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Supramolecular structures of oil systems as the key to regulation of oil behavior

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According to the modern concepts, the oil is a complex multi-component dispersion system. At present, the focused attention is paid to the most high-molecular-mass, polar oil components - asphaltenes. Asphaltenes are characterized by their ability to self-organization (or self-assembly), and therefore the presence of a hierarchy of structures in oil media: molecules – nanoaggregates – clusters of nanoaggregates in connection with which they can be attributed to the objects of supramolecular chemistry.

In modern scientific literature, there are many studies on the self-organization of asphaltenes in solutions of solvents, but the study of the behavior of asphaltenes directly in the oil system is of a great interest, since regularities obtained during the study of asphaltenes in solutions do not reflect the nature and completeness of the processes that occur in real oils. Therefore we studied aggregation of asphaltenes both in toluene solution and in diluted heavy oils by dynamic light scattering technique. The high rate of aggregation of asphaltenes in toluene solution in comparison with the aggregation in diluted crude oils and model mixtures maltenes-asphaltenes was found. The stabilizing role of resins was confirmed, particularly the presence of resins hinders the process of self-organization of asphaltene molecules.

It was shown that extremely stable supramolecular structures in heavy oil were formed, notably their content remains unchanged for different ratios of oil: precipitant.

The effect of the different molecular structures of asphaltenes on the rheological properties of crude oils was also observed. The influence of ultrasonic action for the destruction of stable supramolecular structures and the reduction of oil viscosity was considered.

Asphaltenes are the indicators of many processes that occur in the reservoir. Previously we [10] have shown the possibility of using the gradient of asphaltenes, as well as their structure, for the confirmation of influx of deep hydrocarbons in carbonate reservoirs.

Thus, all obtained results of research of structure formation processes will let regulate the macroscopic properties of heavy oils in the future and allow the identification of the processes occurring in the reservoir.

Biography

A. Z. Tukhvatullina, Ph.D. student in the laboratory of oil chemistry and geochemistry at A.E. Arbuzov Institute of Organic and Physical Chemistry, more than 20 published papers.

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