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Biodiesel Production of Hingot Oil by Mechanical Stirring Method

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Abstract : In a present scenario there is a demand for energy increases continuously very rapidly worldwide. Due to this rising demand for alternative energy. Alternating fuels is one of the part of alternating energy. In last some time there is tremendous growth of transportation and industrial sectors so consumption of energy is increases. Alternating fuels of conventional fuels is needed because demand of petroleum products is rising day by day. Biodiesel is one of the best alternative fuel due to some quality over petroleum fuels like its non-toxic in nature, high cetene number, biodegradable and produced from renewable sources like plants seed oils. Balanitesaegyptiaca Del., also known as Hingot use for preparing biodiesel from the oil also Hingot which is also known as "desert date" in English as a feedstock. To produce biodiesel from the hingot oil in several stages, in first filtered, purified, esterification and then transesterification with different molar ratio such as (1:6), (1:7.5), (1:9), different amount of catalyst 0.5%, 0.75%, 1% with different time for reaction 60min, 75min, 90min. then select the optimum yielding combination. With the change of molar ratio we have to find the optimum molar ratio for production of biodiesel. After 20-30 times of experiments with different combination of reaction time, molar ratio and weight ratio of catalyst we have find the optimum combination for that oil.

From that obtained molar ratio, catalyst percentage, and yield time the biodiesel is extracted from the oil of "Hingot". The produce biodiesel is use in 4stroke CI engine for performance testing in laboratory with the blend of biodiesel in different composition of diesel and biodiesel called blend of biodiesel. After that a blend of biodiesel and diesel is prepared B10, B20, B30 and B40 these blend of biodiesel is then tested on 4 stroke diesel engine at different load condition and calculated results with any modification in engine. Its observed that engine runs successfully with the different blends of biodiesel.

Keywords – Biodiesel, Transesterification, Esterification, Catalyst, Blend

I. INTRODUCTION

Looking to current scenario of rapid increase the demand of energy it is necessary to take some arrangement to produce extra energy from some alternating sources. As we know there are lot of alternating source of energy available like solar energy, tidal energy, wind energy, geo thermal energy, biomass, ocean energy and others. We all know the all the above energy are renewable and clean energy means these are non-toxic and environment friendly energy. Fossil fuel is limited resources and looking for the future we need the some alternating of fossil fuels. Another major issue in worldwide which is pollution so if considering a both problem simultaneously we have need a clean alternating fuels which are non-toxic, biodegradable and environmental friendly so biodiesel is a best alternating fuel.

A biodiesel is fatty acid ethyl or methyl ester made from vegetable oil which is edible or non-edible oil seeds and animal fat. These are mainly used for combustion to produce heat in industries, electricity generation and in IC engine as a fuel. Biodiesel is generally not used directly a blend of biodiesel and diesel is used in practical application without modification in engine design. There are several advantage of biodiesel over diesel it is biodegradable and more than 90% can be biodegraded within 21 days.

A. Hingot Oil

Balanitesaegyptiaca Del., also known as 'Desert date' in English, and "Hingot" is Called in Hindi a member of the family Zygophyllaceae, which is most common but neglected wild plant species of the dry land areas of Africa and South Asia.[17-18]. This tree is native to much of Africa and parts of the Middle East. In India, it is particularly found in Rajasthan, Gujarat, Madhya Pradesh. It can be found in many kinds of habitat, tolerating a wide variety of soil types, from sand to heavy clay, and climatic moisture levels.

Fruit is a rather long, narrow drupe, 2.5 to 7 cm long, 1.5 to 4 cm in diameter. Young fruits are green and tormentose, turning yellow and glabrous when mature.

II. PRODUCTION OF BIODIESEL FROM HINGOT OIL

Production of biodiesel using vegetable (hingot) oil from magnetic stilling method and effect of various different parameters (e.g. molar ratio, weight percentage of catalyst, reaction time, etc) on the yield of biodiesel production is know from the varies the above parameters one by one. There are several methods to produce biodiesel using vegetable oils e.g. conventional method (magnetic stirring), hydrodynamics cavitation method, ultrasonic irradiation method, microwave iteration method. But I had adopted the magnetic stirring method. Generally from many vegetable oils biodiesel is produce in single step called "transesterification" which is low FFA containts oils but hingot oil is containing a high FFA so the production of biodiesel is not possible in single stage therefore in this oil two steps is needed for production of biodiesel called "esterification" and "transesterification"

A. Free Fatty Acid Test of Oil

In Free Fatty Acid (FFA) Test the contains of free fatty acid present in oil is find out. From the FFA percentage of oil is decided the biodiesel is produce in single step of two steps. FFA of hingot oil is 4.6% which is more than 2.3% hence two steps in needed from this oil for biodiesel production.

B. Esterification

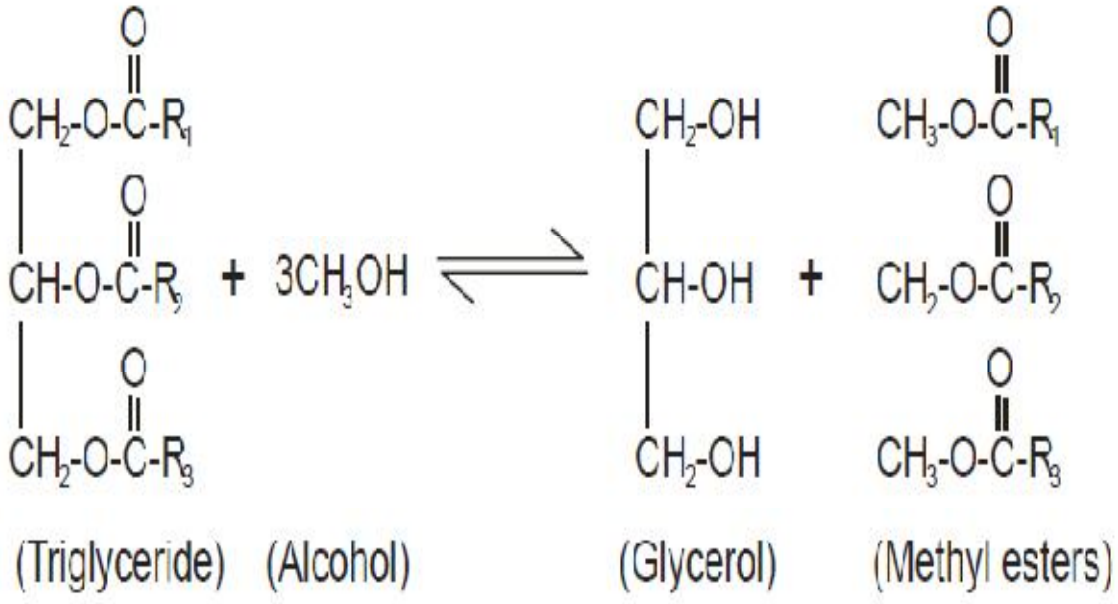
In esterification reaction of vegetable oil this steps is generally used when then FFA is contains more than 2.3% in any vegetable oil. In esterification process vegetable oil is react with acid generally Sulphuric acid (H_2SO_4) in presence of methyl alcohol and catalyst. In esterification vegetable oil is esterifies free fatty acid to form ester of free fatty acid. This reaction is generally slower than transesterification. Esterification is a reversible reaction thus water H_2O produced must be removed to derive the reaction to the right to obtain a higher ester yield. In this step the FFA of oil is reduce to 1.6% from 4.6%.

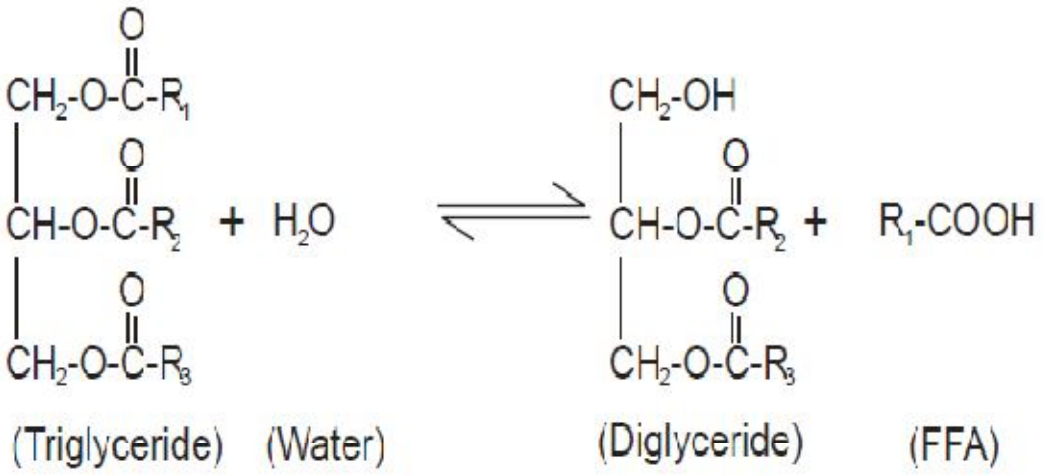
$$R_1\text{–COOH} + \text{ROH} \longrightarrow \text{R–O–CO–}R_1 + H_2O$$

FFA (alcohol) Fatty acid ester (water)

C. Tranesterification

In transesterification reaction vegetable oil i.e. a triglyceride react with alcohols i.e. Methyl alcohol (CH_3OH), Ethyl alcohol (CH_3CH_2OH) etc. to produce ester and glycerin in the presence of some catalyst





The overall process is generally a sequence of three consecutive steps, which are reversible reactions. In the first step, diglyceride is obtained from triglyceride; in second step monoglyceride is obtained from diglyceride, and in the third step glycerin is obtained from monoglyceride. In all these reactions esters are produced. The stoichiometric relation between alcohol and the vegetable oil is 3:1 which is extracted from the chemical formula which is shown equations.

D. Figures And Tables

Properties of vegetable oil after 1st step i.e. esterification

S.No.	Property	Value
1.	Viscosity (μ)	23.416 mPa.s
2.	Kinematic viscosity (υ)	26.221mm^2/s
3.	Density (ρ)	893 Kg/m^3

Properties of vegetable oil after 2nd step i.e. transesterification an average oil of all sample

S.No.	Property	Value
1.	Viscosity (μ)	4.6340mPa.s
2.	Kinematic viscosity (υ)	5.3905mm^2/s
3.	Density (ρ)	859.7 Kg/m^3

Conventional mechanical stirring method (Molar ratio 6:1)

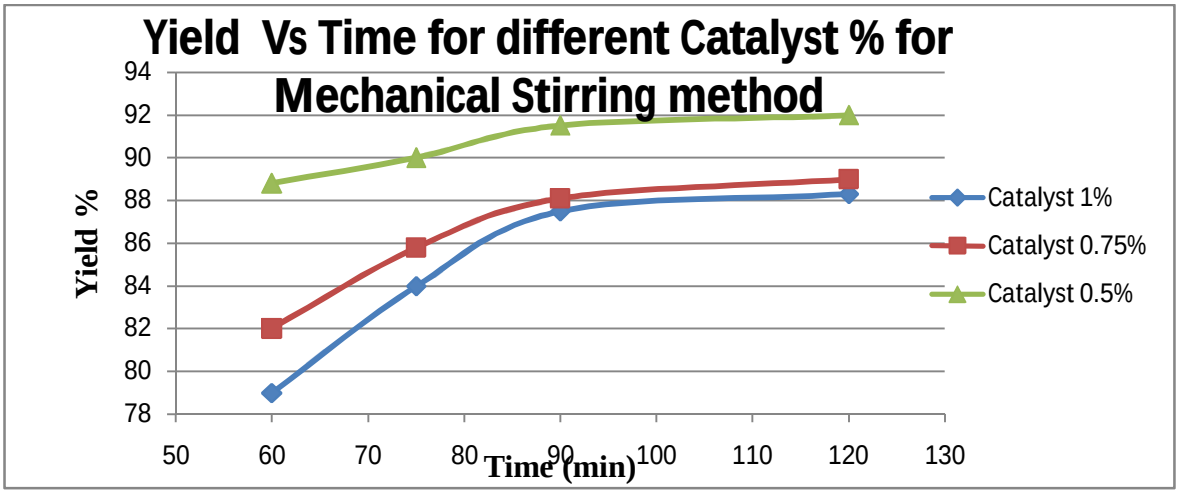


Fig.1 Yield Vs Reaction time for different catalyst percentage for Mechanical stirring method for molar ratio 6:1

Conventional mechanical stirring method (Molar ratio 7.5:1)

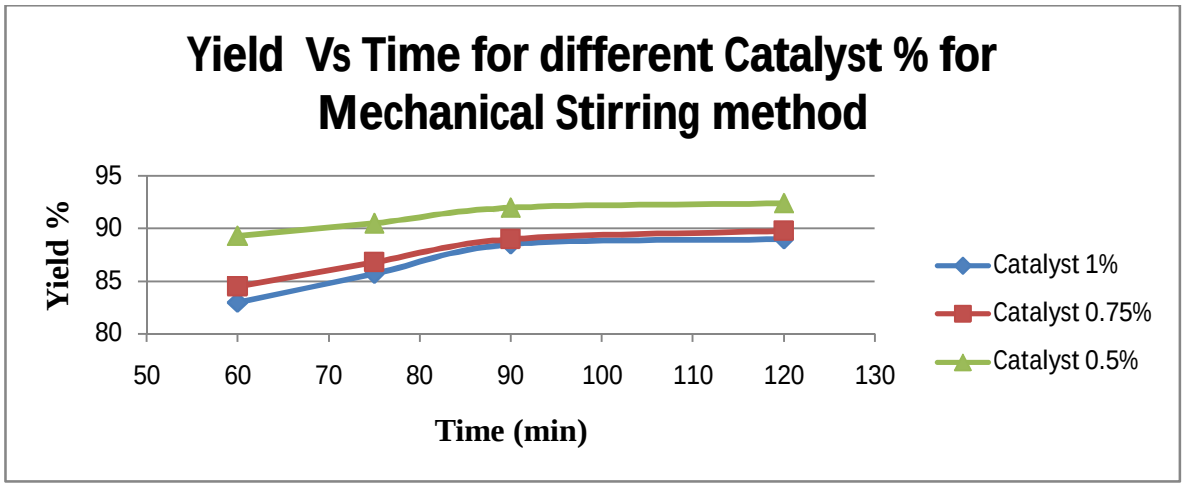


Fig.2 Yield Vs Reaction time for different catalyst percentage for Mechanical stirring method for molar ratio 7.5:1

Conventional mechanical stirring method (Molar ratio 9:1)

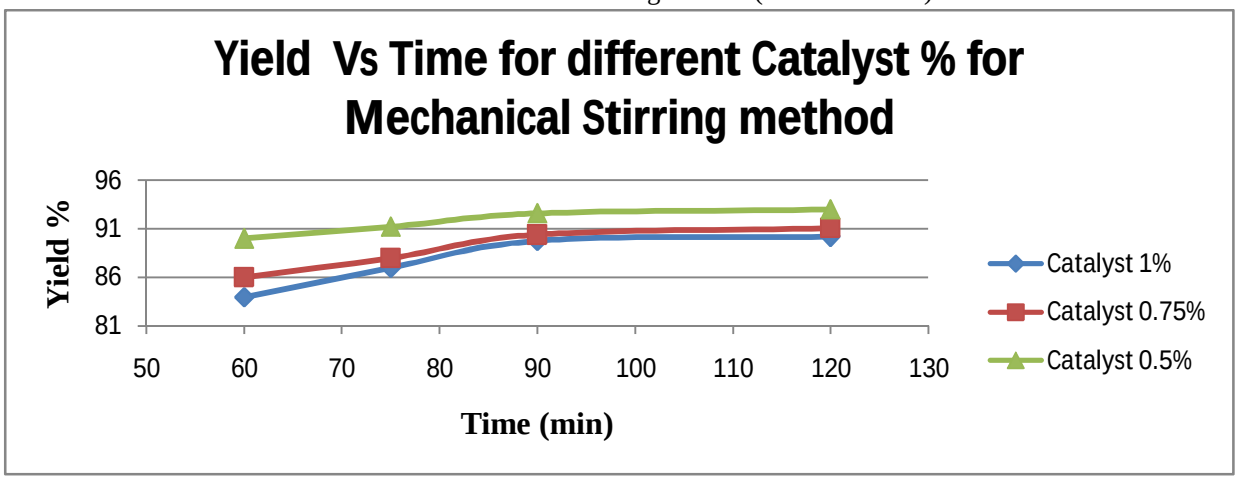


Fig.3 Yield Vs Reaction time for different catalyst percentage for Mechanical stirring method for molar ratio 9:1

Conventional mechanical stirring method (Catalyst 0.5%)

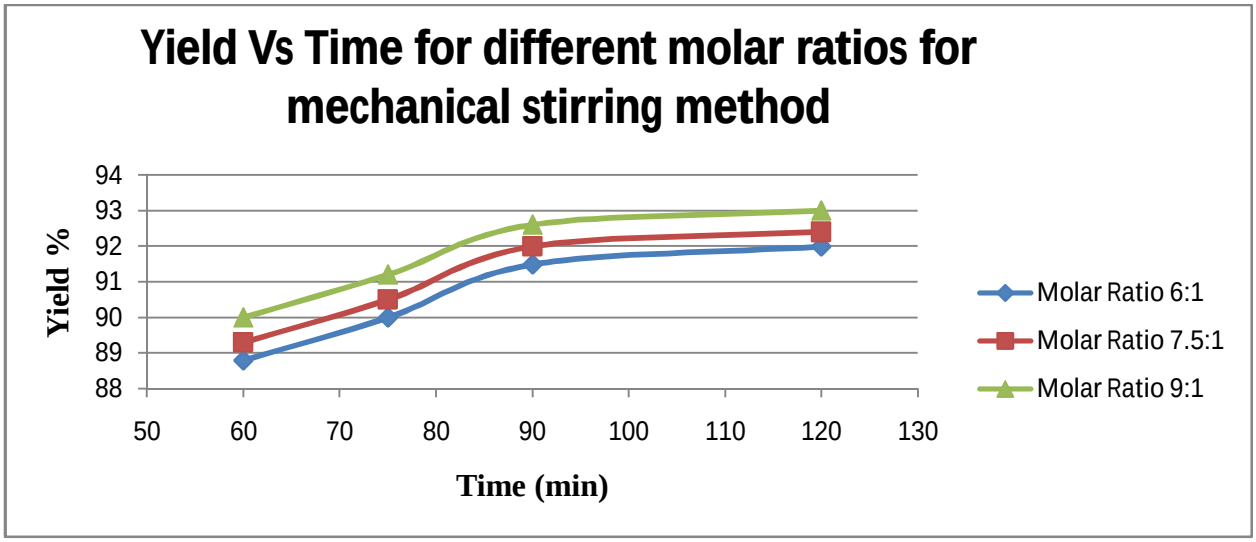


Fig.4Yield vs Time for different molar ratios for mechanical stirring method for catalyst percentage 0.5%

Conventional mechanical stirring method (Catalyst 0.75%)

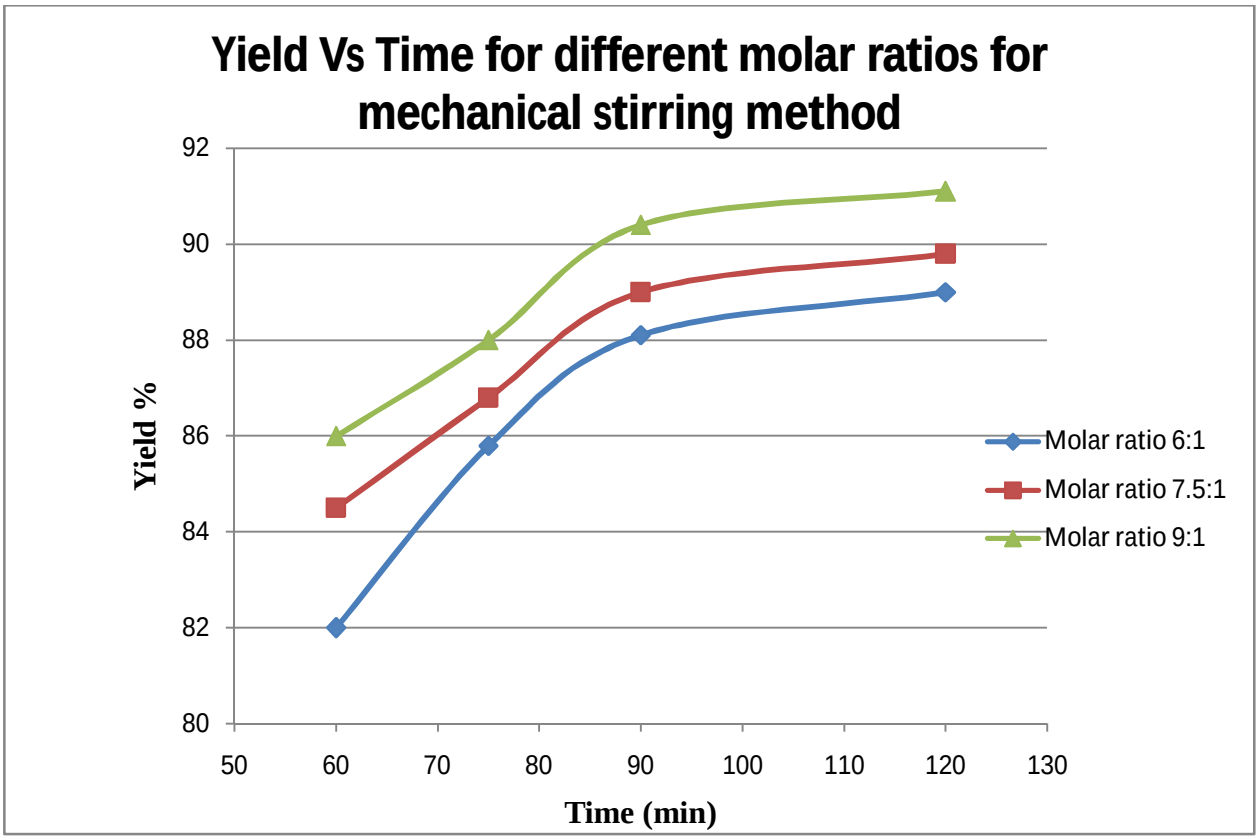


Fig.5Yield Vs Time for different molar ratios for mechanical stirring method for catalyst percentage 0.75%

Conventional mechanical stirring method (Catalyst 1%)

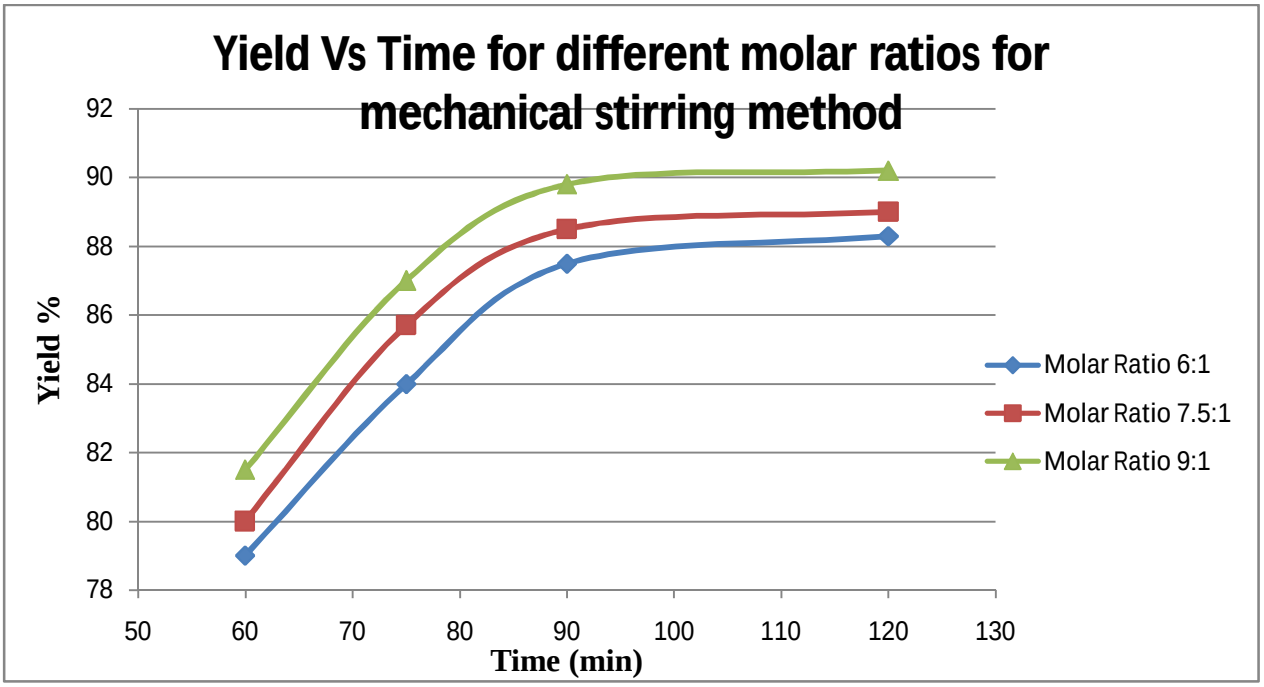


Fig.6Yield Vs Time for different molar ratios for mechanical stirring method for catalyst percentage 1%

III. RESULT AND DISCUSSION

A. *Effect of reaction time*

It is observed from fig.1 which shows a variation of yield with respect to time with the different catalyst %, its clearly shows from the fig.1 that for the molar ratio 6:1 yield is continuously increases with respect to time for the catalyst 0.5%. yield increases from 88.5% to 91.5% from 60 to 90 min. and then 91.5% to 92 % in 90 to 120min. similarly for catalyst 0.75% and 1% the yield increases from82 to 88% and 79 to 87% from 60 to 90 min. respectively. Fig 2 and fig 3 also represented that for molar ratio 7.5:1 and 9:1 the yield increases the reaction time similar that fig 1 which discussed above.

In fig no. 4, fig.5 and fig.6 also shows the variation between the yield and time with constant catalyst % such as 0.5%, 0.75% and 1% respectively. From that fig. we clearly seen that the yield is increase gradually with increases in time and then it is became constant.

B. *Effect of Molar Ratio*

It is observed from fig.4, fig.5 and fig.6 that when molar ratio increases from, 6:1, 7.5:1 to 9:1 then yield is also increases for different catalyst percentage. In the experiment of producing biodiesel from mechanical stirring method it is observed from the several results and concludes that if the molar ratio increases then yield also increases up to a certain molar ratio after that yield becomes constant, because only a certain amount of mole of alcohol is absorb by the oil. According to previous results only 11gm alcohol is absorbed in 100gm of oil. For this experiment the best molar ratio is 9:1.

C. *Effect of Catalyst percentage*

It is observed that from the fig.1, 2 and 3 that when the molar ratio increases then yield is also increases but at a same time if the catalyst increases the yield start decreasing. fig.1, fig.2 and fig.3. clearly showing that if the amount of catalyst increases then yield decreases for almost every molar ratio such as 6:1, 7.5:1 and 9:1.

IV. CONCLUSION

A conclusion section must be included and should indicate clearly the advantages, limitations, and possible applications of the paper. Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions.

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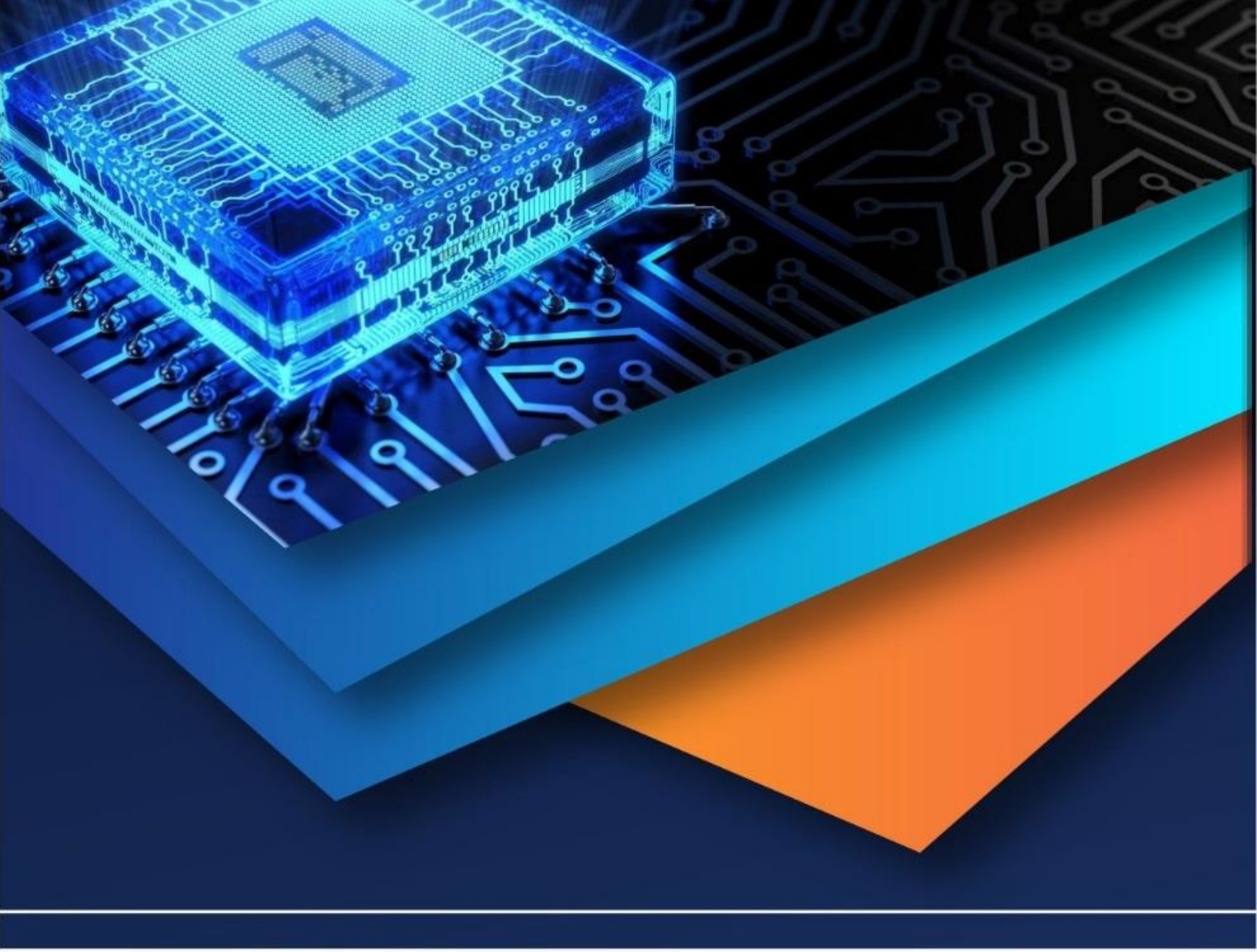

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