

Catalytic Oxidative Desulfurization of Marine Diesel Using Tungsten Oxide Supported on SBA-15 Catalyst and Hydrogen Peroxide

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The International Maritime Organization (IMO) announced an international convention, the MARPOL ANNEX VI. And bunker C oil usage is prohibited in Emissions Control Areas to control the pollution caused by ships. Thus, fuel cells can be an alternative solution because of their higher efficiency and lower emissions[1]. Diesel fuel is suitable for using fuel cell because of high energy density and safety. But desulfurization process to remove the sulfur compounds in diesel fuels is a necessity to prevent catalytic poisoning phenomenon on the cathode in fuel cell.

In this work, tungsten oxide supported on SBA-15 (mesoporous silica) catalyst (WO_x/SiO_2) were prepared by impregnation method for oxidative desulfurization of marine diesel (sulfur concentration = 230 ppmw). Prepared catalysts were characterized by X-ray diffraction (XRD), X-ray fluorescence (XRF) and N_2 adsorption-desorption measurements. WO_x/SiO_2 applied as oxidation catalyst for oxidation of sulfur compounds. Oxidative desulfurization of marine diesel was carried out with hydrogen peroxide as the oxidant and acetonitrile as the extractant, respectively.

Fig. 1 shows that tungsten oxide exists as monoclinic crystal on SBA-15 over 13 wt% of tungsten oxide loading. The sulfur removal efficiency was enhanced with increasing the reaction temperature. According to Fig. 2, the 13 wt% WO_x/SiO_2 catalyst was achieved up to 76.3% by oxidative desulfurization process under mild conditions (at 90 °C, atmospheric pressure and O/S molar ratio of 10 in 3 h) followed by acetonitrile extraction. Furthermore, the repetition experiment of extraction process indicated that sulfur removal could reach 95.7% after 5 times.

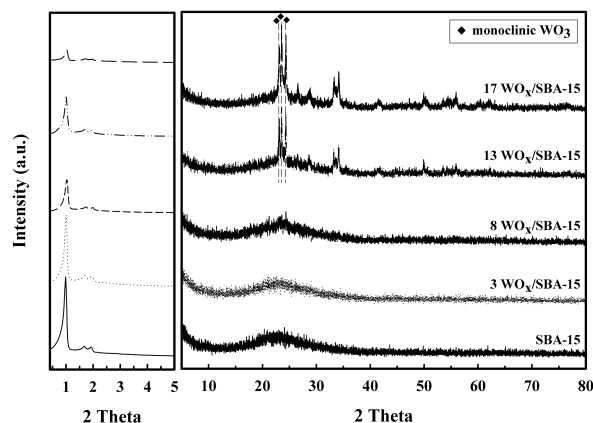


Fig. 1 X-ray diffraction patterns of $\text{WO}_x/\text{SBA-15}$ catalyst with different WO_x loadings.

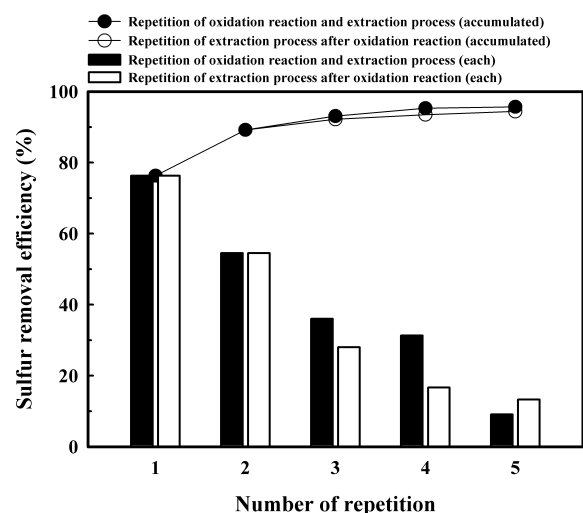


Fig. 2 The effect of reaction and extraction process on sulfur removal. Oxidation conditions: catalyst amount = 0.1 g, $T = 90$ °C, $t = 3$ h and O/S molar ratio = 10.

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