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STUDY IN THE IMPACT OF DISPERSANT ON PARAFFIN CRYSTALLIZATION USING THE METHOD OF DYNAMIC SCATTERING

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During field development paraffins dissolved in oil can be released in the form of solid phase by changing pressure and temperature. Oil flow in the formation and bottom hole zone are negatively affected by phase transition of reservoir oil. When oil flows through pipeline, separated solid phase deposits on pipe and pump equipment walls.

The main phase state characteristic of reservoir oil (liquid-solid phase) is a paraffin saturation temperature of oil. Solid phase formation depends on paraffinic hydrocarbons content in oil [1]. Special additional agents (dispersants and inhibitors) are used to regulate phase transitions. During the initial stage of paraffin crystal formation the additive molecules are embedded in its structure and limit the growth process. The choice of an additional agent is specific for each particular case because of its possible inverse effect [6].

The effect of C-5A dispersant on the transition phase behavior of the model system during cooling process is considered in this paper. To solve this problem, the dynamic light scattering (DLS) method [5] based on the registration and evaluation of photons was used. According to the theory, the measurement of the correlation fluctuation function in the stray light intensity makes it possible to determine the characteristic correlation time and then calculate the particle radius using the diffusion coefficient. The operation of "Photocor Complex" device is based on The DLS method [2]. The algorithm of the photon correlation spectrometer functioning was considered in [4].

The purpose of the experiment was to determine the radii of the solid phase particles formed during isobaric cooling of the system. C-5A dispersant of different concentrations (0.03%, 0.06% and 0.08% by weight) was added to the paraffin-heptane model system (4%, 6%, 10% by weight).

According to the study [1], the paraffin saturation temperature increases with the growth of paraffins concentration in oil. This fact was confirmed in [3], it was also determined that the growth of the additional agent mass leads to the increase in the intensity for all paraffin concentrations.

The solid particles formation temperatures in the initial system without additional agent were 7.9 ° C and 9.3 ° C respectively (for paraffin concentrations of 4% and 6% by weight, respectively). Figure 1 illustrates the results of solid particles formation in the system (paraffin concentration of 10% by weight) at the temperature of 45.3 ° C. The particle sizes vary from 10 to 150 nm.

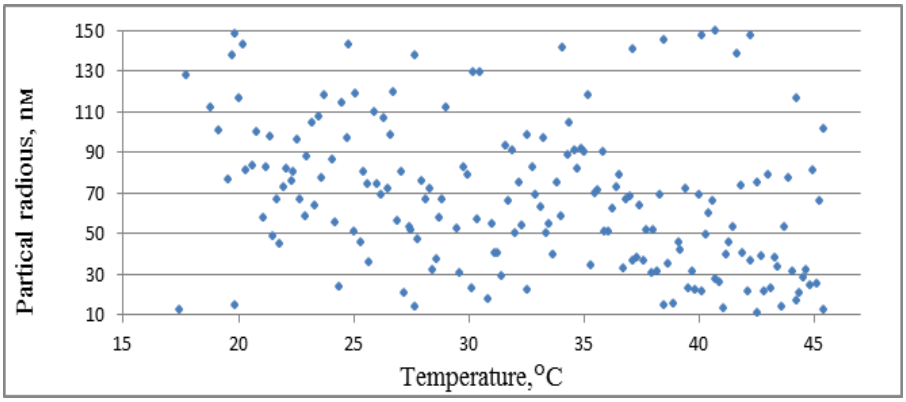

Fig.1 Particle size dependence on temperature (paraffin concentration of 10% by weight; without additional agent)

The action of the additional agent is illustrated by heptane with the paraffin concentration of 10% by weight. Adding the agent (0.03% by weight) to the initial system leads to the system reconfiguration and formation of various particles with radii from 10 to 65 nm (Fig. 2).

When the concentration of the additive increases to 0.06% by weight (Fig. 3), the range of the region of particles with small dimensions decreases from 10 to 45 nm.

When adding an additive 0.08% by weight to the system (Fig. 4), particle size stabilization is observed in the same range with a significant decrease in the number of coarse particles.

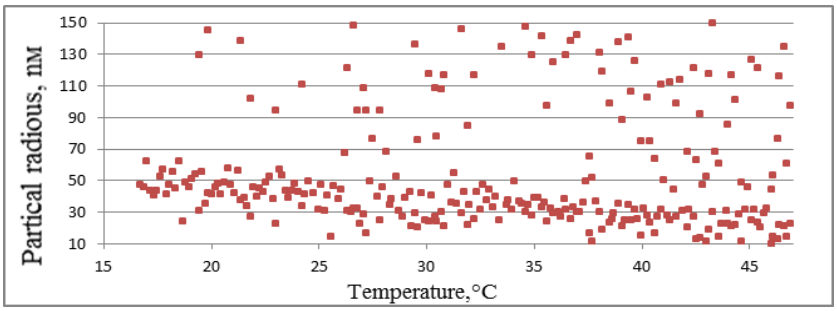

Fig.2 Particle size dependence on temperature (paraffin and additional agent concentrations in heptane are 10% and 0.03% by weight, respectively)

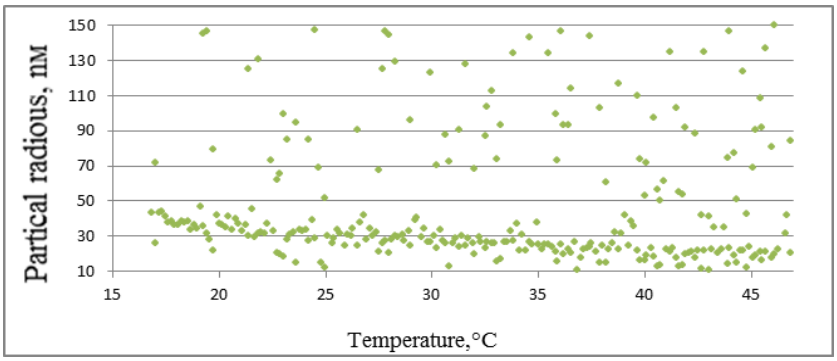

Fig.3 Particle size dependence on temperature (paraffin and additional agent concentrations in heptane are 10% and 0.06% by weight, respectively)

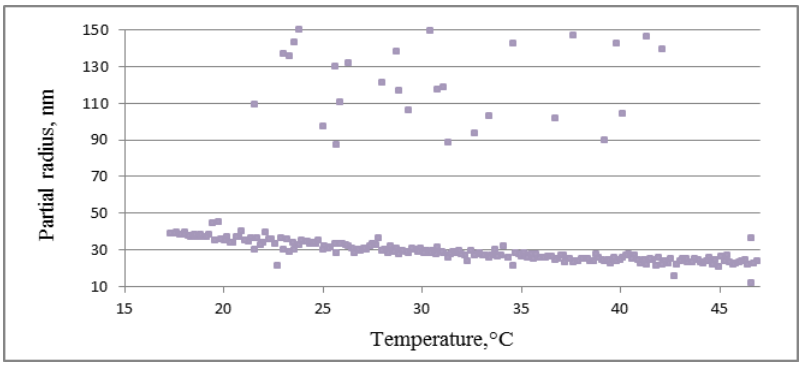

Fig.4 Particle size dependence on temperature (paraffin and additional agent concentrations in heptane are 10% and 0.08% by weight, respectively)

The above analysis has led to the following conclusions:

- the increase in paraffins concentration in research model system results in formation of solid phase particles under higher temperature conditions;

- C-5A dispersant limits the growth of particle size. This effect is the higher if concentration of dispersant is 0.08% by weight.

-This research method allows monitoring particles formation and structural changes in the system.

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