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Hydrogenation of bio-oil via gas-liquid two-phase discharge reaction system

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Abstract: In view of current technical problems of catalyst coking inactivation, poor equipment safety and large amount of hydrogen consumption, which are caused by high hydrogen pressure and operating temperature in bio-oil hydrogenation, an innovative gas-liquid two-phase discharge reaction system was constructed and applied to actualize the hydrogenation of bio-oil under catalyst-free, normal temperature and pressure conditions. Single-factor experiments were performed to explore the effects of working voltage, gas-flow rate and reaction time on the deoxygenation rate and high heating value of refined bio-oil. Furthermore, with the results of multi-factor orthogonal experiments, the operating parameters optimization model for the deoxidation rate of bio-oil was developed. The reasonable reaction pathways for the hydrogenation of various oxygenated compounds under gas-liquid two-phase discharge reaction conditions were well inferred. Under optimized operating parameters, the deoxidation rate of 65.26% with the high heating value of 35.15MJ/kg of bio-oil were achieved. GC-MS analysis results demonstrated that aldehydes, ketones were completely diminished, and alcohols, esters, phenols and acids were decreased. A remarkable increase of hydrocarbons was revealed, which indicated the quality of bio-oil was

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