World Academy of Science, Engineering and Technology
International Journal of Biotechnology and Bioengineering
Vol:11, No:11, 2017

An Experimental Investigation on the Fuel Characteristics of Nano-Aluminium Oxide and Nano-Cobalt Oxide Particles Blended in Diesel Fuel

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Abstract : The research objective is to integrate nanoparticles into fuels- i.e. diesel, biodiesel, biodiesel blended with diesel, plastic derived fuels, etc. to increase the fuel efficiency. The metal oxide nanoparticles will reduce the carbon monoxide emissions by donating oxygen atoms from their lattices to catalyze the combustion reactions and to aid complete combustion; due to this, there will be an increase in the calorific value of the blend (fuel + metal nanoparticles). Aluminium oxide and cobalt oxide nanoparticles have been synthesized by sol-gel method. The characterization was done by Fourier Transform Infrared Spectroscopy (FTIR), X-Ray Diffraction (XRD), Scanning Electron Microscope (SEM) and Energy Dispersive X-ray Spectroscopy (EDS). The size of the particles was determined by XRD to be 28.6 nm and 28.06 nm for aluminium oxide and cobalt oxide nanoparticles respectively. Different concentration blends- 50, 100, 150 ppm were prepared by adding the required weight of metal oxides in 1 liter of diesel and sonicating for 30 minutes at 500W. The blend properties- calorific value, viscosity, and flash point were determined by bomb calorimeter, Brookfield viscometer and pensky-martin apparatus. For the aluminum oxide blended diesel, there was a maximum increase of 5.544% in the calorific value, but at the same time, there was an increase in the flash point from 43°C to 58.5°C and an increase in the viscosity from 2.45 cP to 3.25 cP. On the other hand, for the cobalt oxide blended diesel there was a maximum increase of 2.012% in the calorific value while the flash point increased from 43°C to 51.5°C and the viscosity increased from 2.45 cP to 2.94 cP. There was a linear increase in the calorific value, viscosity and flash point when the concentration of the metal oxide nanoparticles in the blend was increased. For the 50 ppm Al_2O_3 and 50 ppm Co_3O_4 blend the increasing the calorific value was 1.228 %, and the viscosity changed from 2.45 cP to 2.64 cP and the flash point increased from 43°C to 50.5°C. Clearly the aluminium oxide nanoparticles increase the calorific value but at the cost of flash point and viscosity, thus it is better to use the 50 ppm aluminium oxide, and 50 ppm cobalt oxide blended diesel.

Keywords : aluminium oxide nanoparticles, cobalt oxide nanoparticles, fuel additives, fuel characteristics
Conference Title : ICMNB 2017 : International Conference on Microtechnology, Nanotechnology and Biotechnology
Conference Location : Dubai, United Arab Emirates
Conference Dates : November 24-25, 2017