

Hydrodesulphurization over mixed oxides catalyst supported on zeolite to produce environmental friendly cleaner fuels

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Introduction

Deep hydrodesulphurization of transportation fuel is currently investigated extensively since the environmental legislation on the acceptable sulfur levels in gasoline and diesel fuel are becoming more stringent in order to reduce the exhaust gases emitted by motor vehicles.

Indeed, over the last few years, global ultra low sulfur diesel or gasoline regulations have induced a marked improvement in fuel transportation quality and it is expected that this trend continues until reaching sulfur level in the order of wppb (part per billion by weight). Such near zero sulfur emission legislation requires a high efficiency of the hydrodesulphurization catalysts.

Materials and Methods

Therefore, the aim of this work is to develop active supported catalyst based on zeolite for hydrodesulphurization process. The catalyst which consists of mixed lanthanum, cobalt and molybdenum oxides supported on zeolite was prepared by impregnation and ultrasonication process followed by calcination at temperature up to 550°C. The catalyst was characterized by means of various techniques (SEM), (XRD), (EPMA), (BET), (XRF), (DTA) and (XPS).

The catalytic activity of the prepared unsulfided catalyst, in hydrodesulphurization of thiophene as a model sulfur compound in decane, has been evaluated in a continuous gas phase process using fixed bed reactor at variable temperatures ranging from 400 to 500°C and under atmospheric pressure with a space velocity (WHSV) ranges between 0.2-1.0 h⁻¹. The product distributions were identified by GC/MS and quantified by GC technique.

Results and Discussion

The results showed the conversion of thiophene based on the HDS conditions ranging from 33% to 41% with formation of butane and butene fractions. It was also found that the conversion of thiophene is significantly temperature and time on stream dependent. The conversion decreases as the temperature and time on stream increase. The conversion of thiophene (40.5%) was obtained after 30 min. of the reaction time at temperature 400°C. This decreased to (33.0%) after 60 min. at temperature 500°C. Most of the products of the catalytic cracking of thiophene are gases, mostly butane and butene fractions.

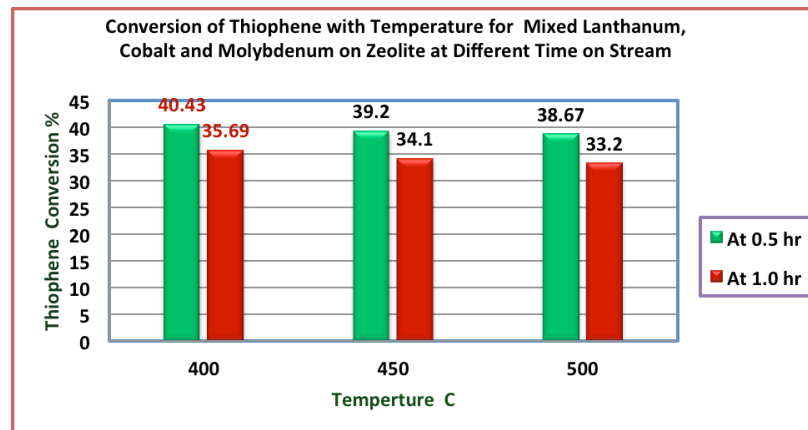


Figure 1. Conversion of thiophene with temperature over a catalyst consists of mixed lanthanum, cobalt and molybdenum oxides on zeolite.

Significance

The performance of the catalyst was found to be more active and superior by about 17% to those conventional sulfided CoMo/ γ -Al₂O₃ catalysts, and has promising activities for HDS of fuels.

References

1. A. Stanislaus, A. Marafi, M.S. Rana, *Catalysis Today* 153 (2010) 1.
1. R.R. Chianelli, M.H. Siadati, M. Perez De la Rosa, *Catal. Rev.-Sci. Eng.*, **48** (2006) 1