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NON-THERMAL PLASMA-ASSISTED HYDROCRACKING OF BENZENE AS A BIOMASS GASIFICATION TAR ANALOGUE USING A DIELECTRIC BARRIER DISCHARGE REACTOR

Faisal Saleem, Kui zhang and Adam Harvey
Newcastle University, UK

Non-thermal plasma (NTP) is an attractive method for decomposing biomass gasification tars. For the first time, this study demonstrated that higher temperature in the presence of a dielectric barrier discharge (DBD) opens up new (thermal) reaction pathways to increase the selectivity to lower hydrocarbons via DBD promoted ring-opening reactions of toluene. In this study, the removal of toluene (as a gasification tar analogue) was investigated in a DBD reactor at ambient and elevated temperatures with hydrogen as the carrier gas. The effect of plasma power (5-40W), concentration (20-82 g/Nm^3), temperature (ambient-400^{o}C) and residence time (1.41-4.23 s) were studied. The present study reveals that the maximum removal of toluene was observed at 40 W and 4.23 s. The major products were lower hydrocarbons (C_1-C_6). Solids were, however, formed in the reactor at low temperatures. Furthermore, the synergetic effect of power and temperature was investigated to decrease the unwanted solid deposition. It was observed that the selectivity to lower hydrocarbons (LHCs) increased from 20 to 90%, as temperature was increased from ambient to 400oC, at 40 W and 4.23 s. Methane and C_2 were the major gaseous products, with a maximum selectivity of 88% (83% of methane, and 5% of C_2,).

f.saleem2@ncl.ac.uk