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Effect of Segregation on the Reaction Rate of Sewage Sludge Pyrolysis in a Bubbling Fluidized Bed

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Abstract : The evolution of the pyrolysis of sewage sludge in a fixed and a fluidized bed was analyzed using a novel measuring technique. This original measuring technique consists of installing the whole reactor over a precision scale, capable of measuring the mass of the complete reactor with enough precision to detect the mass released by the sewage sludge sample during its pyrolysis. The inert conditions required for the pyrolysis process were obtained supplying the bed with a nitrogen flowrate, and the bed temperature was adjusted to either 500 ºC or 600 ºC using a group of three electric resistors. The sewage sludge sample was supplied through the top of the bed in a batch of 10 g. The measurement of the mass released by the sewage sludge sample was employed to determine the evolution of the reaction rate during the pyrolysis, the total amount of volatile matter released, and the pyrolysis time. The pyrolysis tests of sewage sludge in the fluidized bed were conducted using two different bed materials of the same size but different densities: silica sand and sepiolite particles. The higher density of silica sand particles induces a flotsam behavior for the sewage sludge particles which move close to the bed surface. In contrast, the lower density of sepiolite produces a neutrally-buoyant behavior for the sewage sludge particles, which shows a proper circulation throughout the whole bed in this case. The analysis of the evolution of the pyrolysis process in both fluidized beds show that the pyrolysis is faster when buoyancy effects are negligible, i.e. in the bed conformed by sepiolite particles. Moreover, sepiolite was found to show an absorbent capability for the volatile matter released during the pyrolysis of sewage sludge.

Keywords : bubbling fluidized bed, pyrolysis, reaction rate, segregation effects, sewage sludge
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