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Effects of Loading Order of Catalyst with Different Pore Structures in Residue Hydrotreating Process

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The activities of two combinations of three catalysts with different mean pore sizes were examined in the residue hydrotreating process. Packing of catalysts in the order of large to small pores enhanced the catalytic activity, such as for hydrodesulfurization (HDS) and hydrodemetallization (HDM), and the pore volume of the middle catalyst apparently controlled the catalyst life. The order of catalyst packing did not influence the product states, but did affect the molecular weight distributions of asphaltenes and maltenes in the product oil. Packing of catalysts in the order of large to small pores was found most effective for the cracking of asphaltene. In contrast, packing of the catalyst with the small pores in the middle bed enhanced the cracking of maltene and reduced the cracking of asphaltene, thus increasing sludge formation. Packing of catalysts in the order of large to small pores in the catalyst bed increased the solubility of both asphaltene and maltene, thus reducing sludge formation. Solubility parameters (δ) of maltene and asphaltene as defined by Hildebrand could explain the trends in sludge formation.

Keywords: [Atmospheric residue](#), [Hydrotreating](#), [Catalyst loading order](#), [Sludge](#), [TOFMS](#), [Solubility parameter](#)

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