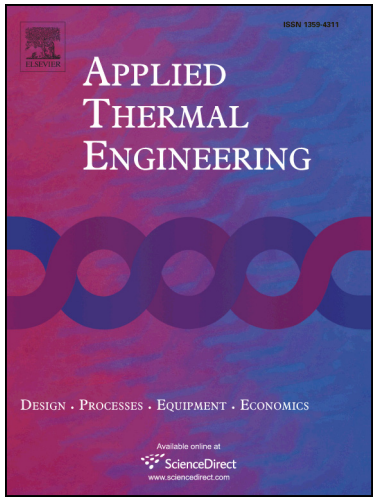

Research Paper

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An Experimental Investigation on the Ultrasound-Assisted Oxidation of Benzothiophene in Model Fuel: Application of Response Surface Methodology

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Abstract: In the present work, the ultrasound-assisted oxidation of benzothiophene (BT) in toluene as model light fuel oil has been studied. Hydrogen peroxide-formic acid oxidation system was used. Response surface methodology, Box-Behnken design, has been applied to study the influences of various operating parameters of the ultrasound-assisted oxidation process. In the present study, the effects of hydrogen peroxide to sulfur molar ratio (10-50), formic acid to sulfur molar ratio (150-400), oxidation temperature (40-70 ˚C) on the benzothiophene (BT) conversion were investigated. A valid quadratic correlation was obtained for the prediction of BT conversion. The effects of sonication time and ultrasound power on the BT conversion have been also studied separately. More than 98 % sulfur conversion has been achieved under the following conditions (i.e., hydrogen peroxide to sulfur molar ratio of 10.82, formic acid to sulfur molar ratio of 379.75, temperature of 52 ˚C, sonication time of 15 min, and ultrasound power of 70 W). It was also found that the BT oxidation reaction can be represented by pseudo-first order kinetic model. The performance of the present UAOD process was also examined for the kerosene feedstock and the obtained results (i.e., over 95 % sulfur removal) were satisfactory.

Keywords: Benzothiophene, Oxidation, Formic acid, Hydrogen peroxide, Homogeneous catalysis, Ultrasound-Assisted Oxidative Desulfurization (UAOD)