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حضور و مشارکت ۵۰ دانشگاه ،انجمن و رسانه فعال علمی در بزرگترین رویداد داخلی حوزه شیمی و نانو شیمی کشور

Phosphotungstic acid on different natural zeolites as nanocatalyst of dibenzothiophene oxidative desulfurization

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ABSTRACT

Desulfurization which produces green fuels and also increases the lifetime of combustion engines is a very crucial process for environmental purposes. Based on the new environmental regulations, the sulfur content of diesel fuel must be less than 10 ppm. Ultra-deep oxidative desulfurization in mild operating conditions is a supplement (temperature less than 100 °C and atmospheric pressure) to remove aromatic sulfur compounds compare to hydrodesulfurization. In oxidative desulfurization, the sulfur compounds are oxidized with an oxidizing agent and a suitable catalyst and a polar solvent are used for extraction of produced sulfones and sulfoxides. In this research, phosphotungstic acid was impregnated on natural zeolites of clinoptilolite, mordenite, ferrierite, and natrolite. nano the nanocatalyst of phosphotungstic acid on ferrierite with the conversion of 82.02% had the best performance in dibenzothiophene removal compared to other synthesized catalysts. Using ferrierite as the support, the amount of phosphotungstic acid has been changed from 0 to 40 %wt and it was concluded that 20 %wt. of phosphotungstic acid had the best desulfurization with the conversion of 91.12%. The synthesized nano catalysts were characterized by BET, XRD, and FTIR as well.

Keywords: *Phosphotungstic Acid, Natural Zeolite, Nanocatalyst, Dibenzothiophene, Oxidative Desulfurization.*

1. INTRODUCTION

Nowadays in the refining industry, there is an increased demand for low sulfur fuels, crude oils and industrial fuels such as gasoline and diesel and jet fuel with better quality that are used in the transportation industry. The fuel contains sulfur in forms of sulfides, thiols, thiophenes, substituted benzo, and dibenzothiophenes, etc. [1]. The presence of sulfur contents in liquid fuels during the purification process after combustion leads to emissions of sulfur oxides (SO_x) followed by acid rain which causes serious health problems and poisoning of the oxidation catalysts that are controllers of the exhaust pollutant in catalytic converters. Therefore, according to the global environmental rules, the sulfur content of liquid fuels in the transport system is limited to < 10 ppm [2, 3]. Currently, the most common method of sulfur removing from fuels is hydrogen desulfurization (HDS) in high operating conditions such as high temperature and pressure and the presence of hydrogen gas. [3-8]. However, this method can't remove aromatic sulfur compounds such as dibenzothiophene (DBT) and especially 4,6 dimethyl dibenzothiophene (4,6-DMDBT) [3, 9]. Also there are other methods including absorption desulfurization (ADS) [10, 11], extraction desulfurization (EDS) [12], oxidative desulfurization (ODS) etc. [13-17]. Regarding all these methods, the most promising method is oxidative desulfurization (ODS) [9, 18], which consists of two stages oxidation of sulfur compounds and separation. In this method, aromatic sulfur compounds in mild operating conditions and absence of hydrogen gas, are oxidized in the presence of an oxidizing agent to sulfone and sulfoxide compounds. Separation of these compounds will be done by extraction or absorption [4, 18-27]. The catalyst used in the oxidation process plays an important role using an oxidizing agent. The catalysts used in these processes are divided into two categories of homogeneous and heterogeneous [28, 29]. Heterogeneous catalysts are most commonly used due to their ability to be removed from the reaction medium easily[30].