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Progress in Thermal Analysis Studies on the Pyrolysis Process of Oil Sludge

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Highlights

- Three aspects of the recent progress in the thermal analysis of oil sludge pyrolysis were reported.
- The relationship between the DTG peak and surface properties of the oil sludge was summarized.
- The active stage of oil sludge ash occurs during Stage-2 and Stage-4 of the oil sludge pyrolysis process.
- The activation energy of three oil sludge samples was calculated using the iso-conversional method.
- Oil sludge ash reduces the activation energy of oil sludge pyrolysis at high temperatures.

Abstract

This communication reports the current progress in thermal analysis studies on oil sludge pyrolysis. The pyrolysis behaviors of three different oil sludge samples were studied and compared using the results of thermogravimetry (TG) and differential thermogravimetry (DTG) analysis. Then, the evaporation stage of the pyrolysis process was analyzed by comparing the peak distribution in the DTG curves of the oil sludge samples with that obtained for artificial oil sludge. The relationship between the DTG peak distribution and the surface properties of the oil sludge particles was determined. As a complement to our previous study, the active stage of oil sludge ash additive was determined based on the results obtained from the pyrolysis of oil sludge with and without the addition of oil sludge ash. The kinetic parameters were calculated using the iso-conversional differential method, the integral method, and the Kissinger method. The results of this study provide reference values for practical engineering applications.

1. Introduction

Oil sludge, which is a semisolid mixture of petroleum and water with inorganic minerals, has been classified as hazardous waste in many countries [1-3] due to its ignitability and toxicity. The compositions of the oil sludge are similar to oil sand (an unconventional oil resource) whose characteristics and treatment processes have been widely studied [4-8]. However, in contrast to oil sand, oil sludge is artificial rather than natural. The human factors as a result of handling impart oil sludge with more complicated and unstable features, causing its treatment or reuse by the traditional