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Combustion Improvements by C4/C5 Bio-Alcohol Isomer Blended Fuels Combined with Supercharging and EGR in a Diesel Engine

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Abstract : Next generation bio-alcohols produced from non-food based sources like cellulosic biomass are promising renewable energy sources. The present study investigates engine performance, combustion characteristics, and emissions of a small single cylinder direct injection diesel engine fueled by four kinds of next generation bio-alcohol isomer and diesel fuel blends with a constant blending ratio of 3:7 (mass). The tested bio-alcohol isomers here are n-butanol and iso-butanol (C₄ alcohol), and n-pentanol and iso-pentanol (C₅ alcohol). To obtain simultaneous reductions in NOx and smoke emissions, the experiments employed supercharging combined with EGR (Exhaust Gas Recirculation). The boost pressures were fixed at two conditions, 100 kPa (naturally aspirated operation) and 120 kPa (supercharged operation) provided with a roots blower type supercharger. The EGR rates were varied from 0 to 25% using a cooled EGR technique. The results showed that both with and without supercharging, all the bio-alcohol blended diesel fuels improved the trade-off relation between NOx and smoke emissions at all EGR rates while maintaining good engine performance, when compared with diesel fuel operation. It was also found that regardless of boost pressure and EGR rate, the ignition delays of the tested bio-alcohol isomer blends are in the order of iso-butanol > n-butanol > iso-pentanol > n-pentanol. Overall, it was concluded that, except for the changes in the ignition delays the influence of bio-alcohol isomer blends on the engine performance, combustion characteristics, and emissions are relatively small.

Keywords : alternative fuel, butanol, diesel engine, EGR (Exhaust Gas Recirculation), next generation bio-alcohol isomer blended fuel, pentanol, supercharging
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