Influence of Heavy oils cComposition on the Physical Impact Processes during Transportation and Refining Pretreatment

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Abstract

At present time, more and more attention is paid to the development of technologies related to the extraction, transport and refining of heavy oils. It is known that chemical and physical effects, as well as mixing of highly viscous heavy oils sharply changes rheological properties, which indicates structure change of the oil dispersed system. The physical-chemical and structural-rheological properties of the oil disperse system are determined by the structure, size and composition of the complex structures resulting from the paraffins and tarry asphaltene components association. Therefore, information of the composition, especially the structure of tars, resins and asphaltenes, is necessary to select a recovery method to provide the required properties.

We have conducted laboratory studies of magnetic and microwave exposure to heavy oils with a density of more than 900 kg/m^3. Samples of different composition of oils, belonging to both Newtonian and non-Newtonian fluids (namely pseudoplastic) were investigated. It was found that for different oils different modes are effective. It was found that under magnetic and microwave effects oil undoubtedly changes its rheological properties depending on the mode and duration of treatment. It can be assumed that a new oil dispersion system is being formed, which in turn can not only improve the rheological properties, but also worsen them. In this connection, we carried out a quantum-chemical study of the geometric and electronic structure of tars and asphaltenes model molecules of the "continent" type. It was found that the number and location of benzene rings does not have a significant impact on the geometric and electronic structure of hydrocarbon fragments. The heteroatoms N, S and OH have a significant influence on the characteristics of model molecules. Moreover, when considering geometrical and electronic structure, it can be assumed that during the physical impact the bond breaks, which provides free radical form formation. Such forms can be in equilibrium or form a new, more complex oil dispersion system. Thus, it has been established that to choose recovery method in the heavy hydrocarbon crude treatment, the elemental composition is important, since it is heteroatoms in multi-core systems with condensed nuclei that affect the reactivity indices. Quantum-chemical calculations were also carried out in a solvent (benzene, heptane). It is established that the reactivity indexes in benzene are higher than in heptane. Thus, when choosing physical impact modes, it is necessary to take into account not only the elemental composition of oil, but also the group one.

Thus, during laboratory and quantum-chemical studies, it was found that in addition to the parameters of physical impact, significantly influence on oil rheological properties both oil elemental composition, namely sulfur content, and group composition.