

# Study of Performance Characteristics of Single Cylinder Diesel Engine Using Water Emulsified Diesel as Fuel

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**Abstract:** In this research paper the effect of water in diesel emulsion on performance characteristics of diesel engine has been studied. Various combination of water in diesel emulsion that is 5% water denoted as W5, 10% water denoted as W10, 20% water denoted as W20 and 30% water denoted as W30 are used in the experiment carried out to find the emulsion which gives best performance characteristics for diesel engine. Best performance characteristics of diesel engine here stands for high brake thermal efficiency, high torque, higher brake power and low brake specific fuel consumption. Thus test was carried out first using pure diesel and then W5, W10, W20 and W30 respectively and the readings were noted down in observation tables and graphs were drawn and conclusion was arrived by carefully analysing the graphs. By using water in diesel emulsion the peak temperature in the combustion chamber is lowered which gives many advantages like low emissions from the engine.

**Keywords:** performance characteristics, load, torque, brake power, brake thermal efficiency, brake specific fuel consumption, emulsion, peak temperature

## 1. Introduction

In order to attain high brake thermal efficiency combined with low brake specific fuel consumption we use water in diesel emulsion in place of pure diesel oil. When water in diesel emulsion is sprayed in the combustion chamber the water droplets absorb the latent heat of vaporisation from the combustion gases and get converted into steam and thus peak pressure increases. In other words the heat which is lost from the cylinder liner jacket to cooling water and the heat loss in the exhaust is utilised in the formation of steam in the combustion chamber. Also as a result of micro explosion phenomenon of water droplets there is good mixing of fuel and air which results in efficient combustion. Thus due to high peak pressure the torque increases which results in increase in brake power combined with high brake thermal efficiency and low brake specific fuel consumption.

## 2. Material and Methods

The engine specification used for the experiment is mentioned below along with the procedure for carrying out the experiment.

### 2.1 Engine Specifications

Kirloskar Engine Type AVI  
Power 3.7 KW @ 1500 RPM  
Mechanical dynamometer with radius of arm 0.14 meter.  
Starting by hand crank manually using decompression lever.

### 2.2 Procedure for carrying out experiment

- 1) The filters of the engine is to be replaced and the injectors is to be cleaned and calibrated according to the desired pressure.
- 2) The fuel tank is to be filled with pure diesel and the engine is to be run.

- 3) The engine should run at various loads of the dynamometer – 1, 2, 3, 4, 5 kg and respective readings were taken for fuel consumption/minute.
- 4) After all the readings are taken, the leftover diesel should be drained out of the tank and emulsion is to be poured.
- 5) Same steps were repeated for emulsion and the readings were noted down for the emulsion.
- 6) After taking all the observations graphs were plotted to compare the performance characteristics of the engine in case of diesel and emulsions W5, W10, W20 and W30.

## 3. Observation Tables

### 3.1 Table for Performance Characteristics of Pure Diesel Oil

Sr No.	RPM	Load in KG	$M_f$ in KG/HR	Brake Power in KW	Brake Specific Fuel Consumption in G/(KWHR)	Brake Thermal Efficiency in %
1	1490	1	0.1835	0.214	0.857	10
2	1470	2	0.226	0.422	0.535	16
3	1460	3	0.245	0.629	0.389	22
4	1450	4	0.285	0.833	0.342	25
5	1430	5	0.303	1.027	0.295	29

### 3.2 Table for Emulsion W5 Performance Characteristics

Sr No.	RPM	Load in KG	$M_f$ in KG/HR	Brake Power in KW	Brake Specific Fuel Consumption in G/(KWHR)	Brake Thermal Efficiency in %
1	1490	1	0.19	0.214	0.88	10.19
2	1470	2	0.24	0.422	0.56	15.9
3	1460	3	0.28	0.629	0.44	20.3
4	1450	4	0.31	0.833	0.37	24.3
5	1430	5	0.33	1.027	0.32	28.15

**3.3 Table for Emulsion W10 Performance Characteristics**

Sr No.	RPM	Load in KG	M <sub>f</sub> in KG/HR	Brake Power in KW	Brake Specific Fuel Consumption in G/(KWHR)	Brake Thermal Efficiency in %
1	1490	1	0.26	0.214	1.21	7.8
2	1470	2	0.39	0.422	0.92	10.3
3	1460	3	0.48	0.629	0.76	12.5
4	1450	4	0.60	0.833	0.72	13.3
5	1430	5	0.75	1.027	0.73	13.11

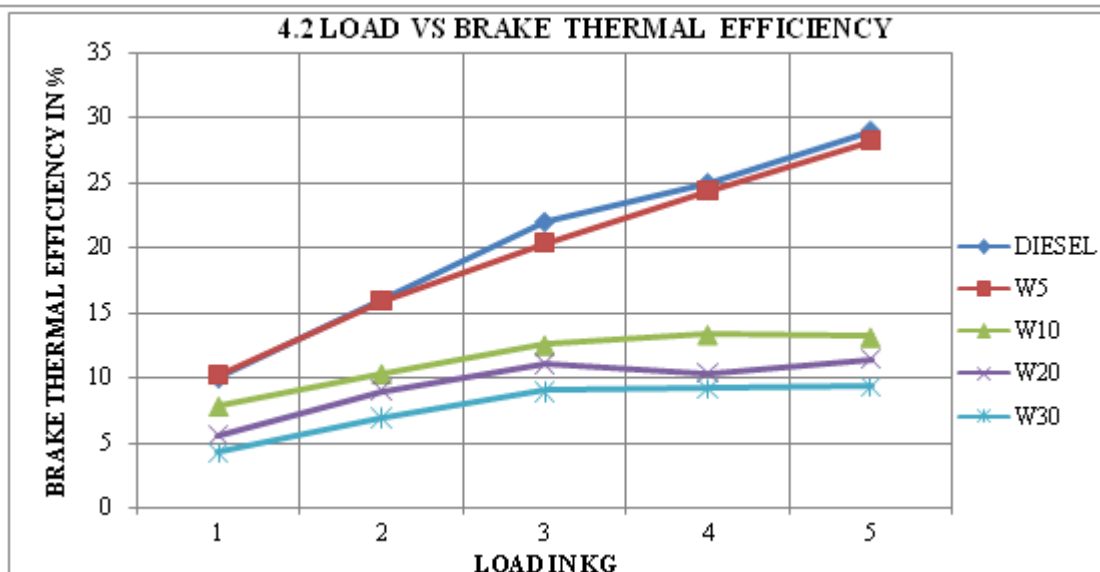
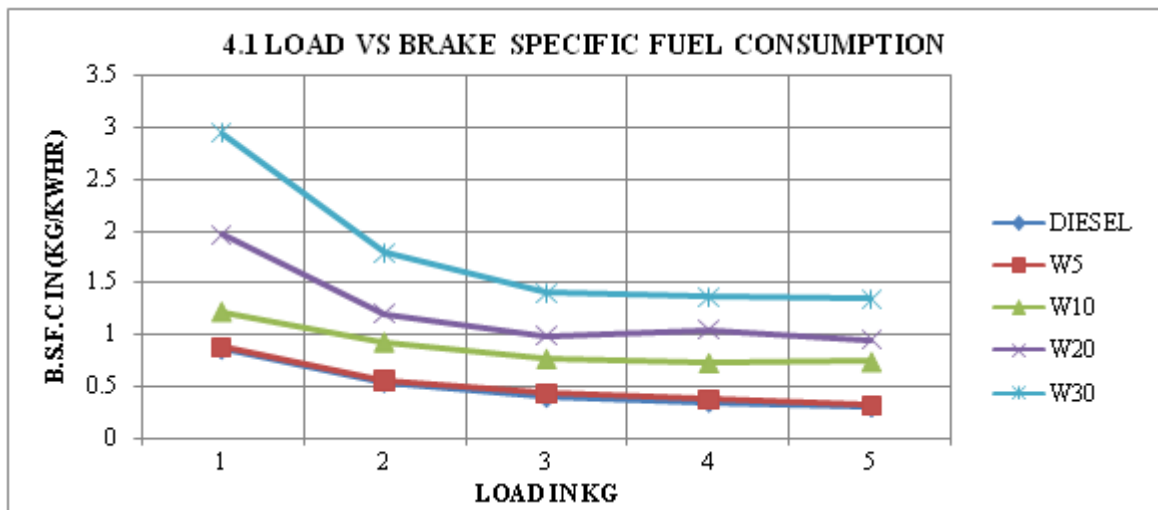
**3.4 Table for Emulsion W20 Performance Characteristics**

SR NO.	RPM	Load in KG	M <sub>f</sub> IN KG/HR	Brake Power in KW	Brake Specific Fuel Consumption in G/(KWHR)	Brake Thermal Efficiency in %
1	1490	1	0.42	0.214	1.96	5.53
2	1470	2	0.51	0.422	1.2	8.98
3	1460	3	0.62	0.629	0.98	11.01
4	1450	4	0.88	0.833	1.05	10.28
5	1430	5	0.98	1.027	0.95	11.38

**3.5 Table for Emulsion W30 Performance Characteristics**

SR NO.	RPM	Load in KG	M <sub>f</sub> IN KG/HR	Brake Power in KW	Brake Specific Fuel Consumption in KG/(KWHR)	Brake Thermal Efficiency in %
1	1490	1	0.63	0.214	2.94	4.25
2	1470	2	0.756	0.422	1.79	6.9
3	1460	3	0.882	0.629	1.40	8.94
4	1450	4	1.134	0.833	1.36	9.2
5	1430	5	1.386	1.027	1.349	9.29

## 4. Graphs



## 5. Result and Discussions

From the trend shown in the graphs it is clear that as the load increases the brake specific fuel consumption decreases when running the diesel engine on pure diesel oil as fuel. But when we use W5 as fuel then also we get the same trend of brake specific fuel consumption with additional advantage of low harmful exhaust emissions. Moreover when we increase the water content in fuel for example W30 there is considerable increase in brake specific fuel consumption at all loads which is a disadvantageous situation. Also from the trend shown in the graph brake thermal efficiency is almost same for pure diesel and W5 but there is considerable reduction in brake thermal efficiency when we use W30, W20 or W10 at all the loads.

## 6. Conclusion and Future Scope

We arrive at a conclusion about the effectiveness of W5 emulsion as alternative fuel because it gives high brake thermal efficiency along with low brake specific fuel consumption at all loads on the engine. Moreover it also gives less harmful emissions from the engine and less thermal energy loss from jacket water cooling or exhaust of the engine.

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