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Effects of Asphaltene Content in Atmospheric Residue and Mean Pore Size of Catalyst on Initial Deactivation of Hydrodesulfurization Catalyst

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Hydrodesulfurization (HDS) of atmospheric residue (AR) over Ni-Co-Mo catalysts supported on γ-alumina was carried out to examine the effect of alumina pore size on HDS activity, hydrodemetallization (HDM) activity and initial catalyst deactivation under deep hydrodesulfurization conditions.

HDM activity slightly increased with alumina pore size, but HDS activity decreased due to the decrease in the surface area of the support. Deactivation of the HDS catalyst was greater on large pore size supports than on medium pore size supports. The combination of HDS catalyst with large pore size supports (40%) and medium pore size supports (60%) did not improve the catalyst life. HDS was carried out with the large pore size support catalyst at the upstream side in the first reactor and the medium pore size support catalyst at the upstream side in another reactor. Catalyst deactivation was greater in the former than in the latter reactor. These results suggest that HDS catalyst supported on alumina with medium pore size has a higher performance than HDS catalyst supported on alumina with large pore size for deep HDS.

To examine the behavior of asphaltene (ASP) at the reaction temperature, adsorption of ASP was investigated on catalyst supports with different pore size. ASP was a large molecule at low temperatures, but the molecular size decreased at HDS reaction temperature caused by the dissociation of the molecular structure. Furthermore, ASP containing sulfur was preferentially adsorbed on the catalyst support. The chemical

interaction between ASP and alumina indicates that alumina is a good support for the HDS reaction.

Keywords: Hydrotreating, Atmospheric residue, Catalyst deactivation rate, Pore size effect, Asphaltene micelle, Asphaltene adsorption

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