Complete oxidative desulfurization using graphene oxide-based phosphomolybdic acid catalyst: process optimization by two phase mass balance approach

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Complete oxidative desulfurization using graphene oxide-based phosphomolybdic acid catalyst: process optimization by two phase mass balance approach

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Abstract

Aiming deep oxidative desulfurization, a novel heterogeneous catalyst of phosphomolybdic acid ($H_3PMO_{12}O_{40}$, HPMo) supported on graphene oxide (GO) was synthesized. The characteristics of the catalyst and its performance in an extractive-oxidative desulfurization (ECOD) process were assessed. The effects of main process variables such as catalyst dosage, reaction temperature, oxygen to sulfur ratio (O/S), and extracting solvent to fuel volumetric ratio (E/F) on the responses including overall, extractive, and oxidative desulfurizations were measured and a detailed discussion about the influence of each process parameter on the three responses was performed. A novel approach was proposed to find the practical optimum conditions through combining two-phase mass balance along with applying central composite design method. Complete oxidative desulfurization was achieved in a short time (within 30 min) by low amount of the catalyst (2.5 g/l), O/S ratio of 6, temperature of 50 ºC, and E/F of 0.3. Similar to dibenzothiophene (DBT), 4,6-dimethyldibenzothiophene (4,6-DMDBT) could also be removed with desulfurization efficiency of 100%. The superior performance of the ECOD was interpreted in terms of catalyst properties and the characteristics of two-phase desulfurization system. HPMo-GO

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