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Steam Gasification of Biochars derived from Saw Dust and Poultry Manure with Lignite for H2 Production

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Abstract

Hydrogen is considered as a fuel of the future and its utilization as a fuel in transportation has further increased the importance of research on renewable hydrogen production. Today, 18% of the total hydrogen in the world is being provided by coal gasification which is known as the most cost-effective way. However, the countries that ratified the Paris Agreement intend the phase-out coal by reducing coal use gradually and to terminate them by 2050. The management of the move away from coal technology will not be easy and rapid since significant investment on coal gasification technologies had already made. Therefore, a cleaner alternative is seeking to be used in existing infrastructure instead of fully transition of the technology. Biochar, which is carbon rich solid product of biomass pyrolysis, is considered as a promising candidate to replace and/or co-utilize with coal. Biochar can be obtained from wide range of biomass type including waste having disposal issues. In this study, biochars derived from poultry manure (PM), saw dust (SD) and their blends were gasified alone and with lignite in presence of steam to produce H_2- rich gas. Biochars were obtained by slow pyrolysis at 300 °C. Biochar blends were prepared by two techniques, mechanical mixing and co-pyrolysis of biomass wastes. Results showed that SD derived biochar alone produced higher H_2 yield than PM derived biochar alone due to high organic content. In case of gasification of biochar obtained by co-pyrolysis, synergistic effect occurred, resulting in increase of H_2 and overall gas production compared to theoretical yields. On the other hand, no interaction was observed during gasification between PL and SD biochars in mechanically mixed biochars. Gasification of SD biochar mixed with lignite with a 50%-50% ratio gave lower H_2 yield than theoretical values whereas theoretical and experimental yield of PL biochar and lignite gasification was almost same. In case of co-gasification of mixed biochars and lignite, adverse effect was observed between co-pyrolysis biochars and lignite, reducing the H_2 yield. The anti-synergistic effect of mixed biochars in co-gasification runs may be attributed to inhibitory effect of newly formed inorganic compounds during co-pyrolysis. Despite of the anti-synergistic effect during co-gasification, all biochar blends gave higher H_2 yield than lignite alone.

Keywords: biochar, steam gasification, poultry manure, hydrogen production

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