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Cracking of Tar Analogue in N_2 Carrier Gas Using Non-Thermal Plasma Dielectric Barrier Discharge Reactor

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Abstract : The role of N_2 carrier gas towards the conversion of tar analogue was studied in a non-thermal plasma dielectric barrier discharge (DBD) reactor. The important parameters such as power (5-40W), residence time (1.41-4.23 s), concentration (20-82 g/Nm^3), and temperature (Ambient-400°C) were explored. The present study demonstrated that plasma power and residence time played a key role in the decomposition of toluene, and almost complete removal of toluene was observed at 40w and 4.23 s. H_2 is obtained as a major gaseous product with a maximum selectivity of 40% along with some lighter hydrocarbons (5.5%). The removal efficiency of toluene slightly decreases with increasing the concentration of toluene from 20 g/Nm^3 to 82 g/Nm^3. The solid residue formation takes place inside the plasma reactor. The selectivity of LHC (lower hydrocarbons) increased up to 15% by increasing the temperature to 400°C. Introducing H_2 to the gas at elevated temperature opens up new reaction routes to raise the selectivity to lower hydrocarbons. The selectivity to methane reaches to 42% using 35% H_2 at 400°C and total selectivity of LHC increases to 57%.

Keywords : biomass gasification tar, non-thermal plasma, dielectric barrier discharge, residence time
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