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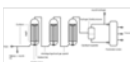
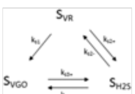
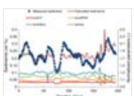
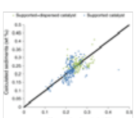








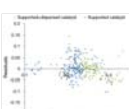
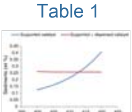
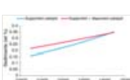


Table 1





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Research article

Hydrocracking of vacuum residue with solid and dispersed phase catalyst: Modeling of sediment formation and hydrodesulfurization

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Highlights

- Mo dispersed catalyst was applied on industrial scale in a residual hydrocracker.
- Lower sediment formation and deeper hydrodesulfurization were observed.
- Developed models for sediment formation and sulfur distribution show good agreement with plant data.
- Effects of process parameters on sediment formation were studied.

Abstract

Effect of dispersed Mo based catalyst on residual hydrocracking was investigated in this paper. The study was performed in an industrial scale hydrocracking unit with the average reactor temperature of 399–419 °C and pressure of 18 MPa. Vacuum residue from Ural crude oil was fed to the reactor. A sediment formation model was proposed with parameters sets for the regime with classical supported Ni-Mo/Al_2O_3 catalyst and for that with a combined system of supported and dispersed catalyst. Four process parameters were incorporated in the model equation: reaction temperature, hydrogen partial pressure, exothermic gain and hydrogen makeup to feed mass ratio. A decrease of the sediment formation with the application of dispersed Mo catalyst was observed, which results in higher Mo concentration in the liquid phase and thus in higher hydrogenation activity and stabilization of coke precursors. Hydrodesulfurization was also investigated and a sulfur distribution model was created with parameters for both regimes. The model contains three lumps with significant sulfur content: sulfur contained in the vacuum residue, sulfur contained in the vacuum gas oil and hydrogen sulfide. Application of the catalyst and increase of reaction temperature from 399–414 °C to 414–419 °C resulted in increase of average sulfur conversion in vacuum residue from 86.5% to 87.9%.

Keywords

Residual hydrocracking; Sediment formation; Hydrodesulfurization; Mathematical

modeling

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