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Experimental design optimization of the ODS of DBT using vanadium oxide supported on mesoporous Ga-SBA-15

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ABSTRACT

Experiment design-response surface methodology is applied in this work to model and optimize the oxidation of dibenzothiophene (DBT) using VOx-Ga-SBA-15 catalyst. The analyzed variables are the influence of the nature of the catalyst (V and Ga loading), the substrate/catalyst mass ratio (g DBT/g of catalyst) and the oxidant/substrate molar ratio (H_2O_2/DBT). The response analyzed is conversion of DBT at 15 min of reaction time. A set of response surfaces were obtained applying the Box-Behnken Design. Based on statistical methodology it was possible to find the best arrangement between the amounts of the gallium heteroatom and the vanadium active species. The higher levels of the objective function were obtained employing the catalyst with 4 wt.% of gallium and 6 wt.% of vanadium; the optimal ratio between g DBT/g of catalyst was 4 and the molar ratio between H_2O_2/DBT was 5. Gallium incorporation as heteroatom in tetrahedral position allowed the better anchorage of the active species of vanadium, generating a very well dispersed catalyst. The optimized catalyst minimized the mass transfer limitation and moreover, was active after several recycles. The best catalyst was likewise very active for the oxidation of the most refractory sulfur compounds as benzothiophene and 4,6-dimetyldibenzothiopene.

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