

Hydrocracking Boscan Heavy Oil with a Cobalt-Molybdenum/Alumina Catalyst Containing an H-Mordenite Zeolite Component

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Abstract

Co-Mo/Al₂O₃ catalysts for hydrocracking heavy oil and residue were modified by adding up to 20 wt % hydrogen-mordenite zeolite. The acidic sites on the external surface of the mordenite crystals were expected to increase cracking reactions. In fact, there was a slight decrease in the +525-degrees-C resid conversion, although vanadium and nickel hydrodemetallization increased as the mordenite content of the catalyst increased. On the other hand, the pseudo turnover frequency for metals removal, i.e, the number of reactions per second per reaction site (or in this case per (nm)²), was greater for catalysts containing greater amounts of mordenite. The catalyst performance was attributed to a combination of two factors. First, both the catalyst bulk density (grams of catalyst per milliliter of reactor volume) and the catalyst specific surface area (m²/g) in pores larger than 3 nm decreased as the mordenite content increased. Hence, a smaller quantity of catalyst could be placed into the reactor and the catalyst that was in the reactor had less surface area per unit mass. Clearly the mordenite changed the structure of the alumina support, which resulted in a net decrease in the effective catalyst surface area. Second, the catalyst acidity, as measured by temperature-programmed desorption of benzofuran, increased as the mordenite component of the catalyst increased. It was concluded that the improved overall hydrodemetallization was caused by both the increased number of acidic sites of the exterior surfaces of the mordenite and the changes in catalyst pore geometry, which improved the rate of diffusion to the catalyst surface.