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A Systematic Approach To Monitor Dual Fuel Engine Emissions

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Abstract- Contamination of air is increasing day by day. The adverse effect of air pollution is experienced this year in India. The burning of hay is increasing the PPM level to a dangerous level. In addition to this the vehicles are also producing lots of pollution at alarming rate. In this research we adopt some alternating methods to make use of hay into production of some useful fuel. That fuel can be used to run the vehicles, by using this biofuel in 20, 40 or 60 % ratio by adding it into normal diesel. In this research the biogas is also used to run the vehicle, the biogas is produced from the waste product of kitchen and cow dunk. We will be able to run the vehicles with biofuels with some modification. But to understand how engine works with these types of fuels we need to collect the data for different BTDC and record the results. The same results are produced/saved using IoT system. The results are captured and discussed in the paper.

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Keywords- Dual fuel engine, air contamination, IoT

1. Introduction

Air is contaminating day-by-day due to the addition of toxic gases such as carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NOx) and sulphur dioxide (SO_2). These gases are mostly generated by the vehicles and industries, which put an adverse impact on human health. In addition to this, the fossil fuels on which vehicles run are also depleting at an alarming rate. Consequently, it is needed to find the alternative fuel or alternate technology for running these vehicles and industrial motors. Better and economical alternative can be the use of renewable resources for instance bio-waste[1]. India is having plenty of bio-waste that can generate more than 10 MW of power[2].

Bio-waste is a better alternative to make bio-diesel fuel as it meets the 1990's Clean Air Act amendments. Its cetane number, the heat of combustion and viscosity makes it different from other fuels. Moreover, the viscosity of these fuels is much closer to diesel fuel which burns clean and has much better lubrication property than today's lower sulphur diesel fuels[3][4]. However, it cannot be used directly in CI diesel engine as biodiesel holds no petroleum it can be mixed in any level with petroleum to make biodiesel mix.[5]. These blends can be used in CI engine with modification either mechanically[6] or electronically[7][8][9][10]. This leads to the development of new type of engine called as Dual fuel engine[11]. In dual fuel engine, two types of fuels are used, one called as a secondary fuel and other as the primary fuel[12][13]. This method reduces the emission pollutants and also the fuel consumption. Merely improving mechanical system will not give appropriate results, so the support of electronic systems is needed to achieve better efficiency of the engine with reduced emissions[14][15].

A. Dual Fuel Engine

In a CI engine, gas fuel which is considered secondary fuel, is filled and compressed with air in the engine cylinder. Small quantity of diesel which is Pilot fuel- primary fuel is injected through the conventional diesel fuel system to ignite the mixture.

The dual-fuel engine works on a defined cycle. The gas fuel mixed to the air inducted by the engine or supplied by the supercharger at a pressure little more than the atmospheric pressure.

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Eventually in the pressure stroke, close to top perfectly focused, a little charge of fluid fuel called pilot fuel (or the auxiliary fuel) is infused through a traditional diesel fuel framework. This pilot goes about as a wellspring of start the gas-air blend in the encompassing territory of the infused shower touches off at various fire fronts. Therefore ignition begins easily and quickly

Need of Dual Fuel Engine

• The lack of fluid fuel and the acknowledgment that vaporous powers are far less expensive than fluid powers have prompted consideration on double fuel engine.

• Gaseous petrol accessible to the majority of part of the world at rates less expensive than fluid energizes.

Working of Dual Fuel Engine

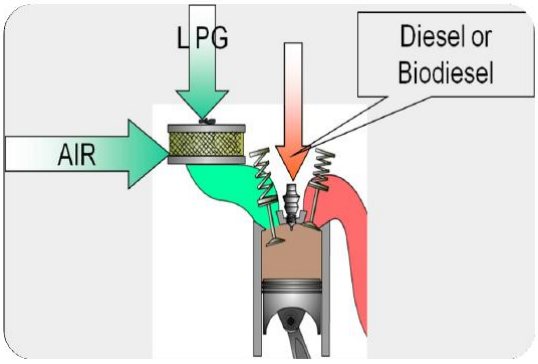

Figure 1: Working of Dual Fuel Engine

Dual-Fuel Operation

1. Dual-fuel operation is achieved by the burning of both a gaseous fuel and diesel at the same time in a CI engine
2. Injection of small amount of diesel fuel can be used as an ignition source.

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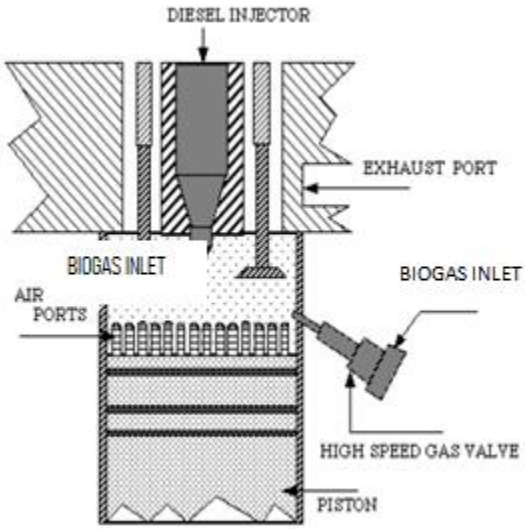

Figure 2: Dual-Fuel Operation

B. Biogas Diesel Engine

Biogas is an alternative and renewable energy, produced by the anaerobic decomposition of organic matter. Cheaper Technology and Recycle of organic matter is possible. Biogas is a GREEN FUEL, can power Earth for days to come. Biogas can reduce CO2 emission as compared to fossil fuels. Biogas can be produced at house levels too.

Performance of Dual Fuel Engine

The Performance Is investigated on the following grounds:

- Engine Torque / Load torque
- Brake Specific Fuel Consumption
- Brake thermal Efficiency
- Emission Characteristics

1. Brake Specific Energy Consumption (BSEC)

Brake specific energy consumption is the proportion of energy obtained by flaming fuel for an hour to the actual energy or Brake power obtained at the wheels. The BSEC is measured in kJ/kWh by considering equation (19), where CV is calorific value of fuel.

$$\boldsymbol{BSEC = BSFC * CV}$$

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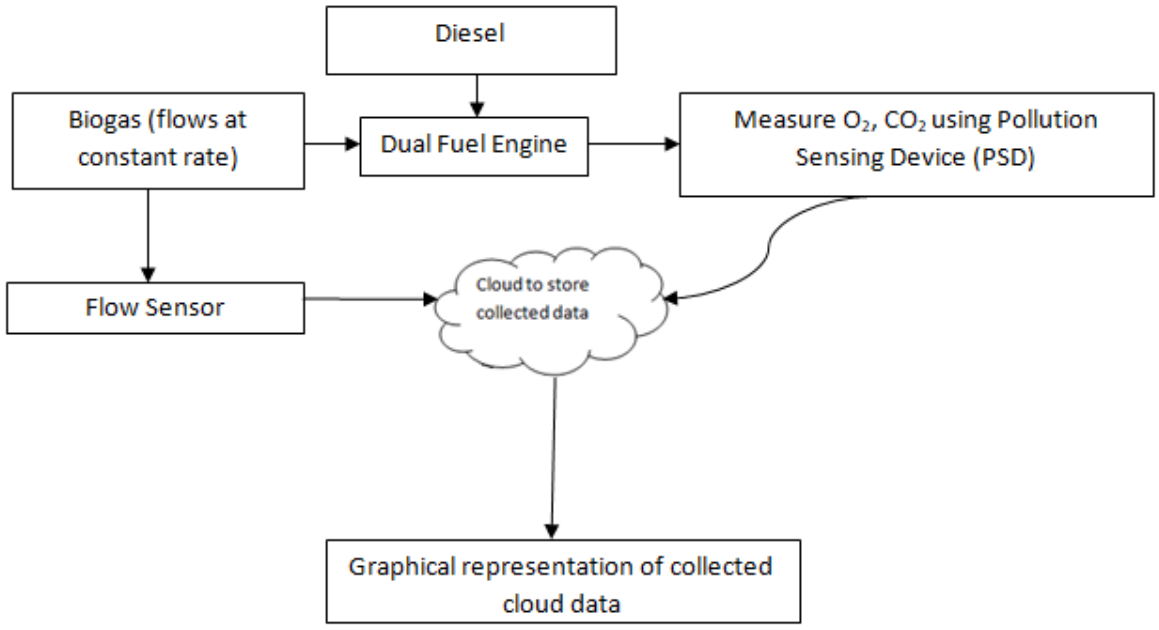
2. Brake Thermal Efficiency

Brake thermal efficiency is defined as break power of a thermal engine as a function of the thermal input from the fuel which can be measured using equation (20). It is used to estimate how well an engine converts the heat from a fuel to mechanical energy. The ratio of brake power output to power input.

$$BTE = \left[\frac{B.P * 3600}{mf * LCV}\right] * 100$$

Methodology



Algorithm Steps

1. Dual fuel is injected to dual fuel engine. Primary fuel (diesel) and secondary fuel gas flows at a constant rate.
2. Flow sensor sends all the collected data to cloud using IoT.
3. Pollution Sensing Device (PSD) is used to measure the CO and CO_2.
4. PSD also sends measured CO to cloud.
5. Collected data is graphically represented for further analysis.

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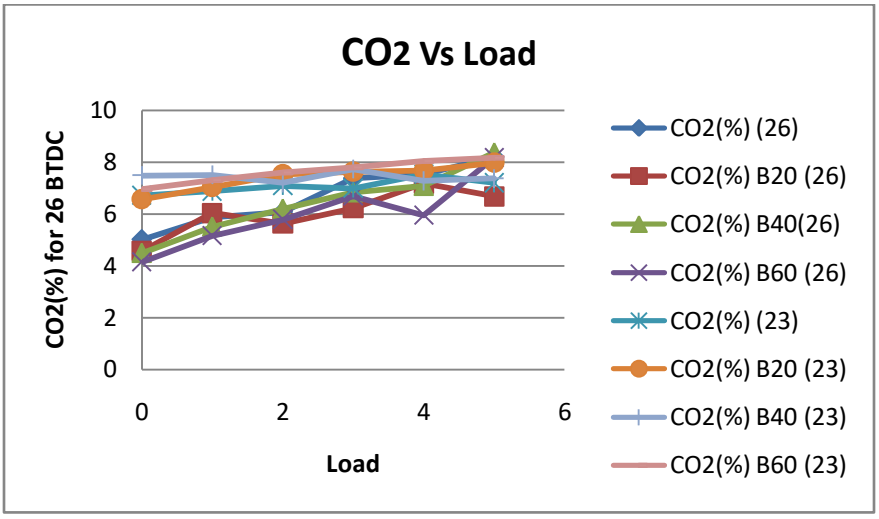
Results

1. CO_2 vs. Load

Table 2: Data collected for CO_2 and Load

Load (kW)	CO_2 (%) (26)	CO_2 (%) B20 (26)	CO_2 (%) B40(26)	CO_2 (%) B60 (26)	CO_2 (%) (23)	CO_2 (%) B20 (23)	CO_2 (%) B40 (23)	CO_2 (%) B60 (23)
0	5.01	4.57	4.49	4.15	6.71	6.57	7.49	6.95
1	5.87	6.03	5.51	5.15	6.87	7.03	7.51	7.29
2	6.07	5.63	6.2	5.79	7.07	7.53	7.2	7.59
3	7.37	6.22	6.83	6.7	6.97	7.62	7.73	7.79
4	7.52	7.17	7.08	5.95	7.52	7.67	7.28	8.05
5	8.19	6.67	8.37	8.17	7.19	7.97	7.37	8.17



2. O_2 vs. Load

Table 2: Data collected for O_2 and Load

Load (kW)	O_2 (%) (26)	O_2 (%) B20 (26)	O_2 (%) B40 (26)	O_2 (%) B60 (26)	O_2 (%) (23)	O_2 (%) B20 (23)	O_2 (%) B40 (23)	O_2 (%) B60 (23)
0	15.64	16.01	16.41	16.67	16.04	16.1	16	16.37
1	13.62	13.23	14.42	14.44	15.02	14.03	15.9	15.04
2	13	13.4	13.11	13.44	14.03	13.84	14	14.04
3	11.43	12.24	11.86	11.93	13.23	13.14	13.1	13.43
4	10.94	11.26	11.47	12.5	10.09	12.06	12.2	11.95
5	9.86	11.37	9.31	9.34	10.06	11.3	11.1	11.04

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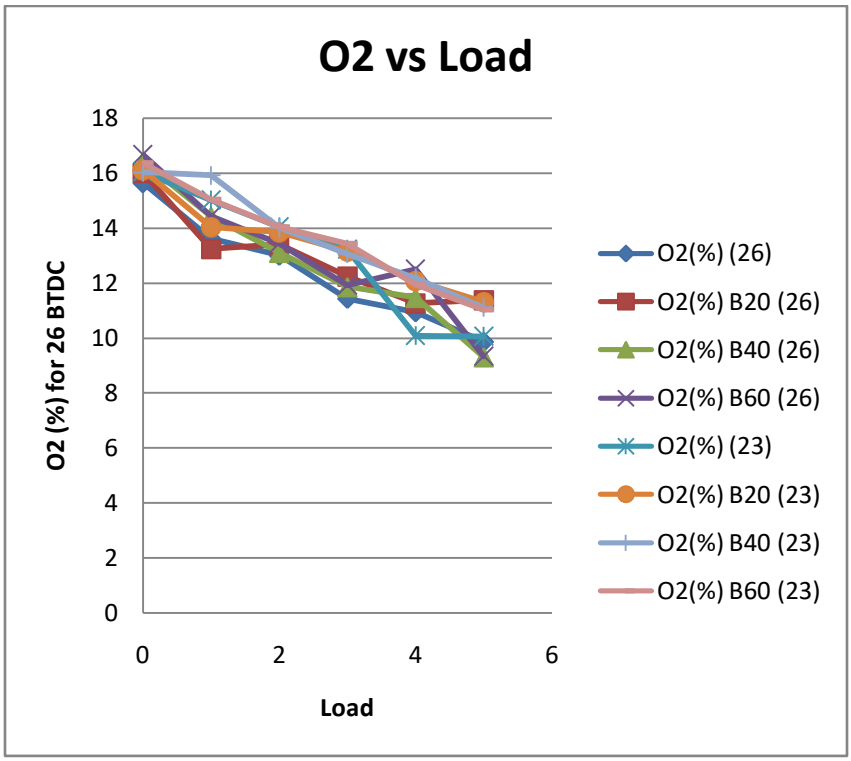
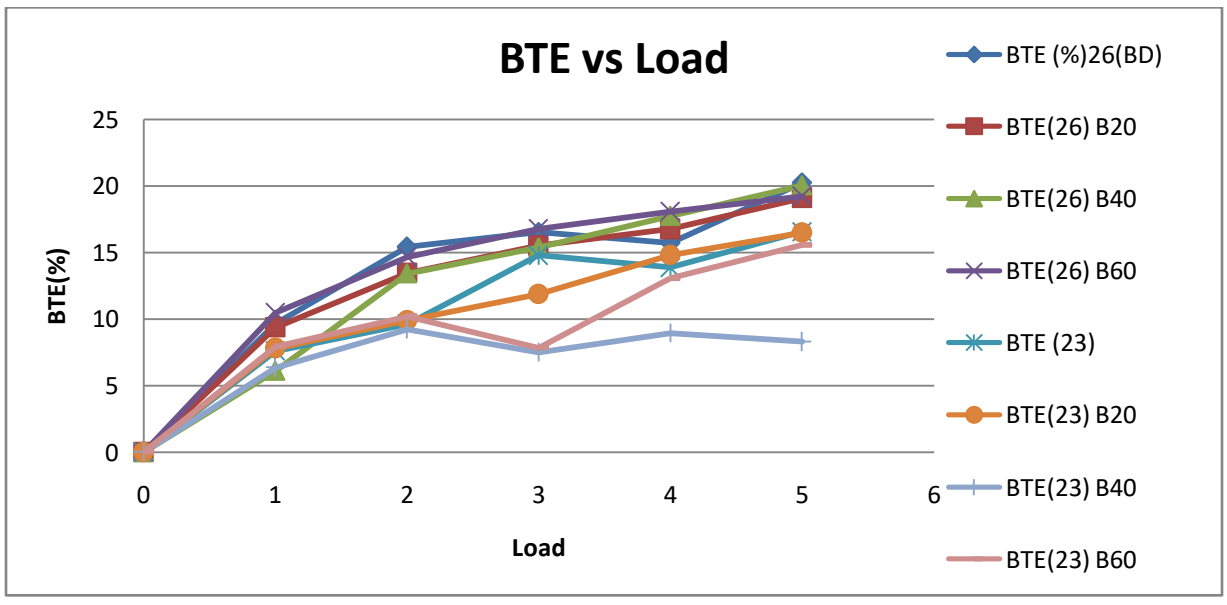


All the above calculated data leads to calculation of BTE against Load values and is calculated using following formula.

The ratio of brake power output to power input

$$BTE = \left[\frac{B.P * 3600}{mf * LCV}\right] * 100$$



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Conclusion

For a dual fuel engine, data against the primary fuel and secondary fuel is gathered to improve BTE. The calculated results show that the maximum amount of BTE is collected at normal Diesel at 26 BTDC against various load values and we observed the O_2 is maximum at 23 BTDC and CO_2 is minimum at 26 BTDC with B20 fuel (60% of biofuel in diesel).

Future Scope

A new hardware to show efficient working of any engine against dual fuels is not feasible every time. To develop an appropriate alternative we can apply neural network modeling to train and optimize the system to achieve maximum BTE and to minimize the emissions.

REFERENCES

[1] E. A. Canesin, C. C. de Oliveira, M. Matsushita, L. Felicidade Dias, M. Reghiany, and N. E. de Souza, "Characterization of residual oils for biodiesel production," Electron. J. Biotechnol., vol. 17, no. 1, pp. 39–45, 2014.

[2] U. Isalkar, "Waste plant to generate 10 MW," Times of India, 2013. [Online]. Available: https://timesofindia.indiatimes.com/city/pune/Waste-plant-to-generate-10-MW-electricity/articleshow/18780500.cms.

[3] R. Kazys, R. Sliteris, R. Rekuviene, E. Zukauskas, and L. Mazeika, "Ultrasonic technique for density measurement of liquids in extreme conditions," Sensors (Switzerland), vol. 15, no. 8, pp. 19393–19415, 2015.

[4] "No Title," Viscopedia. [Online]. Available: http://www.viscopedia.com/viscosity-tables/substances/diesel-fuel/.

[5] V. B. Mane, L. H. Mahind, K. D. Jadhav, S. A. Waghmode, and S. P. Dagade, "Carbon – Science and Technology," vol. 2, pp. 260–264, 2013.

[6] J. P. Yadav, A. Kumar, and R. Kant, "Modeling and Optimization of Diesel-LPG Dual Fuel Engine ' s Performance : An ANN Approach," vol. 99, pp. 1–12, 2017.

ISSN: 0971-1260
Vol-22-Issue-17-September-2019

[7] T. Yalçin, "Compact ECDSA engine for IoT applications," Electron. Lett., vol. 52, no. 15, pp. 1310–1312, 2016.

[8] J. Park, Y. L. Murphey, and M. Abul Masrur, "Intelligent Energy Management and Optimization in a Hybridized All-Terrain Vehicle with Simple On-Off Control of the Internal Combustion Engine," IEEE Trans. Veh. Technol., vol. 65, no. 6, pp. 4584–4596, 2016.

[9] A. Biondi, G. Buttazzo, S. Superiore, and S. Anna, "Real-Time Analysis of Engine Control Applications with Speed Estimation," no. Date, pp. 193–198, 2016.

[10] S. A. O'Briant, S. B. Gupta, and S. S. Vasu, "Review: laser ignition for aerospace propulsion," Propuls. Power Res., vol. 5, no. 1, pp. 1–21, 2016.

[11] M. Farrugia, C. Seychell, S. Camilleri, G. Farrugia, and M. Farrugia, "Development of a programmable engine control unit to multi-fuel capabilities, progression to diesel," 16th Int. Conf. Sci. Tech. Autom. Control Comput. Eng. STA 2015, pp. 174–180, 2016.

[12] A. A. A. Al-Saadi and I. Bin Aris, "CNG-diesel dual fuel engine: A review on emissions and alternative fuels," 2015 10th Asian Control Conf. Emerg. Control Tech. a Sustain. World, ASCC 2015, no. 1, 2015.

[13] B. Ashok, S. D. Ashok, and C. R. Kumar, "ORIGINAL ARTICLE LPG diesel dual fuel engine – A critical review," Alexandria Eng. J., vol. 54, no. 2, pp. 105–126, 2015.

[14] L. P. Goswami, G. Patel, and C. Khadia, "A Review on Dual Fuel Engine using Diesel as Primary Fuel and Various Secondary Fuels," vol. 2, no. 11, pp. 74–80.

[15] J. Kim, E. Yim, C. Jeon, C. Jung, and B. Han, "Cold performance of various biodiesel fuel blends at low temperature," vol. 13, no. 2, pp. 293–300, 2012.

[16] D. Palaniswamy, G. Ramesh, S. Sivasankaran, and N. Kathiravan, "Optimizing the Supercharger Effect on the Performance and Emission of Biogas Diesel Engine using ANFIS," Asian J. Res. Soc. Sci. Humanit., vol. 6, no. 7, p. 1364, 2016.

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[17] R. F. Turkson, F. Yan, M. K. A. Ali, and J. Hu, “Artificial neural network applications in the calibration of spark-ignition engines: An overview,” Eng. Sci. Technol. an Int. J., vol. 19, no. 3, pp. 1346–1359, 2016.