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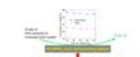
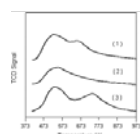
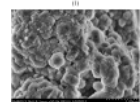
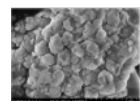


Table 1



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## Hydrocracking of the crude oil from thermal pyrolysis of municipal wastes over bi-functional Mo–Ni catalyst

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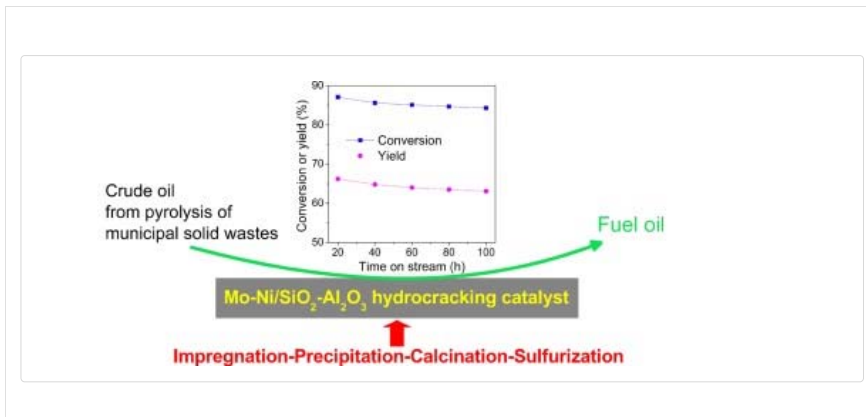
## Highlights

- Overall refining of crude oil from pyrolysis of municipal solid wastes was performed.
- A bi-functional Mo–Ni/SiO<sub>2</sub>–Al<sub>2</sub>O<sub>3</sub> catalyst was prepared for refining of the crude oil.
- A specific preparation procedure was impregnation–precipitation and sulfurization.
- NiO particle size and dispersion were controlled with urea as precipitator.
- High yield of fuel oil was obtained with a good catalytic stability and regeneration.

## Abstract

Bi-functional Mo–Ni/SiO<sub>2</sub>–Al<sub>2</sub>O<sub>3</sub> catalyst was prepared by loading bimetal Ni–Mo over large porous and acidic SiO<sub>2</sub>–Al<sub>2</sub>O<sub>3</sub> substrate via impregnation–precipitation–calcination–sulfurization procedure. Highly dispersed NiO clusters were loaded with urea as a precipitator. The catalytic performance for the hydrocracking of the crude oil from thermally pyrolysis of municipal solid wastes was investigated in a fixed bed reactor. It is found that SiO<sub>2</sub>–Al<sub>2</sub>O<sub>3</sub> composites with the mid-acidity and large pores were more suitable as the substrate than Al<sub>2</sub>O<sub>3</sub> and Al<sub>2</sub>O<sub>3</sub>–Y (Y zeolite). Mo–Ni/SiO<sub>2</sub>–Al<sub>2</sub>O<sub>3</sub> catalyst with 8 wt% Mo and 14 wt% Ni showed the higher reactivity and higher yield of fuel oil. Moreover, its hydrocracking reactivity could be further improved by partial sulfurization of Ni and Mo. Besides, the bi-functional Mo–Ni/SiO<sub>2</sub>–Al<sub>2</sub>O<sub>3</sub> showed a good stability, and the deactivated catalyst could be easily regenerated by on-line combustion. Under the optimized conditions of 10 MPa, WHSV 0.3 h<sup>−1</sup> and 698 K, the conversion of pyrolysis oil was up to 86% with 66% yield of fuel oil, greatly better than a commercial hydrocracking catalyst. The overall hydrocracking refinement converts most of the olefin, acid, ketones and poly-aromatic presented in the pyrolysis oil into alkanes, alcohols, and alkyl-aromatics, with a significant decrease of N and S contents as well as viscosity.

## Graphical abstract



## Keywords

Mo–Ni/SiO<sub>2</sub>–Al<sub>2</sub>O<sub>3</sub>; Bi-functional catalyst; Pyrolysis oil; Hydrocracking; Municipal solid wastes

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