Abstract of the Thesis

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Abstract

We are facing energy crises because fossil fuels are depleted as a result of increasing usage. Biodiesel is widely accepted as a fuel that is similar to diesel with various advantages. Biodiesel's low-temperature flow qualities are one of its characteristics that limits its use. Despite some limitations in fuel use, Biodiesel may be a viable option due to poor fuel properties. The experiment was conducted with coconut and jatropha biodiesel to increase the fuel quality of palm biodiesel. The MATLAB optimizing tool was used to determine the ideal mixing ratio to achieve better fuel qualities. Then experiment was conducted to see how volumetric blends of palm biodiesel and diesel, and diesel as a fuel affected the performance and emissions characteristics of a diesel fired vertical coil type, water tube, and non IBR boiler. Various volumetric blends were prepared like PB25, PB50, PB75, PB100 and test in diesel fired boiler with variation in injection pressure. Performance of PB25, PB50, PB75, and PB100 fuels was observed 62.73%, 62.45%, 62.36%, and 62.32%, respectively; compare to pure diesel the value of all blends is either slightly higher or comparative. The maximum boiler efficiency with B100 fuel is 64.98%, which is lower than the pure diesel as fuel 65.30%. Because B100 has a higher kinematic viscosity, it has a larger droplet diameter which lead to poor spray formation and thus a lower boiler efficiency. At 11 bar fuel injection pressure, maximum EGT for diesel, PB25, PB50, PB75, and PB100 fuels is 300ºC, 295ºC, 308ºC, 328ºC, and 340ºC, respectively. Other blends, with the exception of B25, have higher EGT than diesel fuel. At a same fuel injection pressure of 11 bar, CO emissions from diesel, B25, B50, B75, and pure palm diesel fuels are 0.037%/Vol., 0.0336%/Vol., 0.0326%/Vol., 0.033%/Vol., and 0.036%/Vol., respectively. CO emissions for PB50 are the lowest of all the fuels tested, followed by B25, diesel, and B100. CO emissions from diesel, PB25, PB50, PB75, and PB100 fuels at maximum fuel pressure are 0.0605%/Vol., 0.0616%/Vol., 0.0605%/Vol., 0.060%/Vol., and 0.05%/Vol., respectively. When compared to diesel fuel, CO emissions from B100 fuel are 21% higher. The highest HC emissions are 18 ppm, 16 ppm, 14 ppm, 13 ppm, and 12 ppm for diesel, PB25, PB50, PB75, and PB100 fuel, respectively. When utilizing B100 fuel, HC emissions are reduced by around half compared to when using diesel fuel. Furthermore experiment was carried to investigate influence of fuel injection pressure and air fuel ratio (A/F) by changing damper opening on the performance and emissions characteristics of Boiler using 25 percent palm biodiesel blend with diesel as fuel, then optimization of this parameters carried out using response surface methodology. The experimental parameters for this investigation were designed using a two-factor full factorial design with 13 runs, Minitab 17 software was used for statistical analysis and optimization. It was determined experimentally what effect of variations in fuel injection pressure and damper opening had on boiler

efficiency, EGT, and carbon monoxide and hydrocarbon emissions. Experimental data was used to create response surface models and contour, surface plot of performance and emission parameter. For the 25% palm biodiesel blends with diesel as fuel in diesel fired boilers using RSM, the optimal values of performance and emission parameters are 72.35 percent, 414.34, 0.02725 vol percent, and 8.5 ppm, respectively by graphical optimization of model developed by RSM, and maximum performance response observed at 12.356 bar fuel injection pressure and 42.573 percent damper opening. Finally we develop a design technique for an atomizer nozzle based on fuel properties. However, because it is difficult to produce such dimensions with the precision needed, a nozzle selection technique is proposed in this study. The performance and emission of optimised fuel measured using multiple nozzles were compared for various situations using the same procedure and different nozzle selected for experiment. According to the findings, Nozzle 2 has a greater mass flow rate of fuel, resulting in more mass burn and a higher value of efficiency and exhaust gas temperature than Nozzle 1 (Existing) since more mass contains more energy. Emission characteristics revealed decreased gas emission in particular beginning pressure ranges following increasing emission for both parameters CO and HC. This occurs as a result of the rich mixture and the shorter time for droplet evaporation.

List of Publications:

[1] Krunal B. Khiaiya, Dr. P. V. Ramana & Hitesh Panchal (2021) Diesel-fired boiler performance and emissions measurements using a combination of diesel and palm biodiesel, DOI: https://doi.org/10.1016/j.csite.2021.101324 Volume 27 Page 1-13 (Case Studies in Thermal Engineering Elsevier, Scopus Indexed Journal).

[2] Krunal B. Khiraiya, Dr. P. V. Ramana (2021) Optimum Blend Ratio of Biodiesel Based on Jatropha, Palm, and Coconut to Improve Fuel Properties, RSRICTAS202 Page No.269-280 (IOP Journal of Physics, SCOPUS indexed Journal)

[3] Krunal B. Khiraiya Dr. P. V. Ramana (2021) The Effect of Biodiesel and Diesel Blending on the Physico-Chemical Properties of Biodiesel Derived from Coconut, Jatropha, and Palm Volume-55, No. 1 (1X) 2021 Page 25-33 (Journal of The Maharaja Sayajirao University Of Baroda, UGC-Care Listed).