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Production, Characterisation and Assessment of Biomixture Fuels for Compression Ignition Engine Application

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Abstract : Hardly any neat biodiesel satisfies the European EN14214 standard for compression ignition engine application. To satisfy the EN14214 standard, various additives are doped into biodiesel; however, biodiesel additives might cause other problems such as increase in the particular emission and increased specific fuel consumption. In addition, the additives could be expensive. Considering the increasing level of greenhouse gas GHG emissions and fossil fuel depletion, it is forecasted that the use of biodiesel will be higher in the near future. Hence, the negative aspects of the biodiesel additives will likely to gain much more importance and need to be replaced with better solutions. This study aims to satisfy the European standard EN14214 by blending the biodiesels derived from sustainable feedstocks. Waste Cooking Oil (WCO) and Animal Fat Oil (AFO) are two sustainable feedstocks in the EU (including the UK) for producing biodiesels. In the first stage of the study, these oils were transesterified separately and neat biodiesels (W100 & A100) were produced. Secondly, the biodiesels were blended together in various ratios: 80% WCO biodiesel and 20% AFO biodiesel (W80A20), 60% WCO biodiesel and 40% AFO biodiesel (W60A40), 50% WCO biodiesel and 50% AFO biodiesel (W50A50), 30% WCO biodiesel and 70% AFO biodiesel (W30A70), 10% WCO biodiesel and 90% AFO biodiesel (W10A90). The prepared samples were analysed using Thermo Scientific Trace 1300 Gas Chromatograph and ISQ LT Mass Spectrometer (GC-MS). The GS-MS analysis gave Fatty Acid Methyl Ester (FAME) breakdowns of the fuel samples. It was found that total saturation degree of the samples was linearly increasing (from 15% for W100 to 54% for A100) as the percentage of the AFO biodiesel was increased. Furthermore, it was found that WCO biodiesel was mainly (82%) composed of polyunsaturated FAMEs. Cetane numbers, iodine numbers, calorific values, lower heating values and the densities (at 15 ^oC) of the samples were estimated by using the mass percentages data of the FAMEs. Besides, kinematic viscosities (at 40 °C and 20 °C), densities (at 15 °C), heating values and flash point temperatures of the biomixture samples were measured in the lab. It was found that estimated and measured characterisation results were comparable. The current study concluded that biomixture fuel samples W60A40 and W50A50 were perfectly satisfying the European EN 14214 norms without any need of additives. Investigation on engine performance, exhaust emission and combustion characteristics will be conducted to assess the full feasibility of the proposed biomixture fuels.

Keywords : biodiesel, blending, characterisation, CI engine
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