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The New and Effective Methods for Removing Sulfur Compounds from Liquid Fuels: Challenges Ahead-Advantages and Disadvantages

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ABSTRACT

In the field of environmental science, extraction of clean energy from fuel feedstocks is of great importance. Desulfurization of the fuel is essential to ensure of fuel without the emission of toxic sulfur oxides (SOx gases). Due to the poor performance of current industrial techniques like hydrodesulfurization (HDS) for removal of resistant sulfur compounds and the environmental protection agency's strict rules on fuel sulfur levels, researchers have been encouraged to deliberate further effective approaches. Furthermore recently, the more effective mode such as oxidation and adsorption were used for desulfurization processes.

Keywords: Dibenzothiophene; Adsorptive Desulfurization; Ultrasound Oxidation, Phase Transfer Catalyst

Abbreviations: ADS: Adsorption Desulfurization; ODS: Oxidation Desulfurization; UAOD: Assisted Oxidative Desulfurization; CCD: Central Composite Design

Introduction

Combustion of liquid fuels with organosulfur compounds such as sulfides, disulfides, thiophenes and the corresponding derivatives emits harmful gases SO_x and NO_x. HDS is main methods used for desulfurization, but this process is inefficient in removing organo sulfur compounds [1]. So recently, former techniques such as adsorption desulfurization (ADS) and oxidation desulfurization (ODS) were considered [2]. The main challenge of the ADS method is the selection of adsorbents with high adsorption capacity and selectivity [3]. Vafaee, et al. [4], synthesized nanosorbents of (A: Ni, CO & Mg) AFe_2O_4-SiO_2 by an auto-combustion sol-gel method and used them in the ADS process. Also, Vafaee, et al. [5] used $NiFe_2O_4$-Polyethylene glycol catalyst for ultrasound assisted oxidative desulfurization (UAOD) process using central composite design (CCD) under response surface methodology (RSM). Consequently, ferrites in the adsorbent and phase transfer catalyst were easily separated and recycled via magnetic field for desulfurization process.

Conclusion

In this study, efficiency of ADS and UAOD methods with the AFe_2O_4-SiO_2 (A: Ni, Co & Mg) nanoadsorbent and $NiFe_2O_4$-PEG phase transfer nanocatalysts were reviewed. In the UAOD process, increasing the temperature and oxidant amount had the greatest effect on increasing the percentage of DBT conversion. In addition, one of the main challenges of ADS and UAOD methods is the use of adsorbents and phase transfer catalysts with easy separation and recovery capabilities. Therefore, using the magnetic field caused by ferrites in the adsorbent and phase transfer catalyst structure, they were easily separated and recycled after desulfurization.

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