TEMPERATURE ANALYSIS OF COOLING WATER SUPPLIED IN COMPRESSION IGNITION ENGINE USING DIESEL AND WCO BIODIESEL BLEND

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Abstract- Due to future energy crises in the world it becomes necessary to focus the alternative of conventional fuel. To overcome the need energy due to which this crisis persists and to investigate these substitutes of conventional fuels it is also necessary to examine every aspect of performance of these substitutes in well manner so that they can fulfill the requirement of energy in an economic way. This paper is focused to analysis the thermal performance of such resource that is biodiesel derived from waste cooking oil (WCO) and its blend by setting up experimental setup in compression ignition engine.

In this paper the temperature analysis of cooling water of a compression ignition engine has been carried out using WCO Biodiesel blend as a fuel. This is carried out by measuring the temperature of inlet and outlet cooling water with respect to different values of power output along with the fuel consumption. The Biodiesel is blended with pure diesel in different proportions as B5, B10, B20, B40, B60, B80 and B100 and same is used in CI engine in varying load conditions. Power is measured by electrical load through ac alternator coupled with diesel engine. The observations have been recorded and results have been obtained by load variation from no load to 3kw.

Keywords- CI engine, WCO biodiesel as alternative source, Biodiesel blends.

1. INTRODUCTION

Temperature analysis of cooling water supplied in compression ignition engine is concerned with heat energy that is wasted and carried out. This energy is nothing but a part of energy supplied as a fuel having a great cost today. So object is to just analyse that what variation takes place in the temperature of inlet and out cooling water supplied in engine from water jacket in different working situations where fuels are supplied in different manner using diesel and biodiesel blend and also investigate the energy potential available in water in terms of heat. In biodiesel blend other fuel is blended with diesel in different proportions and results will be discussed according to proportion of biodiesel blend. Here biodiesel blend is concern with the blend of bio fuel incorporated with diesel in different proportions. Another very important aspect of this paper is to understand the relevance of temperature of cooling water when biodiesel incorporated with diesel. As we are aware that in internal combustion engine energy supplied in the form of fuel as diesel, petrol, gasoline etc. is wasted in the form heat through different parts of the engine. It means that (25 to 35) % of total energy is used as mechanical work and (75 to 65) %of total energy is lost in the form of heat to the environment [1]. The energy in terms of heat is carried by cooling system is 30% of total energy supplied. Heat lost through cooling water is measured in terms of temperature of inlet and outlet cooling water by temperature sensing devices like digital thermometer, thermocouples est.. In this context comparative analysis of temperature of cooling water is done by using diesel and bio diesel blend in various proportions.

A survey of literature is done through the review of various papers, journals, and research work for obtaining the way of experiment on the compression ignition engine. Study about types of biodiesel, their production, blending and application in CI engine is covered in the literature survey. The parameters of experiment on diesel engine such as cooling water temperature, brake power, fuel consumption are identified in the survey. So an effective approach is found from literature survey for preceding the experiment in the CI engine [3-16].

2. EXPERIMENTAL SETUP-

3. LISTS OF THE INGREDIENTS USED IN THE EXPERIMENT SETUP-

1. Foundation structure	2. Steel frame mountings
3. Internal combustion engine	4. AC alternator
5. Electrical Load panel	6. Temperature sensing device
7. Speedometer (Tachometer)	8. Air intake measurement system
9. Fuel intake measurement system	10. Diesel and WCO Biodiesel fuel

4. SPECIFICATION OF DIESEL ENGINE USED IN THE EXPERIMENT SETUP-

For conducting the experiments on CI engine a four stroke, single cylinder, vertical and water cooled diesel engine has employed made from Kirloskar oil engine India. Engine have the compression Ratio 17.5:1, Stroke and Bore are 110 mm and 87.5 mm, rated power output 7.5 HP/5.2 KVA and rated RPM is 1500. Engine is hand start and direct injection type.

5. MEASUREMENT OF COOLING WATER TEMPERATURE AT INLET AND OUTLET POINTAS OF WATER JACKET-

Temperature of cooling water is measured at inlet and outlet point (Cw1 & Cw2) supplied from water jacket to engine by digital thermometer. Copper tubes are inserted at inlet and outlet point of engine and filled with lubrication oil. Thermometer is inserted inside the tubes for few seconds and temperature of cooling water is identified.

6. OBSERVATIONS:

7.1- Variation of inlet and outlet cooling water temperature with power for Diesel and various Biodiesel blends-

Readings observed from experimental setup are given in the form of tables in ***annexure*** 1 table no 3 & 4

7.2- Variation of fuel consumption for Diesel and various Biodiesel blends with power-

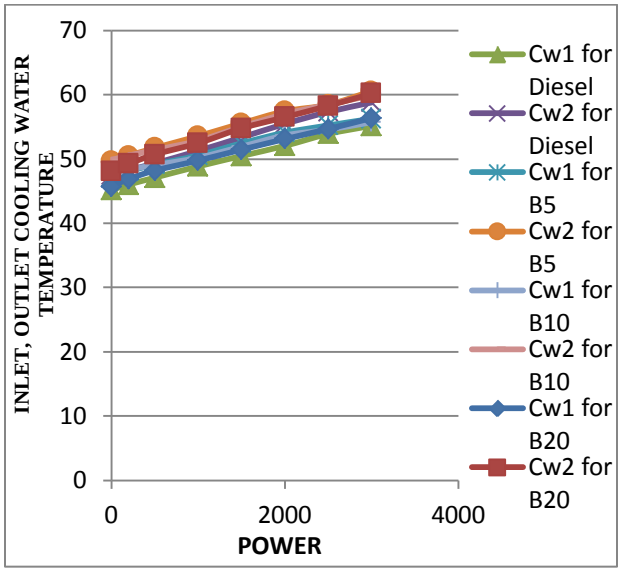
Readings observed from experimental setup are given in the form of tables in ***annexure 1*** table no 5.

7. RESULTS AND DISCUSSION

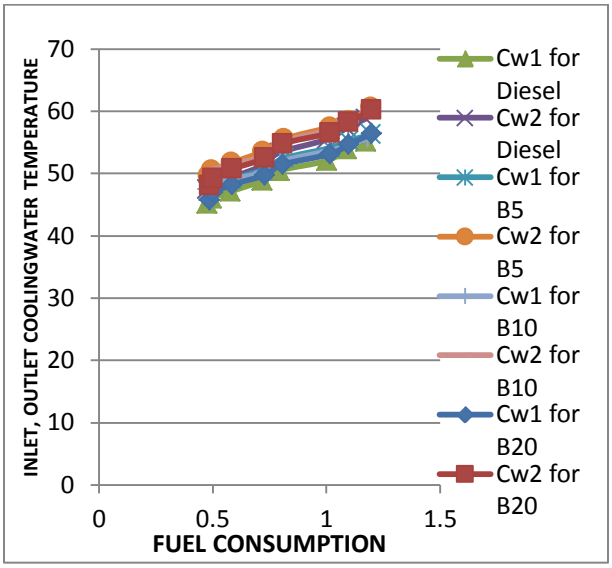
(A)- Variation of cooling water temperature with power for Diesel and Biodiesel Blends-

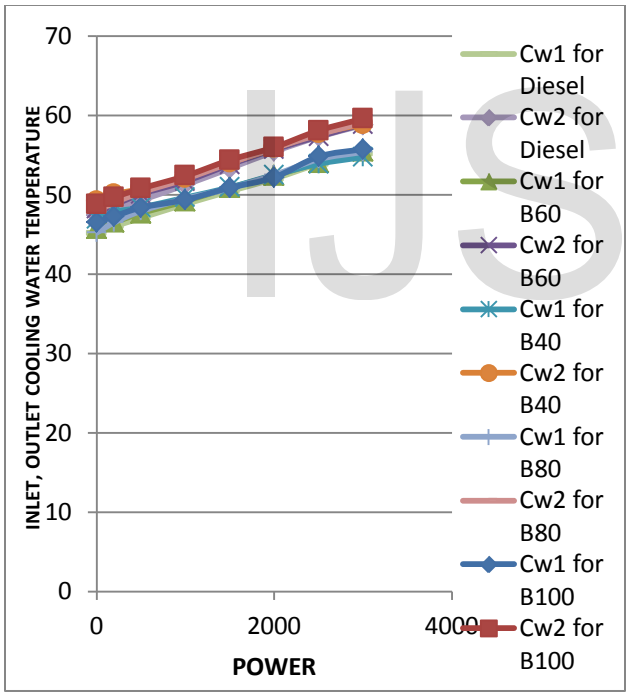
The plots are showing combined variation of inlet and outlet cooling water temperature with power for diesel and Biodiesel blend. Variation of temperature of cooling water at inlet & outlet points is indicated

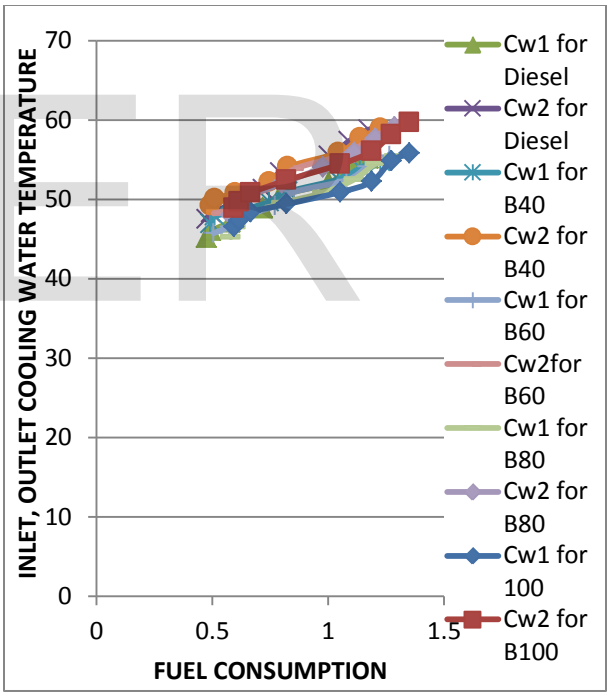
with respect to power for Diesel, B5, B10, B20, B40, B60, B80, and B100 at no load to 3000 watt.



respect to fuel consumption for Diesel, B5, B10, B20, B40, B60, B80, and B100 at no load to 3000 watt.







(B)- Variation of cooling water temperature with Fuel consumption for Diesel and Biodiesel Blends-

The plots are showing combined variation of inlet and outlet cooling water temperature with for diesel and Biodiesel blend. Variation of temperature of cooling water at inlet & outlet points is indicated with

8. CONCLUSION

Following conclusions have been drawn from the experimental investigation on the compression ignition engine using diesel and WCO biodiesel blends as B5, B10, B20, B40, B60, B80 and B100

● The temperature of inlet cooling water is minimum (45.17°C) for diesel and maximum (56.37°C) for B20. Similarly temperature of outlet cooling water is

minimum (54.77°c) for B40 and maximum (60.56 °C) for B5 for the power variation 0 watt to 3000 watt.

- Fuel consumption is minimum (0.47 kg/hr) for diesel and maximum (1.34 kg/hr) for B100 for the power variation 0 watt to 3000 watt.

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Annexure 1

Table no. 1 Properties of WCO biodiesel and Diesel

Property	Unit	Acceptable limit	Diesel ASTM D975	WCO Biodiesel
a- Density at 15°C	Kg/m^3	860-900	831	886
b- Kinematic viscosity at 40°C	m^2/s	$(3.5 - 5)\times10^{-6}$	$(2.5 - 6)\times10^{-6}$	4.3×10^{-6}
c- Flash point	°C	Min 100	51	>210
d- Sulphur contents	PPM	Max 350	500	<120
e- Water content	w/w%	0.02-0.05	0.005	>0.04
f- Calorific value	MJ/kg	….	42	36.34

Table no. 2 Density of different biodiesel blend

Sn.	Fuel type	Proportion of fuel in Volume (ml)	Density (kg/m^3)
1	Pure Diesel	100% Diesel	831
2	B 5	5% WCO Biodiesel + 95% Diesel	833.78
3	B 10	10% WCO Biodiesel + 90% Diesel	836.5
4	B 20	20% WCO Biodiesel + 80% Diesel	842
5	B 40	40% WCO Biodiesel + 60% Diesel	853
6	B 60	60% WCO Biodiesel + 40% Diesel	864
7	B 80	80% WCO Biodiesel + 20% Diesel	875
8	B 100	100% WCO Biodiesel	886

Table no. 3 Variation of cooling water temperature with Power

SN	POWER	B40		B60		B80		B100	
	Watt	Cw1	Cw2	Cw1	Cw2	Cw1	Cw2	Cw1	Cw2
1	0	46.92	49.22	45.75	48.22	45.23	47.96	46.53	48.83
2	200	47.87	50.1	46.55	48.8	46.53	49.03	47.3	49.7
3	500	48.42	50.77	47.7	50.1	47.97	50.32	48.4	50.8
4	1000	49.67	52.15	49.22	51.72	49.52	52.02	49.4	52.4
5	1500	50.95	54.07	50.92	53.82	50.82	54.02	50.9	54.4
6	2000	52.52	55.87	52.42	55.72	52.52	55.9	52.22	56.02
7	2500	53.92	57.75	54.07	57.37	54.5	57.62	54.84	58.12
8	3000	54.775	58.92	55.5	58.92	55.42	59.12	55.78	59.62

Table no. 4 Variation of cooling water temperature with Power

SN	POWER	DIESEL		B5		B10		B20	
	Watt	Cw1	Cw2	Cw1	Cw2	Cw1	Cw2	Cw1	Cw2
1	0	45.17	47.45	47.2	49.65	47.45	49.85	45.72	48.1
2	200	46.025	48.275	48.075	50.5	48.3	50.55	46.9	49.25
3	500	47.1	49.32	49.125	51.725	49.05	51.4	48.2	50.7
4	1000	48.85	51.27	50.57	53.55	50.2	52.85	49.75	52.47
5	1500	50.47	53.35	52.45	55.55	51.92	55.02	51.45	54.77
6	2000	52.05	55.47	54.1	57.425	53.67	57	53.1	56.5
7	2500	53.9	57.32	55.225	58.45	54.575	58.47	54.67	58.27
8	3000	55.17	58.8	56.26	60.56	55.72	59.9	56.37	60.17

Table no. 5 Variation of Fuel consumption with Power

		FUEL CONSUMPTION (Kg/hr)							
SN	POWER (watt)	DIESEL	B5	B10	B20	B40	B60	B80	B100
1	0	0.4742	0.481	0.4762	0.487	0.4921	0.5053	0.5795	0.5946
2	200	0.4944	0.496	0.494	0.5012	0.5098	0.5735	0.6007	0.6153
3	500	0.5771	0.583	0.5809	0.5847	0.5979	0.6216	0.6442	0.6645
4	1000	0.7184	0.721	0.7253	0.728	0.7439	0.7714	0.8003	0.8204
5	1500	0.7922	0.814	0.7979	0.807	0.8255	0.8526	0.9758	1.0506
6	2000	1.0012	1.015	1.016	1.0145	1.0445	1.08	1.1123	1.1866
7	2500	1.0886	1.096	1.1007	1.0983	1.1373	1.1676	1.2041	1.2718
8	3000	1.1721	1.197	1.1809	1.1972	1.2244	1.2644	1.2868	1.3492