International Journal of Mechanical Engineering (IJME)
Vol.1, Issue 1 Aug 2012 41-46

International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

AN EXPERIMENTAL ASSESSMENT OF ENGINE PERFORMANCE USING WATER-DIESEL EMULSIONS

K.V.S. SESHENDRA KUMAR

Department of Industrial Production Engineering, GITAM Institute of Technology, Gitam University, Visakhapatnam-530045, India

ABSTRACT

The project deals with the efficiency enhancement of an IC Engine by supplying an alternate fuel based on the concept of duel fuel injection. The experimental setup is prepared for generation of 'Brown's Gas from the electrolysis of water. The Brown's generator or electrolyzer consists of spiral stainless steel electrodes connected to a rated DC power supply where the electrolysis will begin as soon as the circuit is closed resulting the generation of Brown's gas. The performance tests are conducted separately on diesel engine and petrol engine at varying load conditions along with testing the exhaust gasses and their effects on environment. As the result of adding additional oxygen and hydrogen the fuel efficiency has been increased to a certain extent and also reduced the harmful emissions from the IC engine.

KEYWORDS: Brown Gas, Efficiency Enhancement, Electrolyzer, Fuel Cells, Micro Emulsion Systems, Total Fuel Consumption, Thermal Efficiency.

INTRODUCTION

Diesel oil is a fossil fuel used in compression ignition engines. Combustion of diesel fuel contributes greatly to environmental pollution due to carbon monoxide, nitrogen oxides and particulate matter emissions to the atmosphere. The necessity of reducing gas emissions and the search for better engine performance have increased the interest in alternative fuels or emulsion/microemulsion systems, such as: blends of diesel with biodiesel and vegetable oils, diesel-based microemulsions, natural gas/diesel blends, and water-in-oil emulsions (Crookes et al., 1997; Nabi et al., 2006; Rakopoulos et al., 2006; Sarvi et al., 2009; Ochoterena et al., 2010; Papagiannakis et al., 2010; Lif et al., 2010; Singh et al., 2010). Microemulsions are mixtures of two immiscible liquids, like water and oil, which re stabilized by a surfactant, located at the oil/water interface, and sometimes a co-surfactant when an ionic surfactant is used (Hoar and Schulman, 1943). They are formed spontaneously and exhibit nano-dispersed structures. Microemulsions have special features, such as: high thermodynamic stability, large interfacial area, ultralow interfacial tension and optical transparency.

The liquid usually in excess in a microemulsion system is termed the continuous or external phase, while the liquid dispersed in small droplets is termed the internal or dispersed phase. When the external phase consists of water and the organic phase is the internal phase, the system is called "oil-in-water" (o/w). If the water is finely dispersed in the organic phase the system is named "water-in-oil" (w/o). Bicontinuous systems can also be formed when both components form continuous interpenetrating domains, with none of the two circling each other. It is well known that the addition of water to diesel, forming o/w microemulsions and/or emulsion systems, leads to reduction in NOx, carbon monoxide (CO), total unburned hydrocarbon (HC) and particulate matter emissions. This is attributed to improved combustion efficiency and reduction in exhaust gas temperatures, which are important factors in reducing pollutant emissions (Peckham, 2001; Wang and Fu, 2001; Abu-Zaid, 2004; Park and Kwak, 2004; Armas et al., 2005; Lif and Holmberg, 2006; Bemert et al., 2009; Alahmer et al., 2010).

Brown′s gas is invented by Yull Brown of (originally of Hungary) Australia in 1979. The water is converted into a completely safe compressed stochimetric hydrogen and oxygen mixture. The flame of this gas under the right lighting conditions, normally almost transparently colorless, can be seen to possess a small blue cone, as it emits from a torch, with a longer, pale red-blue extension. The most unusual property of the flame is that it is not formed as a set of explosions, as are ordinary flames, but as a set of internal collisions between the molecules violently. This blue cone region separates the inner sustained vacuum from the continuously forming implosion products. The flame, upon application to an element or compound of elements, increases its temperature due to an interactive combustion property which is one of the unique characteristics of Brown's Gas. There is no theoretical temperature limit to the flame as applied to materials as the local environment of the combustion will determine the extent of incremental calorific energy supplied and/or released. The temperature of the flame while in contact with only the surrounding air was measured to be 264ƒ to 269ƒ F (129ƒ to 137ƒ C). When the same flame was applied to the face of an ordinary building brick the temperature was measured at 3100ƒ F. When the flame was applied to a tungsten wire the temperature was measured at nearly 6000ƒ C.

The ratio 1,860:1 refers to the fact that when the gas is electrically sparked, it immediately returns to water. If the amount of gas sparked, and thus imploded could fill 1,860 units, then the amount of water produced by its internal collision would then only fill one unit. The resulting space instantly becomes filled with a very high and particularly clean vacuum.

METHODOLOGY

Brown′S Gas Generation

Brown gas is generated in the hydrogen generator which is a compact and affordable device which can be easily adoptable. The Electroizer ("Hydrogen Generator") has SPIRAL electrodes rather than plates, thus producing more HHO - for less energy from the battery. Contained in a quart-size highly durable jar. Fill it with Distilled Water and a little bit of Baking Soda. The device gets vacuum and electricity (12 Volts) from the engine, and produces HHO gas (Hydrogen Oxygen).

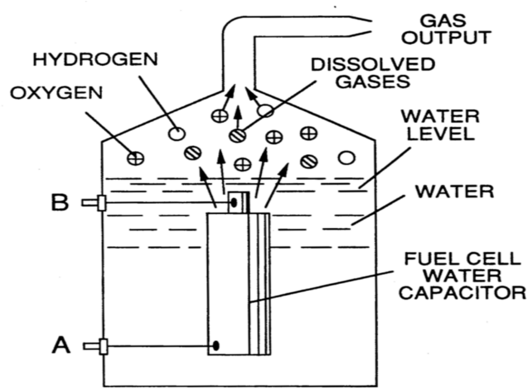

Figure 1: HHO Generator

Construction of Electrolizer

The electrolizer is a device in which electrolysis of water is carried out. The Brown's gas is generated in the Electroizer which is an affordable device which can be easily installed. The electrolizer is compact that it can be fitted to the motor cycle easily. It is an economical device whose capital cost is very less. Not many modifications are required to install the electrolizer.

The Electroizer is a cylindrical jar fitted with electrodes. This electrolizer consists of two electrodes. The electrodes are made of 'stain less steel' material. There is a opening provided on the top of the electrolizer for filling the water. The electrodes are attached to the top of the electrolizer through brass nuts. The electrodes are sealed to prevent air leakage. Other parts of electrolizer top are sealed with M-SEAL.

Experimental Setup for Collection of Brown's Gas

The electrolizer is filled with water initially. The electrodes are sealed with an adhesive. The electrodes are connected to a Regular Power Supply (RPS) using two probes. Electricity is passed by switching the supply to RPS. RPS is a device which converts 230V and 50HZ AC current to a DC current which is variable to a range of 0-30V at 0-6A current. Voltage should be varied gradually from 0V to avoid the failure of circuit. The RPS will give a digital reading of voltage and current.

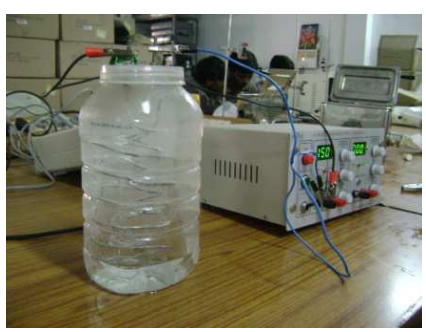

Figure 2.Experimental Setup of Electrolysis

Along with the above apparatus an immersion water heater is also required for heating up of water. The heater is of 1000W capacity and is fitted to heater vessel. A set of thermometers is also required for measuring the temperature of the water instantaneously.

Pure water is heated up to 60°C using immersion water heater of 1000W for 10-12min to incorporate faster rate of reaction .Then heated water is filled in the electrolizer so that there is no air trapped inside the electrolizer. The electrolizer is sealed properly so that the gas generated can be collected without escaping. Now the gas collecting balloon is attached to the outlet of the electrolizer. DC current is supplied to the electrodes by a RPS which can be variable to 30V at 6A. The gas collecting balloon was supposed to collect gas but after the experiment observed that it collected water along with mud.

RESULTS AND DISCUSSIONS

Table-1

Time(sec)	Initial reading ml	30	60	90	120	150	180	210	240	270
Fuel consumed (with air)Ml	7.5	14	19	23.5	29	33.5	38.5	43.5	48	---
Fuel consumed (with HHO)Trail-1	7.8	13	17	22.2	26.5	31.2	36	40.5	45	48
Fuel consumed (with HHO)Trail-2	8.7	14	18	22.5	26.6	34.5	39.5	43.5	45	48

Table-2: Case 1: With AIR

S.No.	Mass FlowRate of air Ma (Kg/sec)	Ma/Mf	Brake Power (KW)	η B.th
1	0.007737	55.22	0	-
2	0.007737	41.64	3.466	44.41
3	0.007737	32.34	8.851	88.08

Case2: With HHO

S.No.	Mass Flow Rate of air Ma (Kg/sec)	Ma/Mf	Brake power (KW)	$\eta_{B.th}$
1	0.007737	64.26	0	-
2	0.007737	46.89	3.078	44.4
3	0.007737	32.99	8.676	88.07

CONCLUSIONS

In this study, the preparation, characterization, engine performance and emissions of a surfactant/diesel blend systems were investigated. The main conclusions can be summarized as the density and viscosity of all studied systems were higher than those obtained for neat diesel and these properties increased with increasing water content. The results for the cloud point and corrosiviness showed that the presence of surfactant and water did not significantly affect these parameters. According to the results for specific fuel consumption, the presence of water in microemulsions improves diesel fuel combustion. Brown's gas is generated efficiently at an electricity input of 30v,1.2A in 1.5liters of water and proved to be a combustible gas. The total fuel consumption of the PSG diesel engine decreased to an average rate of 11.40%. which is proportional to increase in mileage. No considerable variations observed in other performance characteristics of engine and the S.F.C of the engine has been decreased to a rate of 10.70%.

REFERENCES

1. bu-Zaid, M., A. Dantas Neto,A,,Fernandes,M.R.,Barros Neto,E.L.,Castro Dantas,T.N. and Moura,M.C.P.A., (2004),Performance of single cylinder, direct injection diesel engine using water fuel emulsions. Energy Conversion and Management, 45, 697-705.

2. Alahmer, A., Yamin, J., Sakhrieh, A., Hamdan, M. A., (2010), Engine performance using emulsified diesel fuel. Energy Conversion and Management, 51, 17081713.

3. Armas, O., Ballesteros, R., Martos, F. J., Agudelo, J. R., (2005), Characterization of light duty diesel engine pollutant emissions using water-emulsified fuel. Fuel, 84,1011-1018.

4. Bemert, L., Engelskirchen, S., Simon, C., Strey, R., (2009), Low emissions with microemulsion-fuels. Prepr. Pap.-Am. Chem. Soc., Div. Fuel Chem., 54, 290.

5. Crookes, R. J., Kiannejad, F., Nazha, M. A. A., (1997), Systematic assessment of combustion characteristics of biofuels and emulsions with water for use as diesel engine fuels. Energy Convers. Mgmt., 38, (15-17),1785-1795.

6. Hoar, T. P., Schulman, J. H., (1943), Transparent water-inoil dispersions oleophatics hydromicelle. Nature, London: 152, (102). A

7. Lif, A., Holmberg, K., (2006), Water-in-diesel emulsions and related systems. Advances in Colloid and Interface Science, 123-126, 231-239.

8. Lif, A., Stark, M., Nydén, M., Holmberg, K., (2010), Fuel emulsions and microemulsions based on Fischer- Tropsch diesel. Colloids and Surfaces A: Physicochemical and Engineering Aspects, 354, 91-98.

9. Nabi, M. N., Akhter, M. S., Zaglul Shahadat, M. M., (2006), Improvement of engine emissions with conventional diesel fuel and diesel-biodiesel blends. Bioresource Technology, 97,372-380.

10. Ochoterena, R., Lif, A., Nydén, M., Sven, A., Denbratt, I., (2010), Optical studies of spray development and combustion of water-in-diesel emulsion and microemulsion fuels. Fuel, 89, 122-132.

11. Papagiannakis, R. G., Rakopoulos, C. D., Hountalas, D. T., Rakopoulos, D. C., (2010), Emission characteristics of high speed, dual fuel, compression ignition engine operating in a wide range of natural gas/diesel fuel proportions. Fuel, 89, 1397-1406.

12. Park, K., Kwak, I., (2004), The Effect of water emulsified fuel on a motorway-bus diesel engine. KSME International Journal, 18 (11), 2049-2057.

13. Peckham, J., (2001), Citgo microemulsion cuts NOx 2527%, PM by 40-52% in test. Diesel Fuel News, Oct 15.

14. Rakopoulos, C. D., Antonopoulos, K. A., Rakopoulos, D. C., Hountalas, D. T., Giakoumis, E. G., (2006), Comparative performance and emissions study of a direct injection Diesel engine using blends of Diesel fuel with vegetable oils or bio-diesels of various origins. Energy Conversion and Management, 47, 3272-3287.

15. Sarvi, A., Kilpinen, P., Zevenhoven, R., (2009), Emissions from large-scale medium-speed diesel engines: 3. Influence of direct water injection and common rail. Fuel Processing Technology, 90, 222-231.

16. Singh, P. J., Khurma, J., Singh, A., (2010), Preparation, characterization, engine performance and emission characteristics of coconut oil based hybrid fuels. Renewable Energy, 35, 2065-2070.

17. Wang, L.-P., Fu, W.-B., (2001), An analysis of the combustion characters and the mechanism of oil-consumption economy for diesel engines using water-blended oil. Fuel Processing Technology, 72, 47-61.