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Changes of Asphaltenes' Structural Phase Characteristics in the Process of Conversion of Heavy Oil in the Hydrothermal Catalytic System

Kayukova G., Gubaidullin A., Petrov S., Romanov G., Petrukhina N., Vakhin A.

Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 2016 American Chemical Society.The composition of heavy crude oil from the Ashal'cha field (Volga-Ural Basin, Republic of Tatarstan) and the peculiarities of the changes of its asphaltenes' structural phase characteristics in the model hydrothermal-catalytic system have been studied very thoroughly. It has been established that in the water vapor media the process of destruction of the heavy crude oil high-molecular-weight components with the new light fraction formation in the presence of a natural catalyst, namely, hematite, containing iron oxide and at the temperatures of 210, 250, and 300 °C respectively, takes place which has an effect on the changes in its component hydrocarbon, fractional, and structural group composition as well as in the structural parameters of its asphaltenes. As the experiments temperature increases and the water content in the reaction system decreases, the general tendency of growth the asphaltene associates aromaticity factor revealed that in turn it is accompanied by the extension (increase) of the distance between the aromatic layers and polymethylene chain fragments under the reduction of the size of associates and the number of their aromatic layers; this results from the destructive processes course, taking place along/on the most stable asphaltene heteroatomic bonds with/accompanied by further peripheral alkyl fragments breaking off, which has been confirmed by the molecular mass of the fragments above as well as destruction of vanadyl-porphyrin complexes and increase of free radicals concentration. A significant ability of asphaltene associates to immobilize their maltenes has been revealed. Within the process of oxidation cracking at the temperature of 300°C and under the low water content in the reaction system, the increase in aromaticity and in the degree of association asphaltenes transform to carben-carboids and then to coke and are precipitated out of the oil in the solid form.

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