

Reduce toxic emissions of As, Cr, and Cu during woody biomass gasification: A thermodynamic equilibrium study

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Abstract:-

Gasification of blended waste wood samples resulting from different activities and operations would be beneficial for reducing toxic emissions of metal (loid) elements while producing energy. This paper deals with willow wood (40%) and demolition waste wood (60%) gasification specifically focusing on the phase transformation temperature and speciation formation of As, Cr, and Cu which are regularly present in woody biomass. The gasification of mixed fuel was modelled under atmospheric pressure as typical reaction zones; partial combustion reaction (PCR) and boudouard reaction (BR). The PCR performed at temperature range of 0-1800 (°C) and both equivalence and steam/air ratios were 0.28 and 1:2, respectively. On the other hand, the BR model was operated from 0 to 1300 (°C) along with typical CO₂ to biomass ratio of 1:3. The samples were selected from ETI-UK database (83 willow wood) and ECN PHYLLIS2 database (9 demolition waste wood). Further, @Risk analysis simulation package was exploited to estimate the best composition data of each element in these samples. Refinement of the obtained results by PCR reveals that the phase transformation temperature of both As and Cr increased about 150 (°C) and 100 (°C), respectively, comparing to those obtained by gasification of willow wood. On the other hand, solid –gas phase transition of Cr was decreased about 100(°C) comparing to that when only demolition wood was gasified. In regards to BR, the phase transformation temperature of As, Cr, and Cu was similar (~1100(°C)) for all gasified woods. However, only concentration shifts were observed in gaseous phase of these elements. Eventually, the results from this study could be useful to reduce emissions and to disposal contamination waste wood via gasification process.

Keywords— Reduce toxic emissions; Waste wood; Elemental contaminants; Gasification; MTDATA.