Sludge

1- Thermochemical conversion of sewage sludge: A critical review

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Abstract

The increasing levels of sewage sludge production demands research and development to introduce more commercially feasible options for reducing socio-economic and environmental problems associated with its current treatment. Sewage sludge may be processed to produce useful products or as a feedstock for energy generation. Initially, the characteristics of sewage sludge are discussed in terms of composition and the current options for its treatment with the associated environmental impacts. Processes to valorize sewage sludge are discussed, including heavy metal removal from sewage sludge, production of bio-char, production and use of activated carbon and use of sewage sludge combustion ash in cement and concrete. Thermochemical processes i.e., pyrolysis, co-pyrolysis and catalytic pyrolysis, also gasification and combustion for process intensification, energy and resource recovery from sewage sludge are then critically reviewed in detail. The pyrolysis of sewage sludge to produce a bio-oil is covered in relation to product bio-oil composition, reactor type and the use of catalysts. Gasification of sewage sludge focusses on the characteristics of the different available reactor types and the influence of a range of process parameters and catalysts on gas yield and composition. The selection and design of catalysts are of vital importance to enhance the selectivity of the selected thermochemical pyrolysis or gasification process. The catalysts used for sewage sludge treatment need more research to enable selectivity towards the targeted desired end-products along with optimization of parametric conditions and development of innovative reactor technologies. The combustion of sewage sludge is reviewed in terms of reactor technologies, flue gas cleaning systems and pollutant emissions. In addition, reactor technologies in terms of technological strength and market competitiveness with the particular application to sewage sludge are compared for the first time for thermochemical conversion. A critical comparison is made of the drying techniques, co-feedstocks and catalytic processes, reaction kinetics, reactor technologies, operating conditions to be optimized, removal of impurities, fuel properties, their constraints and required

improvements. The emphasis of this review is to promote environmental sustainability for process intensification, energy and resource recovery from pyrolysis, gasification and combustion involving the use of catalysts.

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Sewage sludgeThermochemicalCatalystsPyrolysisGasificationCombustion
Keywords Plus
WASTE-WATER SLUDGEFLUIDIZED-BED GASIFICATIONAIR-STEAM GASIFICATIONTEXTILE DYEING SLUDGELIFE-CYCLE ASSESSMENTPOLYCYCLIC AROMATIC-HYDROCARBONSHIGH-TEMPERATURE PYROLYSISGREENHOUSE-GAS EMISSIONSCATALYTIC FAST PYROLYSISHYDROGEN-RICH GAS

Sludge

2- A critical review on biochar for enhancing biogas production from anaerobic digestion of food waste and sludge

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Abstract

The conversion of food waste and sludge into biogas via anaerobic digestion technology is gaining attention in recent years, which plays a significant role in waste valorization into bioenergy and promotes environmental sustainability. Biochar is a carbonaceous material produced via thermochemical conversion of biomass waste, and tailoring biochar for diverse environmental applications adheres to the principle of circular economy. The emerging application of biochar as an additive in the anaerobic digestion of food waste and sludge has been intensively investigated in the last few years. However, a comprehensive understanding of multifunctional roles of biochar and its mechanisms in the production of biogas via miscellaneous/complex anaerobic digestion process is yet to be attained. This review scrutinizes the key roles of biochar as an additive and emphasizes the influences of biochar characteristics on the anaerobic digestion processes and their capability to address the foremost challenges. This review also evaluates the techno-economic and environmental impacts of biochar synthesis and its emerging application for biogas production via anaerobic digestion to make the integrated process more economical and environmentally sustainable, and identifies challenges and prospects for future studies.

Keywords
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Waste valorizationPyrolysisBlack carbonBiomethane productionCircular economyEnvironmental sustainability

Keywords Plus

INTERSPECIES ELECTRON-TRANSFERMUNICIPAL SOLID-WASTELIFE-CYCLE ASSESSMENTMICROBIAL COMMUNITYMETHANE PRODUCTIONSEWAGE-SLUDGECO-DIGESTIONAMMONIA INHIBITIONSEMICONTINUOUS OPERATIONPOTENTIAL ENHANCEMENT