

The Effect of diesel Fuel Mixed Water in Engine Performance and Emission

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Abstract— The diesel engine has been the engine of choice for heavy-duty applications in agriculture, construction, industrial, and transportation for more than 50 years. Diesel Fuel has high gas emissions such as in NO_x, CO, S and opacity. In this study, In order to reduce the gas emissions-water is added into the diesel fuel. Bio Water Diesel Fuel (BWDF) is made and compared to Diesel Fuel (DF). Experiment was conduct in one hour and 17 hours engine performance. Test fuels are diesel fuel (DF) as a datum and BWDF. The results, BWDF can reduce NO_x emission up to 42%, CO up to 23.7% and opacity up to 3.2%. From one to 9 hours endurance test, BWDF has no advantages in fuel consumption compared to DF. But in 11 hours of running engine, BWDF is more efficient 5% than DF. In 17 hours of running engine, BWDF is the highest efficiency up to 15.85%.

Index Term— Diesel Fuel, Bio Water Diesel Fuel, water, emissions, engine performance.

I. INTRODUCTION

The diesel engine has been the engine of choice for heavy-duty applications in agriculture, construction, industrial, and transportation for more than 50 years. A difficult challenge for diesel engine designers is the emission of oxides of nitrogen (NO_x) [1]. NO_x emissions are associated with high gas temperatures and lean fuels conditions; in contrast to most other pollutants, they usually increase when biodiesel is used [2].

One of the most properties of diesel fuels is its readiness to auto ignite at the temperatures and pressures present in the cylinder when the fuel is injected [1]. The laboratory test that is used to measure is the Cetane Number (CN) test [1]. Fuels with high CN will have short ignition delays and a small amount of premixed combustion because little time is available to prepare the fuel for combustion.

This work was supported by PT.Lapi fujitamina Teknologi and part of The Faculty of Industrial Technology, Mechanical Engineering Department, Trisakti University and

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Indonesia needs diesel fuel for electrical purposes and vehicles almost 74 millions per day. The limitation of crude oil and the increasing of oil crude price make the scientist to develop new alternative energy that more friendly to environment. Indonesian diesel fuel has high emissions such as NO_x, CO and opacity.

In this study, the diesel fuel is added by water 20% and additive 15%. The purpose of water is to reduce the emissions such as NO_x, CO and opacity. And Bio Water diesel Fuel (BWDF) is made and compared with diesel fuel (DF). And those fuels are compared by engine performance and emissions.

II. RESEARCH METHODOLOGY

A. Preparing Bio Water Diesel Fuel

To make Bio Water Diesel Fuel (BWDF), we prepared diesel fuel 75%, water 15% and additive 15% [5]. First, we blended all the ingredients not less than 15 minutes. The longer for blending the fuel, the results will become better. And the results, diesel fuel is mixed perfectly by water shown in figure 1.

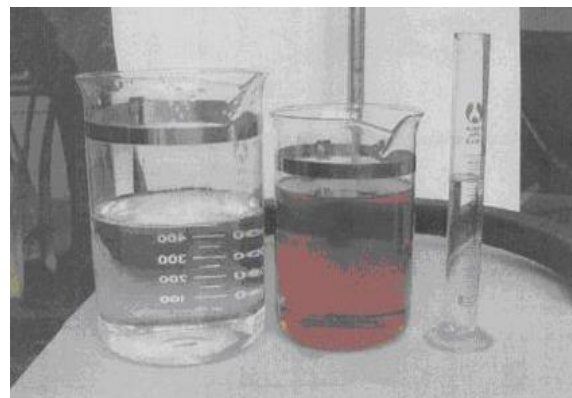


Fig. 1. Preparing for water , diesel fuel and additives

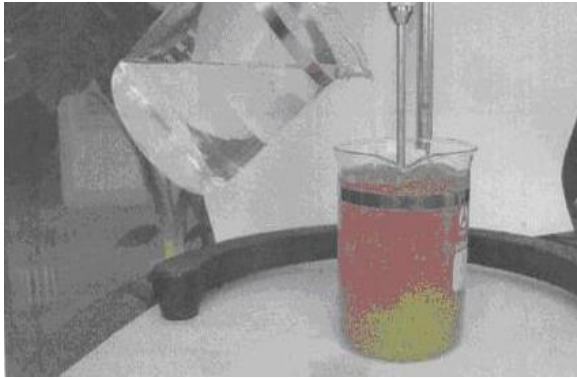


Fig. 2. Blending all the materials

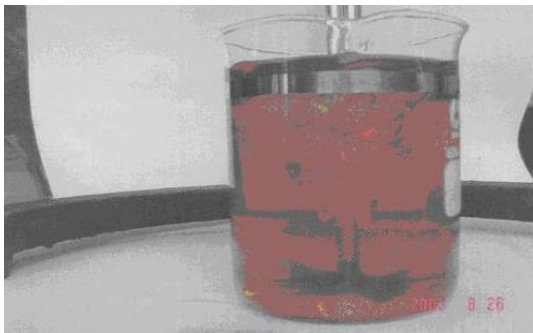


Fig. 3. Stirring for minimum 15 minutes



Fig. 4. Bio Water Diesel Fuel is made and has a perfectly burning

B. Test Engine

These experiments were conducted on 1000cc single cylinder engine and direct injection. The engine specification is shown in table 1.

TABLE I
Engine Specification

Parameter	Specification
Brand Name	Tianli
Type	AS195
Made In	China
Max Power	14 HP
Rated Power	2200 rpm
Capacity Volume	1000 cc
Number of Cylinder	One
Load	Electricity Generators, One Phase

TABLE II
Operating Condition in 17 Hours Endurance Test

Speed (rpm)	Load (kW)	Time (Minutes)
900-950	0	15
1500	4	10
2000	4	5
900-950	0	15
1500	4	10
2000	4	5

Experiments were carried out following SAE Technical Series 942010 "Diesel Fuel Detergent Additive Performance and Assessment" [2]. As mentioned in that reference, experiments were done in diesel engine one cylinder with zero load, 45% load, 65% load and maximum load. The operating condition was in 1500 rpm and with zero load, 1 kW, 2 kW, 3 kW and 4 kW (4kW=80%).



Fig. 5 . Installation of Diesel Engine with Electrical Loads

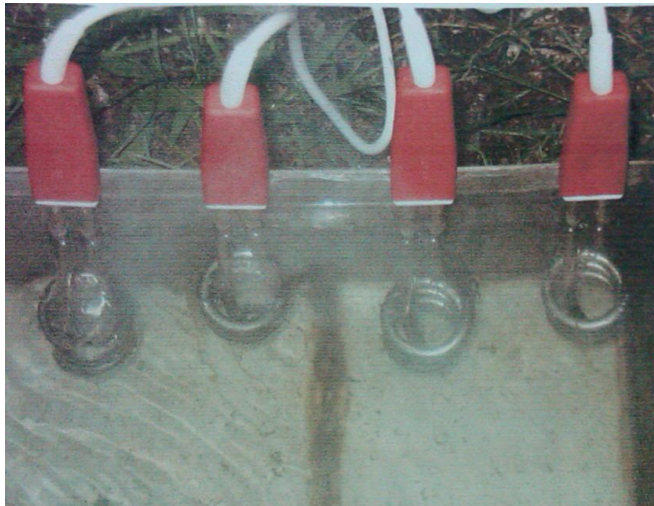


Fig. 6. Electrical Loads

III. RESULT AND DISCUSSION

A. Engine Performance

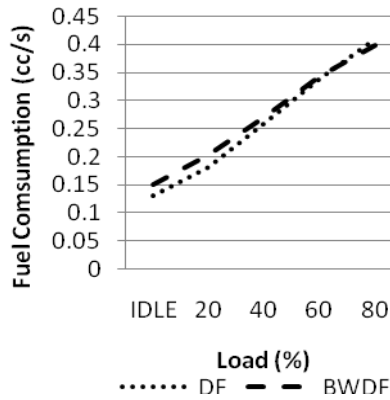


Fig. 7. Fuel Consumption Before Endurance Test

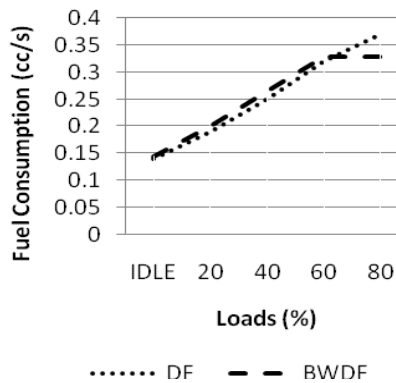


Fig. 8. Fuel Consumption After Endurance Test

After Endurance test, in 60% loads BWDF has more

efficient 11% than DF. In contrast, in minimum load before and after endurance test DF has more efficient compared to BWDF.

B. Emission Test

NO_x

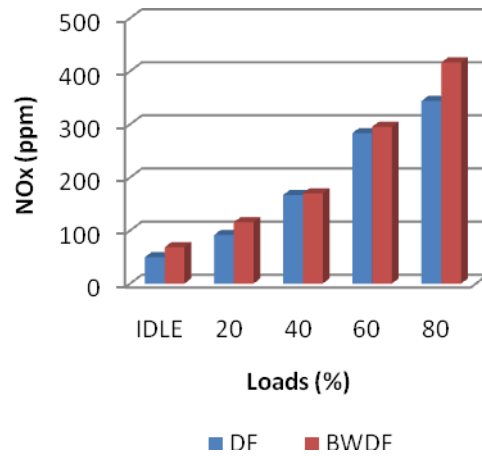


Fig. 9. Nox Emission DF and BWDF Before Endurance Test

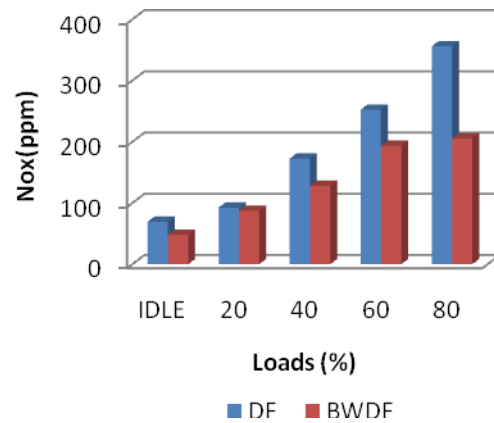


Fig. 10. Nox Emission DF and BWDF After Endurance Test

After Endurance test, BWDF can reduce NO_x emission in minimum and also in maximum loads. in maximum load (80%) BWDF can reduce NO_x emission up to 42 %.

CO

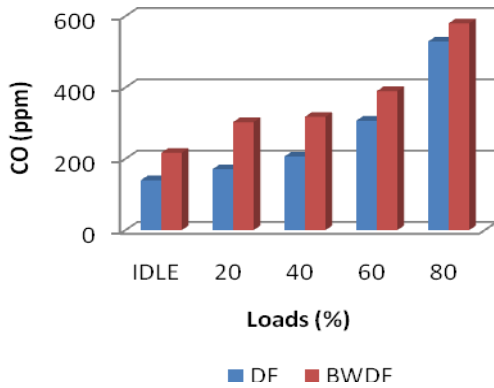


Fig. 11. CO Emission DF and BWDF Before Endurance Test

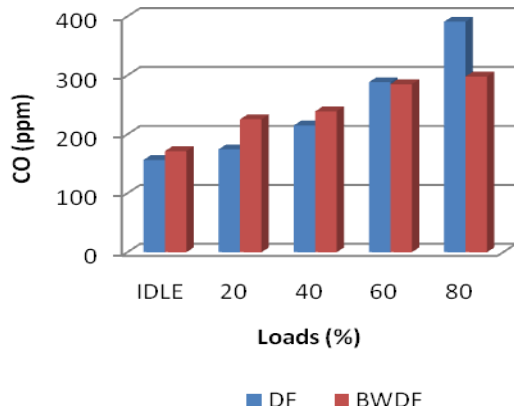


Fig. 12. CO Emission DF and BWDF After Endurance Test

After endurance test in maximum load (80%) BWDF can reduce the CO emission up to 23.7% comparing to DF.

NO

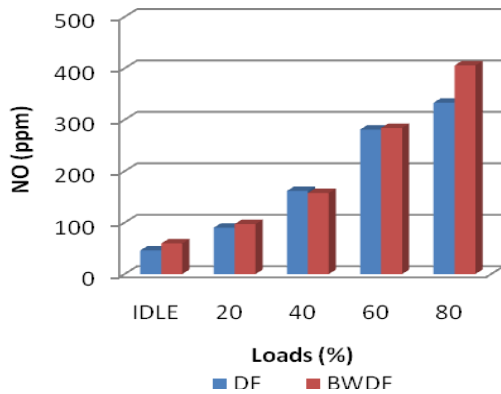


Fig. 13. NO Emission DF and BWDF Before Endurance Test

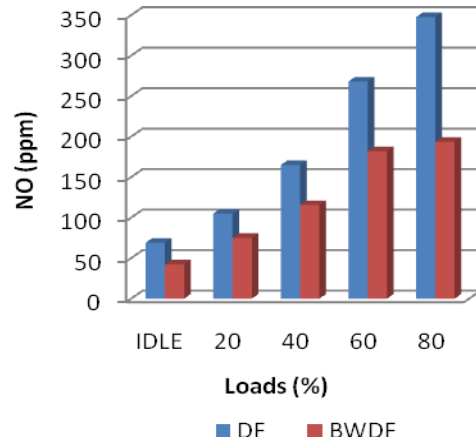


Fig. 14. NO Emission DF and BWDF After Endurance Test

After endurance test, BWDF can reduce the NO emission from minimum to maximum load up to 44.31%.

OPACITY

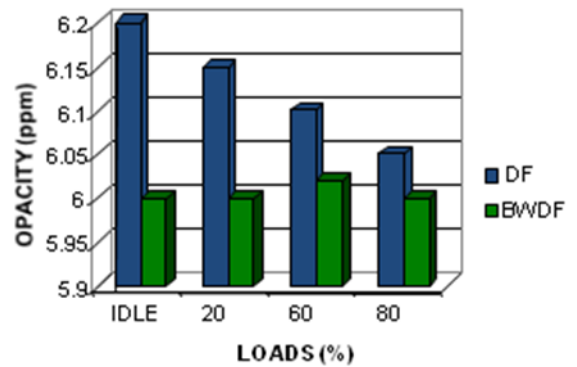


Fig. 15. Opacity DF and BWDF

In figure 15, the opacity in BWDF in minimum to maximum is lower than DF. In minimum load, BWDF can cut down the opacity up to 3.2%.

For all of these reasons, BWDF can take into account for its use in the future as a new alternative fuels, it can reduce emissions especially in big city such as Jakarta or other big cities in the world.

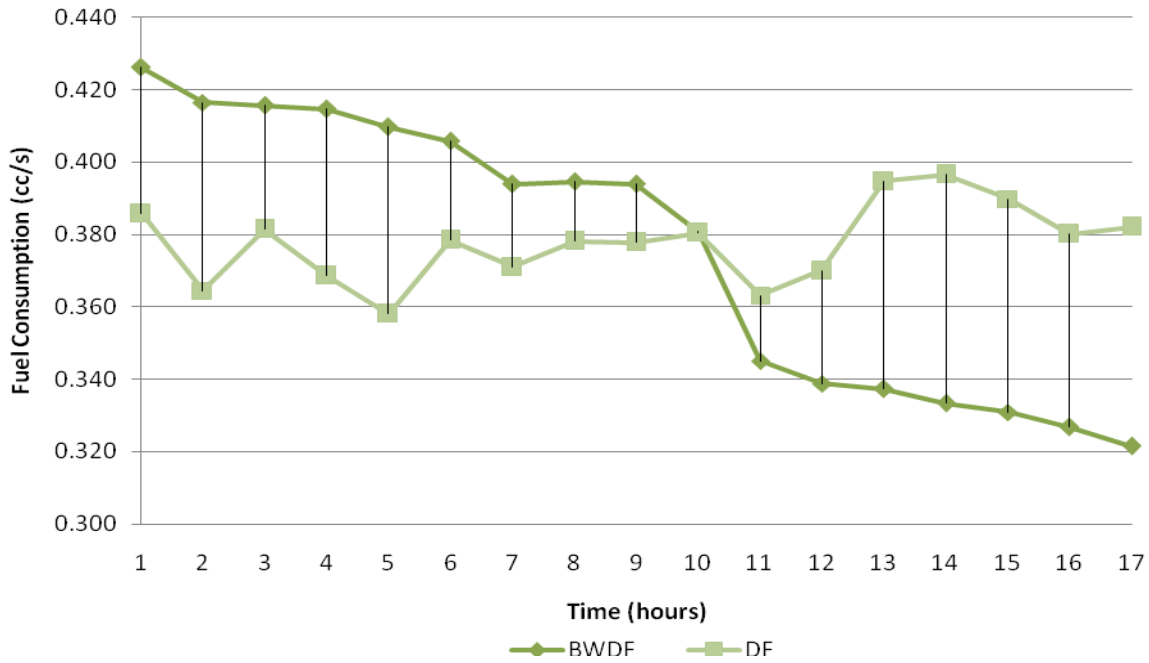
C. Fuel Consumption in 17 Hours Endurance Test

Fig. 15. Fuel Consumption in 17 Hours Running Engine (1500 rpm – 4 kW)

TABLE III

Data of Fuel Consumption in 17 Hours Running Engine (1500 rpm-4kW)

Time (Hours)	BWDF	DF
1	0.426	0.386
2	0.417	0.365
3	0.416	0.382
4	0.415	0.369
5	0.410	0.358
6	0.406	0.378
7	0.394	0.371
8	0.395	0.378
9	0.394	0.378
10	0.381	0.380
11	0.345	0.363
12	0.339	0.370
13	0.337	0.395
14	0.333	0.397
15	0.331	0.390
16	0.327	0.380
17	0.322	0.382

From figure 15, from one to 9 hours endurance test, BWDF has no advantages in fuel consumption compared to DF. In 10 hours running engine, DF and BWDF have similar in fuel consumption. But in 11 hours of running engine, BWDF is more efficient 5% than DF. In 17 hours of running engine, BWDF is the highest efficiency up to 15.85%.

IV. CONCLUSION

1. BWDF can reduce emission such as NO_x up to 42%, CO up to 23.7%, NO up to 44.31%
2. In 11 hours of running engine, BWDF is more efficient 5% than DF. In 17 hours of running engine, BWDF is the highest efficiency up to 15.85%.
3. BWDF can reduce the smog or opacity up to 3.2% compared to DF.

ACKNOWLEDGMENT

The authors would like to thank to the Faculty of Industrial Technology, Mechanical Engineering Department for their support, also thank you to PT. Fujitamina Teknologi for their financial support and thank you to Institute Bandung of Technology for supporting in endurance test engine.

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