



Review



Progress in thermochemical co-processing of biomass and sludge for sustainable energy, value-added products and circular economy

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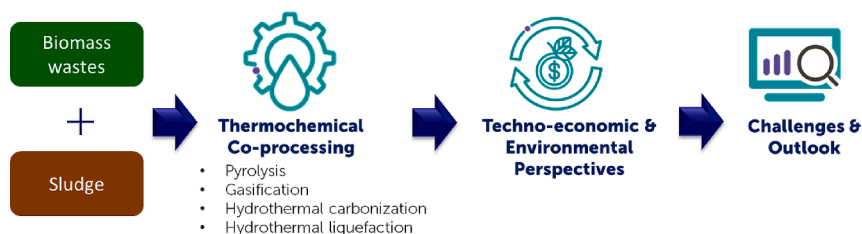
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HIGHLIGHTS

- Various biomass-sludge thermochemical co-conversion techniques are reviewed.
- Co-processing of biomass and sludge has promoted the synergistic effects.
- The synergistic effects have improved the performance/efficiency of the process.
- Products from co-processing are of superior qualities and characteristics.
- The products can be upgraded for many applications in line with circular economy.

GRAPHICAL ABSTRACT



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ABSTRACT

To achieve the main goal of net zero carbon emission, the shift from conventional fossil-based energy/products to renewable and low carbon-based energy/products is necessary. Biomass has been perceived as a carbon-neutral source from which energy and value-added products can be derived, while sludge is a slurry waste that inherently contains high amount of minerals and organic matters. Hence, thermochemical co-processing of biomass wastes and sludge could create positive synergistic effects, resulting in enhanced performance of the process (higher conversion or yield) and improved qualities or characteristics of the products as compared to that of mono-processing. This review presents the current progress and development for various thermochemical techniques of biomass-sludge co-conversion to energy and high-value products, and the potential applications of these products from circular economy's point of view. Also, these technologies are discussed from economic and environmental standpoints, and the outlook towards technology maturation and successful commercialization is laid out.

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