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Green Hydrogen Production From Pig Manure Gasification in Supercritical Water

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The world can produce 7.27×109 Kg of pig manure in only one year. Between 2018 and 2020, China's major livestock produced 1.27×1010 Kg of manure annually, of which pig manure accounted for one-eighth. Pig manure is overflowing with HMs, Escherichia coli, nitrogen, phosphorus, and carbon, contributing to global climate change and environmental pollution through nitrous oxide, ammonia, and bioaccumulation. Supercritical water gasification (SCWG) technology can convert pig manure into green hydrogen or hydrogen-rich gas, which has immense potential in waste-to-wealth conversion while controlling environmental pollution. This work experimentally investigated the impact of multiple variables in batch reactor: (1) reaction temperature, (2) reaction time, and (3) the type of catalyst on H2-enriched syngas production. Results showed that the gasification efficiency increased with the growth of temperature (580–660 °C), extension of residence time (1-45min), and addition of alkali homogeneous catalyst (K2CO3). The GC–MS analysis showed that organic component in liquid products was mainly composed of aniline, phenolic, and N-heterocyclic compounds. The optimum conditions for generating carbon gasification efficiency (CE) of 85.78% and H2 yield of 15.23 mol/kg were the addition of K2CO3 at 620 °C, 30min, and 10 wt% feed concentration. In particular, the H2 yield is significantly enhanced by 100.2% compared with non-catalyst SCWG. Subsequently, with an average relative error of 8.08%, a double-intermediates kinetic model was established to obtain the gasification mechanism and yield prediction of pig manure in SCWG.

Biography:

Dr. Bin CHEN got his Ph. D degree in Xi'an Jiaotong University and worked as PostDoc researcher fellow in Japan Society for Prompting Science. Now he is a full professor and vice director of State Key Laboratory of Multiphase Flow, Xi'an Jiaotong University. For more than decades, Dr. Chen has devoted his efforts to the research on high-efficient conversion of fossil fuel and clean production of hydrogen from biomass gasification in supercritical water. He has published over 150 peer-reviewed journal papers and was invited for more than 30 keynote speeches.