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RESEARCH

FEATURES OF INTERMEDIATE LAYER FORMATION IN WATER–OIL EMULSIONS

I. N. Evdokimov, N. Yu. Eliseev, and V. A. Iktisanov

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New data on the mechanisms of intermediate layer formation in petroleum emulsions are reported. The possibility of structural phase transitions preceding the inversion points of these multicomponent media was experimentally demonstrated. Many features of these transitions are similar to the phase transitions in model dispersions of the Winsor III type. In manufacturing processes, the formation of undesirable "intermediate layers' can be interpreted as the appearance of a bicontinuous phase at ratios of the volume fractions of water and crude close to unity.

In acceptance, storage, and preparation of crude oil for refining, important volumes of crude-containing sludges, which are valuable hydrocarbon feedstock, are formed [1], although they are traditionally considered a source of environmental pollution. Prolonged storage of crude mixed with stratal water, contact with atmospheric oxygen, the presence of solid particles and hydrophobized resins and asphaltenes and waxes favor the formation of such sludges as "intermediate layers," which are very stable petroleum emulsions [2].

More exhaustive studies of the mechanisms of formation of intermediate layers in oil emulsions are necessary to develop effective technologies for the utilization and processing of such sludges. We report the results of such studies here.

We investigated mixtures of crude oil and stratal water sampled from well 60 (Tula stratum) in the Aktanysh field. The stratal water phase had a density of ρ_w = 1153.9 kg/m^3 at 20°C, which corresponds to a salt content of close to 150 g/liter. The degassed petroleum phase had a density at 20°C of ρ_p = 902.2 kg/m^3 and a viscosity of 64.80 mm^2/sec and contained 5.59% waxes, 19.25% resins, 8.89% asphaltenes, and 3.68% sulfur.

The ratio of the total resin and asphaltene content to the wax content in the crude was equal to 5.03. Based on this index, the crude can be classified as high-resin crude [3]. In turn, based on the difference in the densities $r_w - \rho_p$ = 251.7 kg/m^3, the mixtures are classified as tending to form difficult to separate emulsions [4].

The properties of the water-oil emulsions were determined in the 5-50°C temperature range characteristic of the Aktanysh field. The volume fraction *x* of aqueous phase in the emulsions did not exceed 0.6.

I. M. Gubkin Russian State University of Oil and Gas. V. D. Shashin Tatar Scientific-Research Institute of Petroleum. Translated from *Khimiya i Tekhnologiya Topliv i Masel*, No. 4, pp. 37 – 39, July – August, 2005.

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