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Deep dewatering of sewage sludge and simultaneous preparation of derived fuel via carbonaceous skeleton-aided thermal hydrolysis

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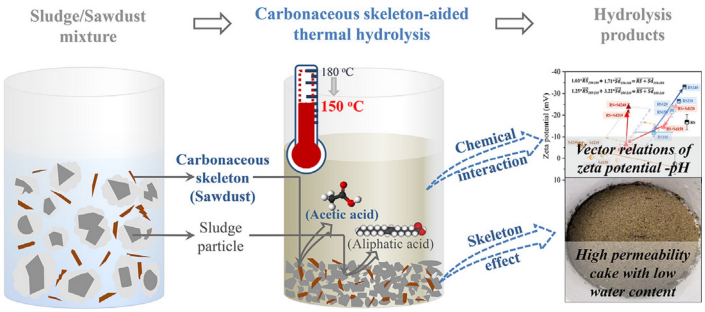
HIGHLIGHTS

- Sawdust-aided thermal hydrolysis significantly improved sludge dewaterability.
- Effective hydrolysis temperature was lowered from 180 °C to 150 °C by sawdust.
- Vector relations of zeta potential-pH in co-thermal hydrolysis were revealed.
- Sawdust was able to accelerate thermal hydrolysis reaction.
- Sludge derived fuel had a better combustion performance.

GRAPHICAL ABSTRACT



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ABSTRACT

To simultaneously solve problems of high water content and poor fuel performance hindering sludge incineration, carbonaceous skeleton-aided thermal hydrolysis was firstly developed in this study. Results showed that thermal hydrolysis could break sludge particle and release bound water. Sawdust as a typical carbonaceous skeleton improved permeability of sludge, decreased the specific resistance to filtrate significantly and lowered effective thermal hydrolysis temperature from 180 °C to 150 °C. The water content of sawdust-aided 150 °C hydrolysis sludge reached 42.2% after dewatered at 1 MPa. Zeta potential was not always linked to sludge dewatering performance after carbonaceous skeleton-aided thermal hydrolysis. The changes of zeta potential-pH in sawdust-aided thermal hydrolysis at different temperature, which was affected by aliphatic acid and acetic acid derived from sludge and sawdust respectively, were vector sums of that in hydrolysis alone. Zeta potential-pH vector relations and filtrate composition revealed that sawdust could interact with sludge and accelerate thermal hydrolysis reaction. Maillard reaction was the main color reaction in thermal hydrolysis consuming protein and polysaccharide in EPS. There were two stages for the combustion of derived fuel. Thermal hydrolysis could homogenize the sludge and reduce the temperature intervals between two stages. More fixed carbon, higher heating values and comprehensive combustibility index suggested a better combustion performance of derived fuel.

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