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RESEARCH ON THE EFFECTIVENESS OF THE COMBINED METHOD OF POLYMER AND WATER-GAS IMPACT ON OIL RESERVOIRS

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Summary. This paper focuses on the issue of effective technology for extracting high-viscosity oil from heterogeneous reservoirs. The study examines methods for enhancing oil recovery from depleted fields containing high-viscosity oil. Three different reservoir impact methods are analysed in this research. Two of these methods are well known in oil production practice: polymer flooding and oil displacement using a water-gas mixture. The results obtained from these experiments are compared with the outcomes of the proposed combined impact method. The experiments utilized oil with a viscosity of 205 mPa·s at 20°C. In all conducted experiments, the first stage involved oil displacement using distilled water. In the first scenario, after the initial stage, a slug of polymer solution was injected and subsequently pushed forward by distilled water. In the second scenario, a slug of polymer solution was injected and then displaced using a water-gas mixture. In the third scenario, after the initial stage, oil displacement continued by injecting a water-gas mixture into the porous medium. A comparative analysis of the conducted experiments showed that the worst result was obtained when only the polymer solution slug was used. The effectiveness of the combined impact technology based on a polymer solution slug with a 0.25% concentration and a water-gas mixture was found to be approximately equal to that of using only a water-gas mixture with a high water-gas ratio.

Introduction. Currently, the development of oil fields with complex geological structures and the physical-chemical properties of fluids saturated in productive reservoirs are carried out using active recovery methods.

The early detection of complications that arise under diverse geological and operational conditions in high-viscosity oil fields is a critical challenge. This is because each oil reservoir depending on the field differs significantly in terms of structural volume changes and technological parameters.

The widespread application of advanced oil recovery technologies aimed at effectively reducing residual oil saturation through the displacement of oil with viscous compositions will allow for the long-term maintenance of stable production levels in most fields with complex geological structures that are in the final stages of development. It has been proven that the viscosity of liquids can be controlled using various types of polymers. These substances are capable of altering the rheological properties of aqueous solutions and forming gel structures with varying densities (Kukin, Solyakov,1982; Polymers for Oil Production, accessed 2025; Shevtsov et al., 2001). A detailed analysis of studies has shown that polymer compositions have been used both to enhance oil recovery due to their flow-diverting properties and as water-isolating components in production wells (Babaev et al., 2016; Fyodorova et al., 2012; Manzhay et al., 2017; Thomas et al., 2017; Veliyev, 2020). The use of polymer solutions enables the implementation of various methods to reduce permeability or block the water-saturated porous structure. The reduction of water inflow into oil wells is due to the ability of polyacrylamide (PAA) to adsorb onto pore surfaces or form cross-linked polymer networks that hinder fluid filtration. It has been found that as the polymer concentration increases, the mobility of the solution decreases (Sparlin, 1976; Smith, 1970). Among the numerous studies confirming the effectiveness of polymer flooding, some indicate its low efficiency in the final stages of field development (Aleazar-Vara et al., 2016).

Many researchers have dedicated their work to the use of water-gas mixtures to increase oil production from fields developed in the later stages (Drozdov et al., 2007; Mullaev et al., 2016).

A detailed study of polymer and water-gas injection technologies (Mamalov et al., 2022) suggests their combined application.

The combination of polymer and water-gas injection allows the following results:

- Increased reservoir coverage due to better penetration of the polymer solution and foam into low-permeability zones;
- Enhanced oil displacement from the reservoir by reducing interfacial tension between oil and water, as well as forming more stable emulsions;
- Reduction of residual oil in the reservoir due to the formation of more stable emulsions and oil displacement by foam;
- Lower risk of fracture formation in the reservoir through more uniform pressure distribution;
- Improved waterflood efficiency by increasing the viscosity of the polymer solution.

Methods and Materials of the Study

To evaluate the effectiveness of the combined polymer and water-gas injection method, a series of experiments were conducted in this study. These experiments, which varied in terms of displacement agents, were performed using a reservoir model setup, as shown in Figure 1. The reservoir model length is 0.84 m, with a diameter of 0.025 m. The experiments used oil with a viscosity of 205 mPa·s at 20°C.

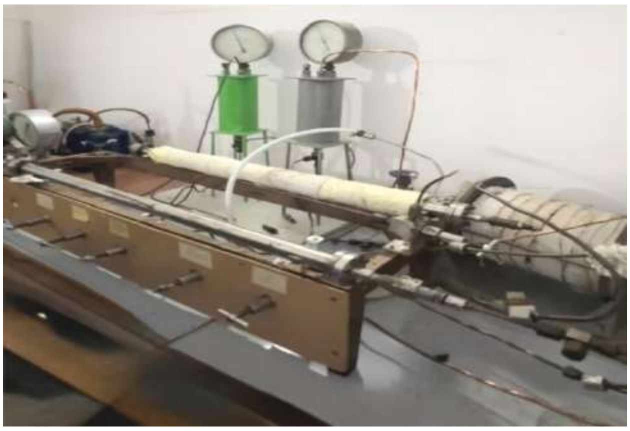

Fig. 1. Reservoir Model Setup

Quartz sand with a particle size of less than 0.2 mm was used as the porous medium. Polyacrylamide (PAA) was used as the polymer. The initial experimental data are presented in Table 1.

In experiments No.1 and No.2, oil displacement was carried out using only a PAA solution slug with different concentrations. In experiments No.3, No.4, and No.5, oil displacement was performed using PAA solutions of varying concentrations combined with a water-gas mixture. In experiments No.6 and No.7, after depletion mode, oil displacement was conducted solely with a water-gas mixture. The polymer slug volume was nearly identical in all experiments.

These studies were necessary to conduct a comparative analysis of the combined reservoir stimulation method.

Results and Discussion

Based on this analysis, the effectiveness of different stimulation methods for an oil reservoir developed after depletion was determined. Initially, two experiments were conducted to displace oil from a depleted reservoir using a polyacrylamide (PAA) slug.

The experiments were carried out in the following sequence: first, a depleted reservoir was formed (Stage I). It is important to note that in all experiments the initial oil displacement was performed using distilled water, thereby simulating the depletion phase of the reservoir.

To eliminate the influence of salts contained in natural waters, oil displacement from the reservoir model was carried out using distilled water.

The extraction process was halted after injecting 3-4 pore volumes of water or upon detecting signs of oil in the outgoing flow. At this stage, a significant amount of oil remained in the reservoir.

The results of the conducted experiments are presented in Table 2.

This Table presents the values of the oil recovery factor and residual oil saturation in all seven experiments after Stage I. The variation in the oil recovery factor and residual oil saturation across the experiments is influenced by the initial oil saturation of the porous medium. At the same time, a high water saturation of the porous medium is observed.

The results obtained after Stage I indicate the need for further development of the depleted reservoir, where significant oil reserves remain. To address this and potentially reduce the amount of water in the produced fluid from the reservoir model, it was decided to apply secondary recovery methods.

In our case, three reservoir stimulation options were considered. The first option involves oil displacement using a slug of PAA solution, which is mobilized by injecting distilled water. The second option examines a combined method, where a slug of PAA solution is injected into the reservoir and then displaced using a water-gas mixture. The third option considers oil displacement using only a water-gas mixture. A comparative analysis of these options will help determine the most effective approach.

Table 1

Initial Experimental Data

PARAMETERS \ EXPERIMENT №	1	2	3	4	5	6	7
Water Permeability, μm²	1.8	1.88	1.79	1.82	1.39	1.23	1.39
Oil Saturation, %	86.3	81.8	81.5	81.8	79.9	85.9	81.8
Water Saturation, %	13.7	18.2	18.5	18.2	20.1	14.1	18.2
PAA Solution Concentration, %	0.5	0.25	0.5	0.1	0.25	-	-
PAA Slug Volume, pore volumes	43.8	42.4	41.2	42.4	41.4	-	-

Table 2

Experimental results

PARAMETERS \ EXPERIMENT №	1	2	3	4	5	6	7
Oil recovery factor for stage I (without polymer injection), %	51.5	42	41.6	43.0	42	42	49.0
Final oil recovery factor, %	65.9	54.5	74.5	60.7	67	58.5	81.5
Additional oil recovery factor, %	14.4	12.5	32.9	17.7	25	16.5	32.5
Residual oil saturation after Stage I, %	41.7	50.1	47.6	44.8	40	48.1	40
Volume of produced water after Stage I, pore volumes	4	3.1	4	3.6	2.5	1.35	2.5
Volume of produced water after Stage II, pore volumes	2	2.4	1.6	3.4	5.6	1.36	5.6
Reduction in Water Cut, times	2	1.3	2.5	1.05	1.93	-	-
Residual Resistance Factor (average), R	2.6	1.3	6.7	2.4	3.8	-	-
Residual Oil Saturation after Stage II, %	29.4	37.0	20.8	32.1	26.0	35.9	15.2
Water-Gas Mixture, m^3/nm^3	-	-	0.008	0.013	0.009	0.0015	0.105
Viscosity of PAA Solution, mPa·s	188	38	188	12	38	-	-

Let's consider the first option. In this case, a slug of PAA solution with a concentration of 0.5% (experiment No. 1) and 0.25% (experiment No. 2) is injected into the reservoir. The PAA solution slug moves through the reservoir under the influence of distilled water. The viscosity of the PAA solution slugs depending on the concentration is significantly higher than that of water (Table 2). This leads to a reduction in the mobility of the injected water and partial adsorption of the polymer on the surface of quartz sand grains. As a result, the residual resistance factor increases, and the water production at the outlet of the reservoir model decreases. All of the above is well confirmed by Figure 2. Figure 2 shows the water production dynamics from the end of the depletion phase to the beginning of PAA solution slug injection.

As seen in Fig. 2, from the beginning of the injection of the PAA solution slug (τ = 3.5) until its completion (τ = 0.6), there is a sharp decrease in the amount of water in the produced fluid from the reservoir model. After the complete injection of the slug, a gradual increase in the produced water is observed. From the moment the PAA slug is injected into the reservoir, an increase in the amount of produced oil is observed in both cases.

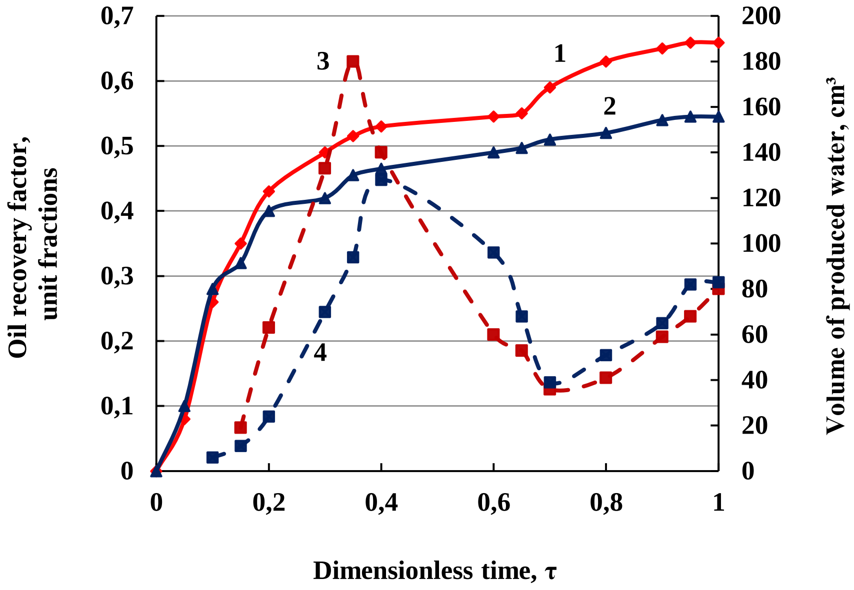

Fig. 2. Dynamics of the oil recovery factor (ORF) and water withdrawal from the reservoir model
1 and 3 – ORF and water withdrawal, respectively, in experiment No. 1,
2 and 4 – ORF and water withdrawal, respectively, in experiment No. 2,
$\tau = t_i / \sum t_i$, where t_i is the current time, h; $\sum t_i$ is the total process time, h

Injection of the PAA slug into the porous medium increases the residual resistance factor (R), which prevents water breakthrough at the outlet of the reservoir model, thereby reducing the water content in the produced oil. In Experiment No.1, the residual resistance factor (R) reached 2.6, while in Experiment No.2, it was 1.3. According to Table 2, the volume of water exiting the reservoir model decreased by a factor of 1.89 in Experiment No 1 and 1.29 in Experiment No.2.

As the PAA slug moves through the porous medium, polymer absorption and dilution occur leading to a decrease in solution viscosity. This results in partial water breakthrough increasing the volume of produced water and reducing oil recovery. The final oil recovery factor in Experiment No.1 was 65.9%, while in Experiment No.2, it was 54%. Higher PAA concentration improves process efficiency, as a more viscous PAA solution enhances water thickening and flow control. This confirms that increasing PAA concentration enhances the efficiency of the polymer flooding process, leading to better oil displacement and reduced water production.

The results of these experiments indicate the need to implement a new technology for more efficient oil recovery from the reservoir. Based on this, a combined technology was tested, which involves injecting a slug of PAA solution along with a water-gas mixture (in this case, air was used as the gas).

After completing oil displacement under depletion mode, the combined technology was introduced. In the second stage, during Experiments No.3, No.4, and No.5, a slug of PAA solution with concentrations of 0.5%, 0.1%, and 0.25% was injected into the reservoir. The slug volume ranged from 41.2% to 43.8% of the pore space (as shown in Table 2).

The polymer displacement through the reservoir was carried out using a water-air mixture. This mixture was chosen as the displacing agent due to its ability to form an emulsion within the reservoir.

The viscosity of the resulting emulsion differs from that of the injected water and, in particular, from that of air. Viscosity under reservoir conditions is a crucial parameter that influences the efficiency of polymer flooding. The higher the viscosity of the mixture, the better it displaces oil from the reservoir. However, if the viscosity is too high, it can cause difficulties in injecting the mixture into the reservoir.

Using the viscosity formula for the mixture provided in reference (Mamalov et al., 2022), we calculate the change in mixture viscosity depending on the water-gas ratio.

The following assumptions are made:

$$V_{g.r} = V_{g,\ n.c.}/P_r\ ;\ B = \sum V_{water} / \sum V_{g,\ n.c.}\ ,$$

where $V_{g,\ n.c}$ – is the gas volume under normal conditions, P_r – is the reservoir pressure, B – is the water-gas ratio, $\sum V_{water}$ – is the cumulative injected water volume, $\sum V_{g,\ n.c}$– is the cumulative injected gas volume under normal conditions. The calculation results are presented in Table 3.

Increasing the viscosity of the water-gas mixture can indeed contribute to more effective propagation of the polyacrylamide (PAA) solution slug.

As the volume of injected water decreases, the volumetric fraction of gas in the gas mixture increases. This leads to an increase in the viscosity coefficient of the mixture. A higher viscosity mixture can improve its ability to move efficiently through a porous medium, such as the PAA solution slug. Increased viscosity of the mixture can help achieve better control and uniform distribution of the PAA solution in the pores and fractures of rock formations, which in turn can enhance the efficiency of the treatment process or other operations.

At the same time, the volume of extracted water decreases. Figure 3 presents the dynamics of viscosity changes in the water-gas mixture depending on the water-gas ratio for the three conducted experiments. It can be noted that up to a certain limit of the water-gas ratio, the viscosity of the mixture increases, after which it reaches a stable state. The point at which stable viscosity values are established is determined by the content of the PAA solution.

Table 3

Results of calculations

Dimensionless time	$V_{g,\ n.c.}$ cm^3	$\sum V_{g,\ n.c}$ cm^3	V_{water} cm^3	$V_{g,r}$ cm^3	$(V_{g,r}+V_{water})$ cm^3	R_c	μ_{cm} mPa·s	$\sum V_{water}$ cm^3	B x10^{-3} m^3/nm^3
0.4	-	-	-	-	-	-			
0.6	-	-	-	-	-	0	0,7679	0	0
0.65	6000	6000	13	1875	1838	0.99	2.6	13	2.0
0.7	4000	10000	32	667	699	0.98	2.57	45	4.5
0.75	3000	13000	52	366	418	0.97	2.56	97	7.5
0.8	4000	17000	72	487	559	0.95	2.52	169	9.9
0.85	4000	21000	78	487	565	0.94	2.50	247	11.8
0.9	6000	27000	76	732	808	0.93	2.48	323	12.0
0.95	7000	34000	79	854	933	0.93	2.48	402	11.8
1.0	3000	37000	98	366	464	0.92	2.46	500	13.5

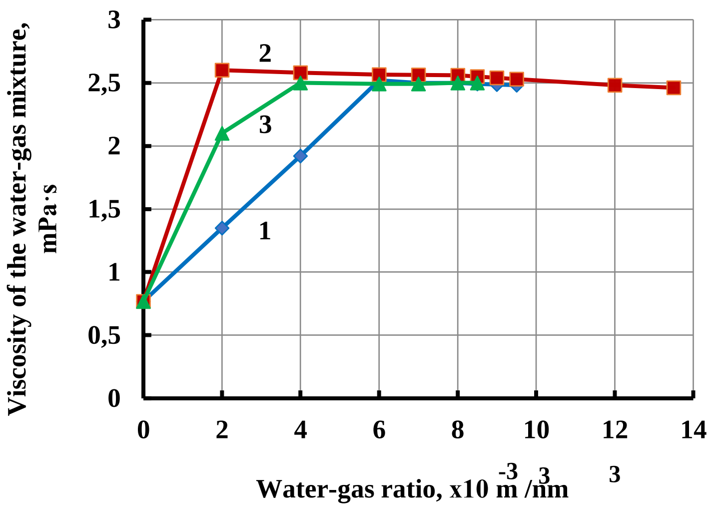

Fig. 3. Dependence of mixture viscosity on the water-gas ratio
1 – Experiment No.3 (C = 0.5%), 2 – Experiment No.5 (C = 0.25%),
3 – Experiment No.4 (C = 0.1%)

With a decrease in the solution concentration, its viscosity reaches the maximum value more quickly and then remains practically unchanged, even with a further increase in the water-gas ratio. This is likely due to differences in the residual resistance factor values observed in the experiments (Table 2). At a lower concentration, and consequently a lower residual resistance factor, a high-viscosity emulsion forms more quickly in the reservoir. Such an emulsion is less susceptible to thinning of the polymer slug retains its characteristics for a longer period, and thus contributes to more effective oil displacement even with low water injection rates. The viscosity of the mixture (usually with added polymers) can vary depending on the water-gas ratio. The water-gas ratio determines the proportion of gas to water in the mixture. As the water-gas ratio increases, the viscosity of the mixture typically decreases. This occurs due to the reduction in interactions between polymer molecules (or other additives) in the mixture, as water is diluted by gas. Increasing the water-gas ratio can enhance the process efficiency for several reasons:

A decrease in mixture viscosity is usually associated with an increase in rock permeability. This can facilitate better penetration of the mixture (containing polymers and other additives) into the rock, ultimately enhancing the efficiency of the oil extraction process.

At lower viscosity, the mixture can be more evenly distributed within the reservoir, promoting more uniform and efficient oil recovery.

Lower viscosity also requires less energy for movement through the reservoir, allowing the mixture to penetrate the rock more easily, which can increase the oil production rate.

Reducing mixture viscosity by increasing the water-gas ratio can enhance the efficiency of the oil recovery process. However, other factors such as reservoir structure, polymer type, well operation parameters, and specific conditions must also be considered to optimize the process and achieve the best results.

Injection of a polymer solution and a water-gas mixture helps create resistance to fluid filtration in the porous medium. Based on the obtained results, the dynamics of the residual resistance factor were determined for each experiment. Figure 4 presents the dynamics of the residual resistance factor for the three considered experiments (No. 3, 4, 5).

At the beginning of the filtration process, the resistance factor is high because the fluid penetrates the porous medium and fills the pores. Then, the resistance factor decreases as the fluid begins to displace gas or oil from the porous medium. Eventually, the resistance factor increases again as the porous medium becomes saturated with fluid, making further fluid movement more difficult. The graph of the resistance factor versus dimensionless time is used to evaluate the efficiency of the filtration process in the porous medium. It is also applied to predict the pressure required to maintain a specific fluid flow rate in the porous medium.

In Fig. 5, the dynamics of the oil recovery factor and the water-gas ratio are presented. As seen in the figure, with the initiation of water-gas mixture injection into the porous medium, a sharp increase in the amount of displaced oil is observed. The combined effect of the PAA solution mechanism and the water-gas mixture enhances the filtration capacity of the injected fluids.

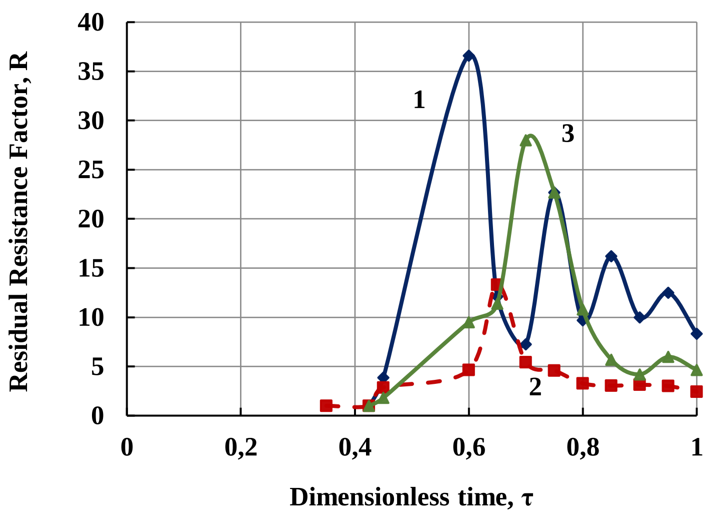

Fig. 4. Dependence of the resistance factor on dimensionless time
1 – Experiment No.3 (C=0.5%), 2 – Experiment No.4 (C=0.1%),
3 – Experiment No.5 (C=0.25%)

It is important to note the well-known fact that an increase in the polymer concentration in the slug leads to a corresponding increase in the oil recovery factor. In Experiment No.4, with a polymer concentration of C=0.1%, the oil recovery factor (ORF) reached 60.7% (with an additional oil production of 17.7%); in Experiment No.5, with C=0.25%, the ORF was 67% (25% additional recovery); and in Experiment No.3, with C=0.5%, ORF – 74.5% (32.9%).

Thus, it is clearly evident that the combined application of the polymer solution slug and the water-gas mixture is more effective than using only the polymer solution. In the third series of experiments, oil displacement after the depletion phase was studied using a water-gas mixture. The residual oil saturation after Stage I was:

Experiment No.6 – 48.1%

Experiment No.7 – 40%

To obtain additional oil recovery, a water-gas mixture was injected into the reservoir. The viscosity of this mixture differs significantly from that of water, which enhances oil displacement. According to the formula provided in reference (Mamalov et al., 2022), the viscosity of the water-gas mixture depends on the volumetric fraction of air (gas) in the water-gas mixture (R). Figure 6 presents this dependency for all experiments. The figure demonstrates a linear relationship. Under combined treatment conditions, the viscosity curve as a function of the gas fraction is positioned higher than the viscosity obtained from oil displacement using only the water-gas mixture. The presence of a high-viscosity polymer solution in the reservoir likely contributes to a partial increase in the viscosity of the water-gas mixture. The dependency of viscosity on the volumetric gas fraction (R) during combined treatment falls within a narrow range of variation.

At a certain water-gas ratio, the viscosity of the mixture reaches stabilisation. The average stabilised viscosity of the water-gas mixture in the experiments was 2.5 mPa·s. Moreover, when the water-gas ratio exceeds 0.006 m^3/nm^3, the viscosity remains stable for all concentrations (Fig. 3).

Additionally, some portion of the gas (air) in the mixture may break through into the oil zone dissolving in it and reducing its viscosity. This process enhances the efficiency of oil displacement from the porous medium. The final oil recovery factor was 58.5% in Experiment No.6 and 81.5% in Experiment No.7. The additional oil recovery amounted to 16.5% in Experiment No.6 and 32.5% in Experiment No.7.

The research results indicate that the higher the viscosity of the mixture (i.e., the higher the water-gas ratio), the more effective the process.

Further the comparative analysis will be provided. Figure 7 presents the dynamics of oil recovery and water-gas mixture displacement of three experiments (Nos.1, 3, and 7), taken as examples from each variation. The starting point for comparison is the moment when oil displacement is ceased by distilled water (Stage I, i.e., depletion drive).

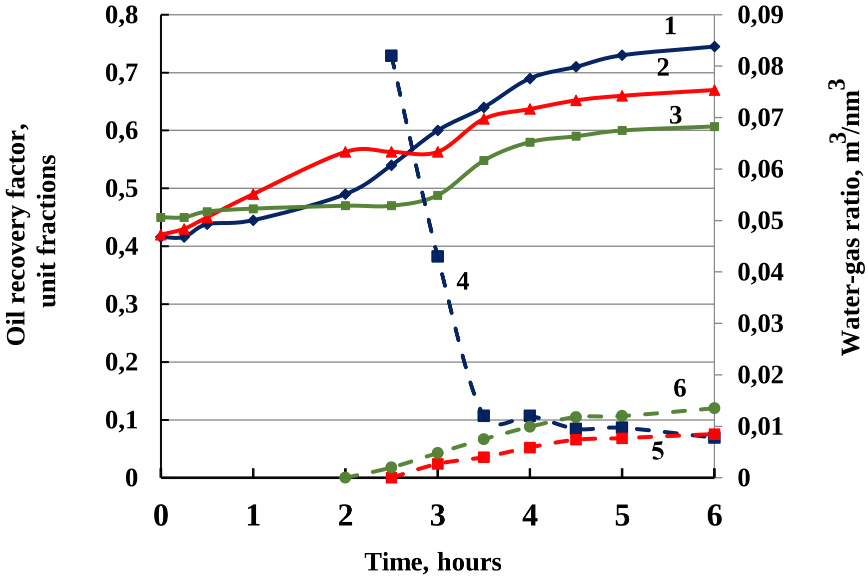

Fig. 5. Dynamics of changes in the oil recovery factor (ORF) and the water-gas ratio
1 and 4 – ORF and water-gas ratio for Experiment No.3, respectively;
2 and 5 – ORF and water-gas ratio for Experiment No.5, respectively;
3 and 6 – ORF and water-gas ratio for Experiment No.4, respectively.

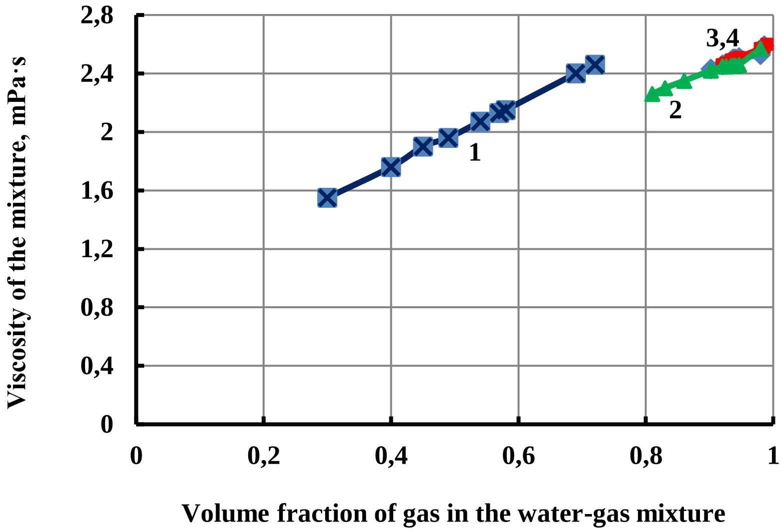

Fig. 6. Dependence of mixture viscosity on the gas volume fraction in the water-gas mixture under reservoir conditions
1 – Experiment No.7; 2 – Experiment No.3; 3 – Experiment No.5; 4 – Experiment No.4

The figure shows that during oil displacement with a polymer solution slug (curve 1) oil recovery increases gradually. However, in experiments No.3 and No.7, once the water-gas mixture is injected, the rate of oil production accelerates significantly. Consequently, the oil recovery factor increases. The highest final oil recovery factor is observed when only the water-gas mixture is injected, while the lowest is observed during displacement using only the polymer solution slug.

At first glance, oil displacement by the water-gas mixture appears to be the most efficient method. However, when comparing the actual increase in recovered oil, the water-gas method (32.9%) and the combined method using a 0.5% polymer solution slug followed by a water-gas mixture (32.5%) show nearly identical effectiveness. This is likely due to variations in the initial residual oil saturation at the beginning of the process.

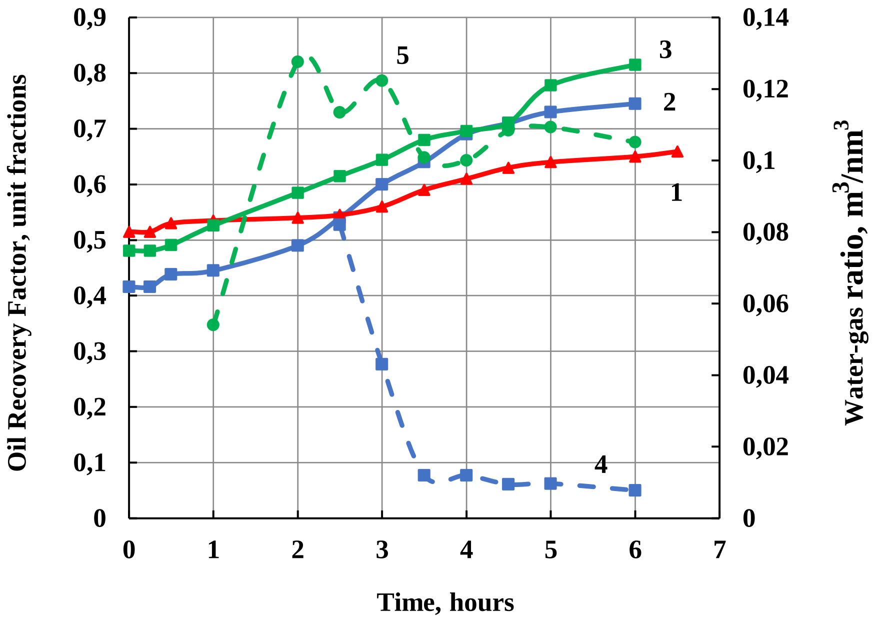

Fig. 7. Dynamics of Oil Recovery Factor (ORF) and Water-Gas Ratio (WGR)
1 – ORF of experiment No.1 (oil displacement by a polymer solution slug with C=0.5%);
2 – ORF of experiment No.3 (oil displacement by a polymer solution slug with C=0.5% and WGR);
3 – ORF of experiment No.7 (oil displacement by a water-gas mixture);
4 – WGR of experiment No.3;
5 – WGR of experiment No.7.

Conclusions

A comparative analysis of the conducted studies showed that the process of combined oil displacement (polymer + water-gas mixture) and oil displacement using a water-gas mixture are the most promising methods. By adjusting the polymer solution concentration and the water-gas ratio, the best results can be achieved. The experiments confirm the potential to improve the oil recovery factor in high-viscosity oil fields using the proposed methods.

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ИССЛЕДОВАНИЕ ЭФФЕКТИВНОСТИ КОМПЛЕКСНОГО МЕТОДА ПОЛИМЕРНОГО И ВОДОГАЗОВОГО ВОЗДЕЙСТВИЯ НА НЕФТЯНЫЕ ПЛАСТЫ

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Резюме. Данная статья посвящена эффективной технологии добычи высоковязской нефти в неоднородных пластах. В работе рассматриваются вопросы увеличения нефтеотдачи с истощенных месторождений, содержащих высоковязкую нефть. В работе изучаются три варианта метода воздействия на нефтяной пласт. Два метода хорошо известны в нефтяной практике. Это полимерное заводнение и вытеснение нефти водогазовой смесью. Результаты, полученные в этих экспериментах, сравниваются с результатами предлагаемого комбинированного метода воздействия. Суть комбинированного метода в следующем. В пористую среду нагнетается оторочка раствора полиакриламида разной концентрации. Перемещение оторочки осуществляется нагнетанием водогазовой смеси (в наших исследованиях в качестве газа использовался воздух). Экспериментальные исследования производились на однородной модели пласта длиной 0,84 м и диаметром 0,025 м. В качестве пористой среды брался кварцевый песок с фракцией ≤0,20 мм. В экспериментах использовалась нефть вязкостью 205мПа*с при 20°С. Во всех проведенных экспериментах на первом этапе осуществлялось вытеснение нефти дистиллированной водой. В первом варианте после первого этапа произвели закачку оторочки раствора полимера с последующим проталкиванием ее дистиллированной водой, во втором варианте – закачку оторочки раствора полимера с последующим проталкиванием ее водогазовой смесью. В третьем варианте дальнейшее вытеснение нефти после окончания первого этапа продолжили нагнетанием в пористую среду водогазовой смеси. Сравнительный анализ проведенных исследований показал, что худший результат получен при использовании только оторочки раствора полимера. Эффективность применения комбинированной технологии воздействия на основе оторочки раствора полимера с концентрацией 0,25% и водогазовой смесью и применение только водогазовой смеси с высоким водогазовым отношением примерно одинаковы.

Ключевые слова: *полимер, концентрация, раствор, водогазовая смесь, коэффициент извлечения нефти*

NEFT LAYLARINA POLİMER VƏ SU-QAZ TƏSİRİNİN KOMPLEKS ÜSULUNUN EFFEKTİVLİYİNİN TƏDQİQİ

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Xülasə. Bu məqalə qeyri-bircins laylarda yüksək özlülüklü neftin çıxarılmasının effektiv texnologiyasına həsr olunmuşdur. İşdə yüksək özlülüklü tükənmiş yataqlardan neftvermə əmsalının artırılması məsələlərinə baxılır. İşdə neft layına təsir üsulunun üç variantına baxılmışdır. Bunlardan iki üsul neft praktikasında yaxşı tanınır. O üsullardan biri neftin laydan polimerlə, digəri isə neftin su-qaz qarışığı ilə sıxışdırılması üsuludur. Bu üsullarla təcrübələr aparılmış və alınan nəticələr laya kombinə edilmiş təsir üsulu ilə alınmış nəticələrlə müqayisə edilmişdir. Kombinə edilmiş üsulun mahiyyəti aşağıdakılardan ibarətdir. Müxtəlif konsentrasiyalı poliakrilamid məhlulu məsaməli mühitə vurularaq val yaradılır və onun yerdəyişməsi su-qaz qarışığının vurulması ilə həyata keçirilir (tədqiqatlarda qaz əvəzinə havadan istifadə edilmişdir). Eksperimental tədqiqatlar 0,84 m uzunluğunda və 0,025 m diametrində homogen təbəqə modelində aparılmışdır və ≤ 0,20 mm fraksiyalı kvars qum məsaməli mühit kimi götürülmüşdür. Təcrübələrdə 20^o C-də 205mPa*s özlülüklü neftdən istifadə edilmişdir. Aparılan bütün təcrübələrdə birinci mərhələdə neftin distilə edilmiş su ilə sıxışdırılması həyata keçirilmişdir. Birinci mərhələdən sonra, polimer məhlulu uyğun olaraq distilə edilmiş su və su-qaz qarışığı ilə sıxışdırılmışdır. Üçüncü variantda birinci mərhələ başa çatdıqdan sonra neftin sıxışdırılması su-qaz qarışığının məsaməli mühitə vurulması ilə davam etdirilmişdir. Aparılan tədqiqatların müqayisəli təhlili göstərdi ki, ən pis nəticə yalnız polimer məhlulunun valından istifadə edildikdə əldə edilir. 0,25% konsentrasiyalı polimer məhlulu və su-qaz qarışığı əsasında kombinəli təsir texnologiyasının tətbiqinin effektivliyi və yüksək su-qaz nisbəti ilə yalnız su-qaz qarışığının tətbiqi təxminən eynidir.

Açar sözlər: *polimer, konsentrasiya, məhlul, su-qaz qarışığı, neftvermə əmsalı*