Hydrogen production from landfill leachate using supercritical water gasification

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Abstract

Landfill leachate generated during the landfill process of municipal solid waste contains high concentration of pollutants and has adverse effects on the environment. Leachate is very difficult to be treated to meet the strict quality standards for direct discharge into surface water. Supercritical water gasification might provide an effective conversion method for leachate to hydrogen energy. Gasification of landfill leachate in supercritical water using batch-type reactor was investigated. The effect of temperature, pressure and retention time on gas component and COD, TOC removal efficiency was researched, respectively. Experiments were conducted under conditions of 380 – 500 °C, 22.5 – 37.5 MPa, 5 – 25 min. The experimental results showed that gaseous products mainly contain H₂, CH₄, CO₂ and CO. The volume percentage of H₂ reaching up to 55.2 % was obtained at 500 °C, 30 MPa and 10 min. Moreover, COD, TOC removal efficiency being 91.96 %, 84.81 % was obtained at 470 °C, 27 MPa, 25 min, respectively. Hydrogen component and COD, TOC removal efficiency increased with the increase of temperature. The suitable retention time is 25 min for leachate gasification in supercritical water. The main liquid intermediate organic products are caproic acid, propionic acid, valeric acid, butyric acid, carbolic acid and p-cresol etc.