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EFFECT OF ASPHALTENES ON THE THERMAL PROPERTIES OF PETROLEUM AND BITUMEN EMULSIONS

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The thermal properties and characteristics of the molecular structure of petroleum and bitumen emulsions were investigated by viscometer and Rayleigh light scattering. The viscosity, structural properties, and character of the intermolecular interactions in the emulsions are determined by the temperature of formation of these media. Formation at "critical" temperatures close to 36-38°C initiates a structural phase transition that alters the size and activity of molecular aggregates of asphaltenes. These aggregates serve as binder material in three-dimensional supramolecular structures containing wax microcrystals. The long (up to several months) "memory" of the emulsions concerning the conditions of formation is due to the strength of the three-dimensional structures that contain not only hydrogen but also covalent bonds.

Detailed information on the properties of petroleum, fuel, and bitumen emulsions is important for perfecting many processes in refining and utilizing crude oils and petroleum products. Crude oil usually contains a large amount of water as contaminant, and the primary product is a water"oil emulsion. Production of bitumen emulsions and boiler-furnace fuels is a common method of improving the fluidity of these highly viscous media.

Despite the previous extensive studies, the physicochemical mechanisms of formation of the internal structures of emulsions and the changes in these structures induced by different process parameters, the temperature in particular, have been very inadequately studied.

Most laboratory methods of investigation allow studying the structure of emulsions only in static conditions, i.e., when the liquid is at rest. Viscometric methods can be used to study the structure of emulsions in liquid streams, i.e., in conditions close to production conditions.

We previously showed [1, 2] that changes in the molecular structure not recorded by other experimental methods could be detected by measuring the viscosity of homogeneous petroleum liquids. We report the results of use of viscometry for investigating the properties and structure of emulsions on a petroleum base.

The samples of water"oil emulsions (25 vol. % interstitial water) were obtained directly from a Romashkino field well (Aznakaevskneft' Oil and Gas Production Administration). The dehydrated crude contained (by weight) 3.5% asphaltenes, 1.6% waxes, and 22% resins. After prolonged storage at room temperature, gravitational separation of the water and petroleum phases was observed, so that the emulsions were formed again before the laboratory measurements by intensive mixing at the given temperatures.

The bitumen emulsions were prepared from KhIMEKO concentrate containing (by volume) 50% asphalt, 40% water, and 10% different surfactants (SF) and stabilizers. According to the manufacturer's recommendation, the concentrate was diluted in the ratio of 1:1 with KORE solvent (bottoms from fractionation of ethylbenzene and styrene).

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