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Usage of Glycerin as an Engine Coolant and Experimental Investigation on Single Cylinder Diesel Engine

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Abstract: Biodiesel exhibits many good properties such as non-toxic fuel, renewable fuel, emits less amount of CO_2 and NO_x and highly biodegradable. Burning of petroleum based fuel results in the accumulation of carbon dioxide; carbon monoxide in the environment [1] and also day by day the cost of petroleum based fuels are increasing. It has been proved in many studies that the algae grown in CO_2-enriched air can be effectively utilized for converting it to oily substance(algae oil) and by doing trans-esterification process biodiesel can be produced. In this study algae' belonging to the Oedogonium species [2] is used for biodiesel production and the byproduct obtained through this process is glycerin. Cooling is very much essential for IC engines because high temperatures damage engine materials and lubricants. Engine cooling removes heat energy fast enough to keep temperatures low so that the engine can survive. A cooling curve test was performed in order to find the effect of using glycerin as engine coolant by mixing 50% of glycerin with 50% of water [3]. The experiment was conducted on kirloskar made 4 stroke single cylinder vertical hand cranking type diesel engine. The main focus of this experiment was to determine the rate of heat carried away by coolant and specific fuel consumption. Temperature of coolant at outside was varied, while the speed of engine was kept constant. To achieve a particular temperature for ethylene glycol based coolant, the flow rate was made to reach a required value and it was compared with the flow rate of water.

Keywords: Algae oil, Biodiesel, Renewable resource, Trans-esterification, coolant, Glycerol based coolants, heat carried, Specific fuel consumption, cooling curve test.

I. INTRODUCTION

The situation is worsened day by day due to the global pollution. Overwhelming consumption of fossil fuels as power source [4] is the major cause for this condition. Large parts of the fossil fuel - mainly petroleum based products are consumed by the automotive sector. Alternative fuels are environment friendly when compared with the conventional fuels. Biodiesel is mainly used as the alternative fuel for diesel in diesel engines. Biodiesel is made from renewable biological sources such as algae, vegetable oil, animal fats and other agricultural products. In this study biodiesel is processed through Trans-Esterification method. The byproduct of this reaction is glycerin and is employed as the engine coolant by mixing it with 50% of water.

II. TRANS-ESTERIFICATION [5]

Trans-etherification (also called alcoholisms) is the reaction of a fat or oil with an alcohol to form esters and glycerol. A catalyst is usually used to improve the reaction rate and yield. Because the reaction is reversible, excess alcohol is used to shift the equilibrium to the products side. Among the alcohols that can be used in the trans-esterification process are methanol, ethanol, propanol, butanol and amyl alcohol. Methanol and ethanol are used most frequently, especially methanol because of its low cost and its physical and chemical advantages. The reaction can be catalyzed by alkalis, acids, or enzymes. The alkalis include sodium hydroxide (N_aOH) and potassium hydroxide (KOH). Sulfuric acid, sulfonic acids and hydrochloric acid are usually used as acid catalysts. Alkali-catalyzed trans-esterification is much faster than acid-catalyzed trans-esterification and is most often used commercially. Low free fatty acid content in triglycerides is required for alkali-catalyzed trans-esterification. If more water and free fatty acids are present in the triglycerides, acid catalyzed trans-etherification can be used.

III. PRODUCTION OF BIODIESEL

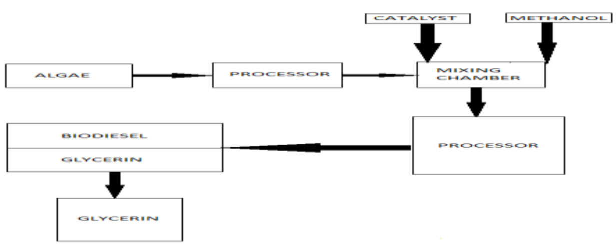

Fig. 1 Production of Biodiesel From Algae And Separation Of Glycerin.

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IV. EXPERIMENTAL SETUP

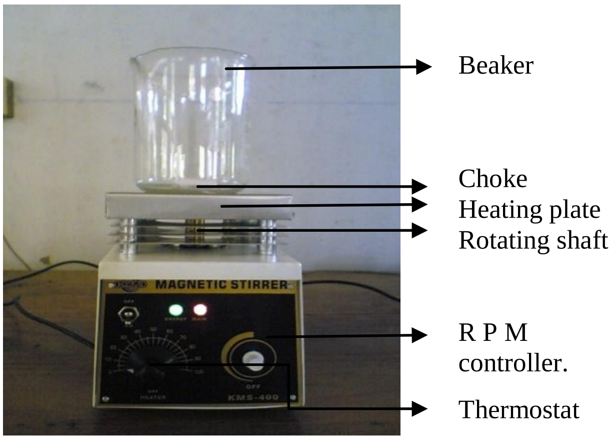

Fig. 2 shows apparatus used for oil extraction.


Fig. 3 shows the single cylinder diesel engine

Engine - Kirloskar Made 4 stroke single cylinder vertical hand cranking type diesel engine
Stroke - 110mm
Bore - 80mm
Rated speed -1500RPM
Cooling system -Water cooled

PROCESSED OIL

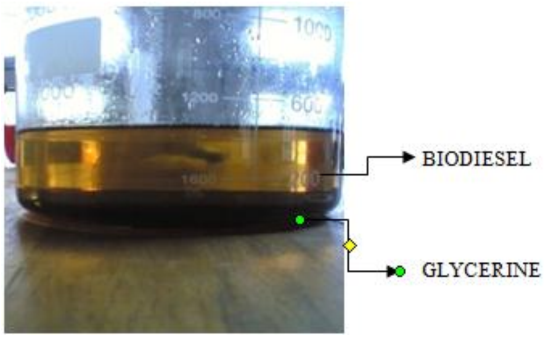

Fig. 4 shows the biodiesel extracted from algae oil.

V. EXPERIMENTAL PROCEDURE

The focus of this experiment is to find out the effect of coolant on brake thermal efficiency and specific fuel consumption by varying the outlet temperature of coolant and also to attain a specific temperature by varying the flow rate of coolant.

Procedure

*** Find out the maximum load by allowing the engine to run at rated speed ***

□ Both the fuel and coolant supplies are opened and the engine is made to start at half load and the speed is adjusted to reach the rated rpm of engine.
□ Engine is made to run for at least 2 times in order to attain steady conditions by adjusting the coolant flow to reach a maximum value.
□ Note the time required for the consumption of a fixed quantity of fuel.
Repeat the above steps for different outlet temperatures of coolant by varying (reducing) the coolant flow rate, without varying the load (i.e. Keeping the load constant).

VI. EQUATIONS USED

Brake power
BP = VI/1000 (kW) (1)
where, V = Voltage in volts
I = current in Ampere

Fuel consumption

TFC= (V*3600*ρ)/(1000*t) (kg/hr) (2)
where, V = Volume of fuel consumed
t = time taken for fixed quantity of fuel consumption (in s)
Specific fuel consumption = TFC / BP (kg/kW-hr) (3)
Heat carried away by cooling water

$$Q_w = M_w(T_o - T_i)\, C_{pw} \text{ (KW)}$$

C_{pw} = Specific heat of water (KJ/KgK)
T_o = Cooling water a outlet Temperature (K)
T_i = Cooling water at inlet Temperature (K)
M_w = Mass of water flow through rotameter (Kg/s)

VII. RESULT

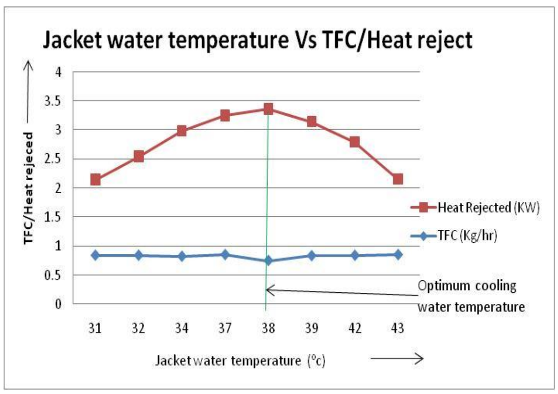

Fig. 5 Shows cooling curve for 50% water and 50% glycerin mixture.

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VIII. CONCLUSION

It was noted that the optimum coolant temperature at outlet was almost 38^{o}C.Maximum heat carried away by coolant and maximum fuel economy was observed at this optimum temperature. There was not much difference in the optimum temperature and fuel economy by varying the coolant alone; they varied when the flow rate was varied. The biodiesel extracted can be used an alternative to diesel fuel.

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REFERENCES

[1] Goldenberg, J., 2000. World Energy Assessment, Preface. United Nations Development Programe, New York, NY, USA.
[2] Arya Krishnan Biodiesel production from Oedogonium algae`, Proceedings of International conference on Materials & future, November 2013.
[3] Mario Pagliaro, Rosaria Ciriminna, Hiroshi Kimura, Michele Rossi, and Cristina Della Pina (April 2007): "From Glycerol to Value-Added Products
[4] Yusuf, C., 2007. Biodiesel from microalgae. Biotechnology. Advances, 25: 294-306.
[5] Basu, H.N. and M.E. Norris, 1996. Process for production of esters for use as a diesel fuel substitute using a non-alkaline catalyst. US Patent No. 5, 525, 126, June 11.

BIOGRAPHIES

Azeem Anzar currently working as Asst. Prof, Department of Mechanical Engineering at ACE College of Engineering, Trivandrum. He has pursued his B.Tech from University of Kerala and M.Tech from University of Calicut. He has 8 years of teaching experience. . He has already published four journal papers and has presented a paper at National Conference on Large Scale Multi-Disciplinary Systems of National Significance Trends and Challenges organized by ISRO SHAR (ISSE Sriharikota- Chennai chapter).

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