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Resource utilization and treatment of landfill leachate using supercritical water gasification

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ABSTRACT

Gasification of landfill leachate in supercritical water using batch-type reactor was investigated. The effect of temperature, pressure reaction time, catalyst Na_2CO_3 on gas composition, gas yield, TOC and TN removal efficiency were studied. The fixed reaction condition was temperature 380–500°C, pressure 22.5–36.5 MPa, reaction time 5–25 min. The results showed that gaseous products mainly contained H_2, CH_4, CO_2 and CO. The maximum hydrogen composition was reached to 55.6% at 500°C, 37 MPa and 10 min. And the maximum hydrogen gas yield of 107.15 mol·kg^{-1} was achieved under the same condition without addition of catalyst. TOC and TN removal efficiency being 85.56% and 49.88% was obtained at 470°C, 27 MPa. Hydrogen production increased from 43.1% to 57.92% with increase of catalyst Na_2CO_3 loading amount from 0 to 10%. Hydrogen composition, gas yield, TOC and TN removal efficiency increased with increase of temperature. GC-MS analysis results indicated gasification liquid phase products of leachate were mainly composed of cyclopentanone, 2-octanone, phenol, p-cresol and nitrogenous compounds. Results from infrared spectrum analysis indicated solid phase products were mainly composed of travertine, ankerite and calcite, and tar and char were not detected in our experiments.

Keywords: Landfill leachate; Supercritical water gasification; Hydrogen production; Wastewater treatment

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