World Academy of Science, Engineering and Technology
International Journal of Biological and Ecological Engineering
Vol:18, No:08, 2024

Catalytic Pyrolysis of Sewage Sludge for Upgrading Bio-Oil Quality Using Sludge-Based Activated Char as an Alternative to HZSM5

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Abstract : Due to the concerns about the depletion of fossil fuel sources and the deteriorating environment, the attempt to investigate the production of renewable energy will play a crucial role as a potential to alleviate the dependency on mineral fuels. In this respect, biofuels are measured as a vital nominee for national energy security and energy sustainability. Sewage sludge (SS), as an alternative source of renewable energy with a complex composition, is a major waste generated during wastewater treatment. Stricter legislation is continuously refining the requirements for the level of removal of various pollutants in treated water, causing continuous growth of sludge production, which has become a global challenge. In general, there are two main procedures for dealing with SS: incineration and landfill. However, there are a variety of limitations in these options (e.g., production of greenhouse gases and restrictive environmental regulations) in regard to negative social and economic impacts. Pyrolysis is a feasible and cost-effective technology that can simultaneously tackle boundaries concerning the current disposal routes while retrieving bioenergy. Pyrolysis of SS has drawn vigorous interest in research due to the ability of high mass yield of pyrolytic liquid production. Nonetheless, the presence of high molecular weight hydrocarbons and oxygenated- and nitrogenated compounds poses a considerable challenge. In this context, catalytic pyrolysis is another attainable route in order to upgrade the bio-oil quality. Among different catalysts (i.e., zeolites) studied for sewage sludge pyrolysis, activated chars are eco-friendly and low-cost alternatives. The beneficial features comprise comparatively large surface area, long-term stability, and enriched surface functional groups. In light of these premises, this research attempts to investigate the catalytic pyrolysis of sewage sludge with a high-performance sludge-based activated char in contrast to HZSM5 from a theoretical and experimental point of view.

Keywords : catalytic pyrolysis, sewage sludge, char, HZSM5, bio-oil.
Conference Title : ICBBBP 2024 : International Conference on Bioenergy, Biogas and Biogas Production
Conference Location : Rome, Italy
Conference Dates : August 22-23, 2024