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Evaporation characteristics influence on exhaust emissions of waste plastic oil petro diesel blends

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Abstract: The present research is aimed to investigate the influence of evaporation and puffing characteristics on the exhaust gas emissions of waste plastic oil and desired blends with petro diesel. Different volumetric proportions of plastic oil blends such as P20, P40, P60 and P80 are prepared and their thermo-physical properties were measured. The evaporation rates of prepared blends were evaluated in a convective environment and compared with the non-blended plastic oil, traditional petrol diesel. These were supplied to a test engine for evaluation of combustion and emission characteristics. The results are shown that the puffing is formed specifically at 773K to 873K at fluctuation evaporation phase in the prepared blends whereas P20 and P80 possess similar specific fuel consumption with huge variation in CO formation at exhaust emissions. The increase in temperature is reduced the time for the formation of bubble and puffing at higher volume blends but the phenomena of incomplete combustion increased the emissions rate.

Keywords: Plastic Oil, Alternate fuels, Evaporation characteristics, Puffing, Exhaust gas emissions

1.Introduction

Vehicle industry is moving to adopt alternate fuels over the traditional fuels to meet the future demands of fuel reserves and reduce the cost on their extraction. Bio-diesels are emerged as one of the promising alternate fuel technologies for reaping the economic benefits which involved in the production of fuel from waste vegetables and naturally available materials like jatropha, cotton seed, orange peel etc. [1].Sezer et al identified that the increase in brake thermal efficiency can be achieved with the bio-diesel blends at partial loads but the emissions are uncontrollable compared to petro-diesel[2]. Gomaa et al revealed that the addition of adequate amount of alcohol can reduce the emissions significantly but the NO_x emissions are higher due to prolongation of ignition period [3]

Sadef et al opinioned that the dependency on agriculturally based products for raw material to bio-diesels production and the problem associated at their availability is uncertain [4]. Because the shortage over their availability can create the turbulence over fulfilling the other human demands associated with it. Rahmanianet al proved that the conversion of plastic-to-fuel (PTF) can be an effective alternate for the traditional fuels and it could enhance the environmental safety in two ways such as organizing the waste, minimizing the damage over production of traditional fuels[5]. Alam et al studied various PTF technologies and identified that the pyrolysis is most effective among gasification, refuse derived fuel, hydrolysis, glycolysis methods [6]. Sharma et al described that the pyrolysis is an effective process to manage char, gases while cracking the organic compounds at higher temperatures such as 300-700^{0}C and can convert them into small hydrocarbon chains [7].

Miandad et al experimentally investigated the performance of various plastics and found that polypropylene based PTF given higher brake thermal efficiency over low density polyethylene, high density polyethylene, polystyrene, polyvinylchloride and polyethylene terephthalate [8]. Kaewbudde et al observed that the emissions are higher compared to petro-diesel and other biodiesels [9]. Kaimal and Vijaya balanet al identified that the rise of peak pressure due to ignition delay in plastic oil blends with petro-diesel is the main reason of higher emissions [10]. Mujtaba et al developed an empirical co-relation to estimate the viscosity and density for estimating the combustion phenomena of plastic oil blends with petro-diesel [11]. Wang et al proved that the combustion phenomena is highly depend on the evaporation characteristics of a fuel and the time of evaporation after puffing can influence the emissions formation[12]. However, the research on plastic oil blends with petro-diesel is not explored in this direction to estimate the emissions rate by studying the combustion phenomena with the help of evaporation characteristics. The following research gaps have been observed from the studied literature: