УДК 622.276.1

ВЛИЯНИЕ ВЫСОКОМОЛЕКУЛЯРНЫХ ПОЛИМЕРНЫХ СОЕДИНЕНИЙ НА СВОЙСТВА НАНОРАСТВОРОВ

EFFECT OF HIGH MOLECULAR POLYMER COMPOUNDS ON THE NANO-SOLUTIONS PROPERTIES

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Аннотация. На модели пласта проведены лабораторные исследования влияния давления на изменение объема пульпы, приготовленной на основе пироконденсатных реагентов и углеводородно-щелочных отходов, обогащенных полимерными соединениями.

Ключевые слова: лабораторные исследования; полимерные соединения; концентрация; степень аэрации, углеводородно-щелочные отходы (УЩО).

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Annotation. On the reservoir model, laboratory studies of the effect of pressure on the change in the volume of slugs prepared on the basis of pyrocondensate reagents and hydrocarbon-alkaline waste enriched with polymer compounds were carried out.

Keywords: laboratory research; polymer compounds; concentration; degree of aeration, hydrocarbon-alkaline waste (HAW).

It is known that many oil fields in Azerbaijan are at the late and final stages of development [1]. The reservoir pressure of these fields does not exceed 0.20…0.25 hydrostatic, the current oil recovery factor fluctuates in the range of 0.40…0.50, and the water cut of well production is 95…98%, although the subsoil contains tens of millions of tons of unrecovered oil. It would be economically unjustified to treat such reservoirs by conventional methods, since many of them have been developed mainly for depletion for a long period [2–4].

Laboratory studies of the influence of the concentration of high-molecular polymer compounds such as CMC-600, SKN-26, and polyisobutylene PIB-15·10^3 on the viscoelasticity of a hydrocarbon solvent (pyrocondensate) have been carried out. It has been established that at a concentration of these polymers in the pyrocondensate in the range of 0.9–1.5%, the viscous elasticity of the mixture increases from 5 to 14 times (as evidenced by the corresponding changes in the relaxation times and elastic moduli of the studied mixtures). The greatest increase in the viscoelasticity of the mixture is achieved when the pyrocondensate contains the CMC-600 polymer, and then this place is occupied by polyisobutylene and SKN-26 polymers.The effect of the polymer concentration on the change in the globule diameter and the stability of solutions prepared on the basis of the pyrocondensate solvent and hydrocarbon-alkaline waste (HAW) was studied. It was found that when 1.5% polymer CMC-600 is added into the composition of the pyrocondensate, the diameter of the mixture globule is $10^{-4}…10^{-5}$ mm, while the stability of mixtures is 260 and 250 s/sm^3 respectively. When SKN-26 and PIB-15 103 polymers are contained in the pyrocondensate, the diameter of the pyrocondensate mixture globule increases to $10^{-3}–10^{-4}$ mm, respectively, and the stability of the mixture is 254 and 248 s/sm^3, respectively. The HAW mixture globule diameter is $10^{-2}…10^{-3}$ mm, and stability is about 235 s/sm^3.

The effect of polymer additives on the globule diameter and the stability of solutions consisting of 1.5% polymer, 2% surfactant, 20% solvent and 76.5% water at an aeration degree of 40 was studied. Pyrocondensate, has a nanosize ($10^{-8}…10^{-9}$ mm) with a content of CMC-600, and the diameter of the globule of the solution prepared on the basis of HAW is $–10^{-5}…10^{-6}$ mm. In this case, the stability of the solutions of pyrocondensate and HAW was 274 and 260 s/cm^3, respectively. It has been established that the sizes of globules of solutions of pyrocondensate containing SKN-26 and PIB-15 10^3 are identical, and their stability is slightly different, amounting to 262 and 256 s/sm^3, respectively; the solution prepared on the basis of HAW containing SKN-26 and PIB-15·10^3 has a globule diameter of $10^{-3}...10^{-4}$ mm with a constant stability of 250 s/sm^3.

On the reservoir model, studies of the effect of pressure on the change in the volume of slugs prepared on the basis of pyrocondensate and HAW reagents and enriched with polymer compounds were carried out [5].

It has been established that the slug prepared on the basis of pyrocondensate has the ability to increase the oil displacement coefficient from the porous medium to 0.98 at 7...10% of the formation pore volume.

This is much more than the volume of the rim prepared on the basis of the HAW reagent. This is explained by the fact that the pyrocondensate solvent belongs to «highly active reagents» and, other conditions being equal, it is able to significantly improve the rheological properties of non-Newtonian oil than the HAW reagent.

The effect of pressure on the change in the volume of two-phase foams containing 2.0 and 2.5% sulfonic acid was studied at different degrees of aeration of the system. The results of studies carried out at 30°C are shown in the table.

At a relatively low degree of aeration (in particular, when the degree of aeration of the system is equal to 15 and 35), the decrease in the volume of two-phase foam occurs with a relatively lower intensity (see table).

This is explained by the fact that at a low degree of aeration, the system mainly consists of an aqueous phase.

With an increase in the degree of aeration, the volume of the gas phase significantly exceeds the liquid phase, which manifests itself in a decrease in the volume of foam.

It should be noted that when oil is displaced from a porous medium by a system developed on the basis of two-phase foams, especially when the system moves in a porous medium with a foaming agent - gas (air), the degree of its aeration exceeds 15 or even 40.

Table 1 – Influence of pressure on the change in the volume of two-phase foam, %

Two-phase foam composition,%		Degree of aeration of two-phase foam	Pressure, MPa						
Water	Surfactant		0	0,5	1,0	4,0	7,0	10,0	13,0
98,0	2,0	15	100	60	55	42	40,0	40,0	40,0
		35	100	55	40	31	6,0	2,0	2,0
		55	100	50	28	3,5	1,0	0,8	0,8
		75	100	45	28	3,0	0,4	0,3	0,3
97,5	2,5	15	100	62	56	39	37,0	37,0	37,0
		35	100	58	41	32	0,6	0,6	0,6
		55	100	54	24	2,0	0,5	0,6	0,2
		75	100	48	25	3,9	0,9	0,8	0,5

At a relatively high degree of aeration, which is in good correspondence with the practice of using foams, their volume undergoes a sharp change, and at a pressure of 4 or 7 MPa, their use as an agent that displaces oil from a porous medium is not recommended [6]. At a high degree of aeration (55 and higher), an increase in the pressure of the medium significantly affects the decrease in the volume of two-phase foam (see table).

This is especially observed at pressures of 4 MPa and above. For example, at a pressure of 4 MPa and an aeration degree of 55, the foam volume is only 2% of the initial one, and at a pressure of 7 MPa, it is only 0.5% of the initial one, and the foam passes into the micro-nuclear phase [7].

This is explained by the fact that the foam is an unstable system and when the pressure increases; its bubbles coalesce and, merging, burst, as a result, its volume decreases.

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