **Table 3 : Procedures**

**Data, Calculation and Results:-**

1. Volume of pure methanol = 15ml
2. Weight of Anhydrous NaOH= 0.5g
3. Volume of Vegetable oil = 50ml
4. Weight of Anhydrous Na2SO4 =0.5g
5. Weight of empty beaker = 48.94g
6. Weight of empty beaker with Biodiesel = 73.34g
7. **Weight of Biodiesel= (6)-(5) = 24.4g**
8. **Volume of Biodiesel = 29ml**

**Tests on Biodiesel:-**

1. pH: paper turned from yellow to green ـــpH= 8-9
2. Density = Mass/ Volume = 24.4g/29ml = 0.8413g/ml

**Vegetable oil:-**
1- pH: What Is the pH of Vegetable Oil?
Actually, we can't measure the pH of vegetable oil because it doesn't have one! pH is a measure of the hydrogen ion concentration [in an aqueous solution](https://www.thoughtco.com/definition-of-aqueous-solution-604370) (water). Because there is no water in vegetable oil, there is no pH value.(2)

2- Density = 0.915-0.928. (3)

**Extra:-**

**Discussion & Comments:-**

The purpose of this experiment was to synthesis biodiesel fuel from vegetable oil and methanol. The vegetable oil, triglyceride, was heated and mixed with an excess of methanol and sodium methoxide was used to speeded up the reaction between the two. Methanol was used in excess to ensure that when the reaction shifted to reestablish equilibrium, it shifted towards the products and produced more biodiesel. Once the reaction is completed and the solution cooled, two layers formed. These layers are glycerol and Methyl Esters is the layer with the lower density, also the hydrophilic layer, and it is the layer on top. Glycerol, which is more dense and hydrophobic, collected at the bottom of the beaker.**(4)**

Biofuel is an important and viable resource that may be able to one day serve as an alternative to all nonrenewable resources.

The percentage yield = 52.36%, this show that there is an error is the experiment the error may be from the heat of the mixture (we did not heat it well).

 **Questions:-**

**Q1.** Biodiesel in the top and glycerin in the bottom, this because glycerin is polar, but biodiesel is non-polar, and glycerin has a higher density than biodiesel.

**Q2.** (Like dissolve like). More soluble in the glycerin layer, because glycerin and NaOH exist naturally. Methanol is used as an ion in this reaction. NaOH is strong enough to pull off the hydrogen connected to the oxygen(CH3OH).

**Q3.**Vegetable oil is known to react very easily: it ignites and melts at a lower temperature when compared to biodiesel. Vegetable oil can undergo combustion with oxygen. This means vegetabLe oil can easily start fires  and solidify quickly that would damage a car’s engine and harm one’s life. viscosity of the triglycerides. Also, it is vegetable is more viscous, its  thicker and does not flow as quickly as biodiesel would through the car’s engine. As a result, biodiesel is safer to store, handle, and use than vegetable oil.

**Q4.** Our pH was closer to the neutral side. This found pH would not produce  corrosive effects on an engine. I would compare biodiesel relationship to a car like a human and water relationship. Humans need water to survive  it is neutral element that washes and cleanses the human body and keeps  it running, this can also be seen in biodiesel.Biodiesel is a neutral element used in car to make it perform better without causing harm to the car.

**Q5.**

1. Produced from Renewable Resources
2. Can be Used in existing Diesel Engines
3. Less Greenhouse Gas Emissions
4. Better Fuel Economy
5. Positive Economic Impact
6. Reduced Foreign Oil Dependance
7. More Health Benefits

**References:-**

1. <https://www.scribd.com/doc/284429828/BIODIESEL-SYNTHESIS-lab-report>
2. https://www.thoughtco.com/the-ph-of-vegetable-oil-608887

3-https://hypertextbook.com/facts/2000/IngaDorfman.shtml

4-https://www.coursehero.com/file/p7f9ir8/III-Results-and-Discussions-The-purpose-of-this-experiment-was-to-synthesis/

**Good Luck**