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Impact of using fresh sewage as aqueous medium on the fuel characteristics of lignocellulosic hydrochar

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ABSTRACT

In various parts of the world, coal-fired power plants contribute to a major fraction of the produced electricity, which drastically increases the carbon footprint of the energy sector. Resultingly, coalification of various biomasses has been looked at as one of the approaches to reduce the reliance on coal-based power generation. One of the ways to achieve that is through hydrothermal carbonization (HTC), which converts wet biomass into a carbon-rich product known as hydrochar. This approach is especially suitable for wet biomasses like sewage sludge, food waste and microalgae. However, an external water source is required when lignocellulosic residues are intended to be used as feedstocks, which can also make it challenging to scale up the process due to the added burden on freshwater resources.

In this study, oven-dried sugarcane bagasse was used as the lignocellulosic feedstock and fresh sewage was used as the aqueous medium to reduce the overall freshwater requirement. The fresh sewage was filtered through a Whatman 40 filter paper, and the filtrate was used at a solid-liquid ratio of 1:15. The reaction temperature and residence time adopted in this study were 230 °C and 4 h, respectively. The hydrochar obtained by using double distilled water as the aqueous medium was considered as the base scenario to compare its fuel characteristics through proximate analysis, high heating value and thermo-gravimetric analysis. As compared to the base scenario, using fresh sewage as an aqueous source improved the hydrochar yield and fuel ratio by about 5% and 11%, respectively. The findings of this study can support further research for the field-scale application of hydrochar as a substitute for bituminous or sub-bituminous coal in coal-fired power plants and also reduce the freshwater footprint during HTC.

KEY WORDS

Hydrothermal carbonization; biochar; hydrochar; municipal solid waste; sewage

BIOGRAPHY

Rajarshi Bhar is the presenting author, currently pursuing his PhD research in the field of solid waste management and renewable energy. He holds a B.Tech in Civil Engineering from the National Institute of Technology Hamirpur and an M.Tech in Environmental Engineering and Management from the Indian Institute of Technology Kharagpur. His research interests include waste valorization, renewable energy, and life cycle assessment. He has authored and co-authored six peer-reviewed journal articles and review papers.

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