Pyrolysis of waste activated sludge from food manufacturing industry: Thermal degradation, kinetics and thermodynamics analysis

ABSTRACT

Rising environmental concern on industrial waste disposal drives the exploration of alternative managing methods. The route of waste-to-energy sparks interest as the uncontrollable amount of waste can be potentially transformed into energy-rich by-products. Waste activated sludge (WAS) from the food manufacturing industry is a novel feedstock in pyrolysis and is investigated through a thermogravimetric analyser coupled with FTIR. During pyrolysis, a large composition of WAS is degraded within 190 e550 C, which is due to the breaking down of carbohydrates, protein and fats components. Phenols, alkanes, aromatics, acids, aldehydes, ketones and carbonyl are volatile chemicals, whereas light gases, such as CH4, CO and CO2, are produced. The kinetic analysis through model-free methods shows that the activation energy of WAS during pyrolysis increase with conversional level (Ea ¼ 68.9e693.1 kJ mol-1 for a ¼ 0.15e0.7). Polyacrylamide addition during wastewater treatment complicates the decomposition process, potentially imposing a higher Ea and consume more energy. The thermodynamic analysis of WAS demonstrated an endothermic and endergonic condition during pyrolysis where these are important information required for the designing of pyrolysis rig. From the large portion and valuable volatile composition with average activation energy, pyrolysis is found to be a feasible pathway for the management and transformation of WAS into bio-products.