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THE EFFECTIVENESS OF USING PHYSICAL IMPACT ON THE PRODUCTIVE FORMATION TO INCREASE OIL RECOVERY

Annotation. This article assessed the technical and economic efficiency of using physical impact on the productive formation in one of the fields in Western Kazakhstan. World experience in using this technology in fields testifies to its high technological efficiency. To optimize oil production, changes in oil viscosity, increase in oil production, and decrease in water content were analyzed. All Cretaceous horizons are characterized by good reservoir properties. The high viscosity of oil and insufficient cementation of the rocks forming the horizons significantly limit the complete extraction of the valuable product. The precise determination of phase permeabilities in the oil-water system was carefully carried out in controlled laboratory conditions during stationary filtration. As a result of the effective use of physical impact, the viscosity of oil decreased by almost half, from 700 cP to 480 cP, which helps notably to increase oil production and reduce the water content in the produced products.

Keywords. physical impact, viscosity, oil recovery factor, technical and economic efficiency, physical impact technology, geological and technical event

Cretaceous horizons are confined to Neocomian terrigenous deposits of the Lower Cretaceous, Jurassic - to terrigenous deposits of the Middle Jurassic.

In the Cretaceous deposits, 3 oil horizons were identified, lying at a depth of 190-300 m (Fig. 1).

All Cretaceous horizons have good reservoir properties, however, the high viscosity of oil and weak cementation of the rocks composing the horizons do not allow full extraction of the product.

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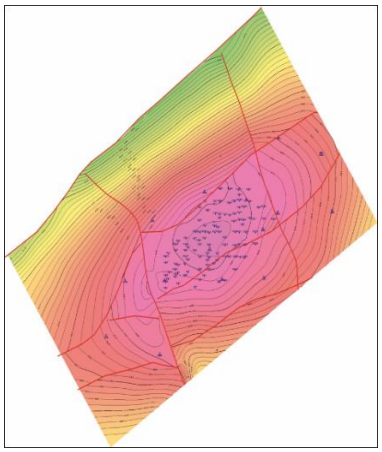

Figure 1 - Reflective horizon at the base of the Cretaceous deposits

The discussion of the results

The Yu-II horizon, taking into account new data from newly drilled wells, is divided into two layers Yu-II-A and Yu-II-B. Within the Yu-III horizon, two layers can also be traced; the upper Yu-III-A layer is associated with an oil deposit, the lower Yu-III-B is an aquifer.

A special feature of this deposit is its fluid system. Table 1 shows the properties of oil from all horizons.

Oil class in terms of sulfur content, oils from all productive horizons belong to class 1 with a concentration of 0.10-0.43% by weight and are low-sulfur.

In terms of oil density, all productive horizons are classified as both heavy and bituminous oils. The average value over the horizons varies between 876-917 kg/m3 (types 2, 3). In terms of paraffin content, oils from all productive horizons are low-paraffin and paraffinic (U-III-A). The average paraffin value across the horizons ranges from 0.49-2.08 wt%. In terms of tar content, oils from all productive horizons are classified as low-resin. The average resin content across horizons is in the range of 6.4-14.3% wt.

Based on viscosity values above 200 mPa•s, oil is classified as highly viscous or super viscous oil (Table 1). The dependence of the viscosity of reservoir oil on the density of reservoir oil was plotted (Fig. 2).

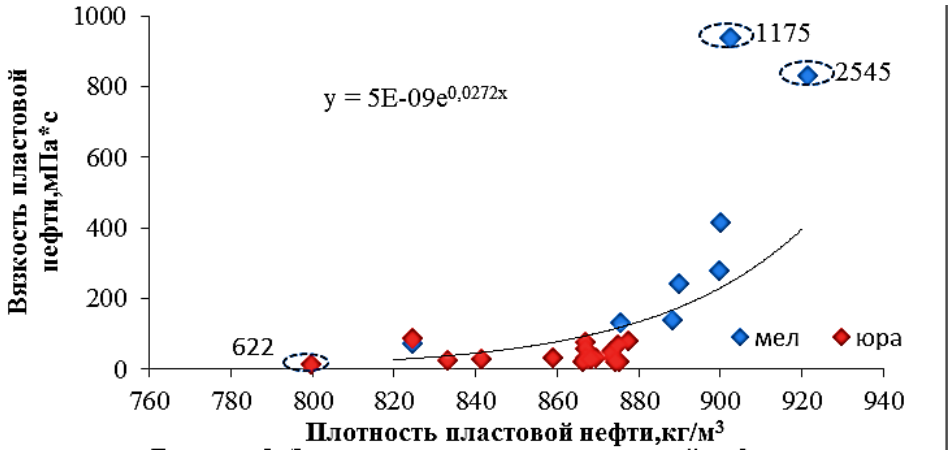

Figure 2 - Dependence of reservoir oil viscosity on reservoir oil density

Figure 3 shows the change in oil density with depth, i.e. As the depth decreases, the oil becomes heavier. This is also confirmed by other parameters: gas content, viscosity.

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The determination of phase permeabilities in the oil-water system was carried out in laboratory conditions with joint stationary filtration. Oil was used with the following parameters: for chalk deposits with viscosity □н = 48 mPa•s and density □н = 0.91 g/cm3 at Tm = 25ºC; for Jurassic deposits with viscosity □н = 30 mPa•s and density ρн = 0.878 g/cm3 at Tm = 30ºC.

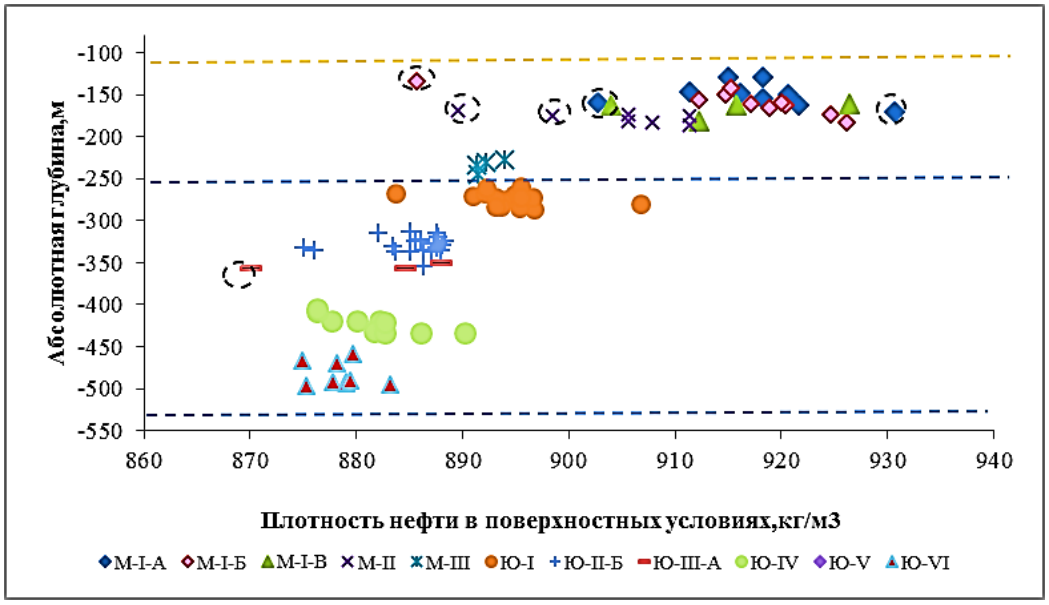

Figure 3 - Change in oil density with depth

The results of determining the RPP of model 1 are given in Table 1 and Figure 4, from which we can conclude that the reservoirs of both Cretaceous and Jurassic deposits are hydrophilic.

For Cretaceous deposits, 1 model was studied using samples from the M-II horizon - the residual water saturation is 23.1%, the residual oil saturation is 36.7%, and the displacement coefficient is 52.3%.

Table 1 - Results of determining the RPP in the oil-water system using model No. 1

Mode No.	Fluid fraction in the flow, %		Saturation, fractions of units		Phase permeability, μm2*10-3	
	oil	water	oil		oil	water
1	0	100	0	1	0	3021.38
2	100	0	0.769	0.231	2818.45	0
3	75	25	0.694	0.306	2209.7	14,092
4	50	50	0.645	0.355	1739.01	31
5	25	75	0.592	0.408	1319.1	70.46
6	10	90	0.526	0.474	808.91	129.65
7	5	95	0.477	0.523	532.7	183.2
8	0	100	0.367	0.633	0	763.81

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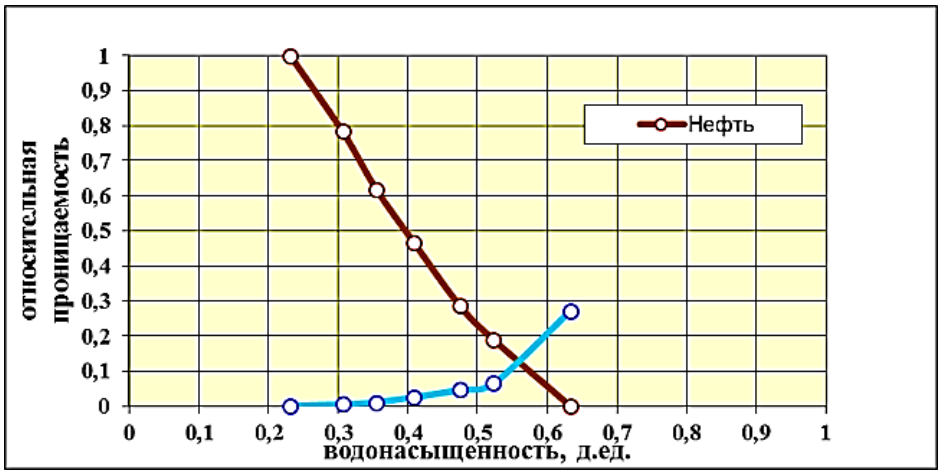

Figure 4 - Relative phase permeabilities “oil-water” (chalk)

The exploitation of the field in this area is carried out using mechanized methods, such as ultrasonic and electromagnetic influence, due to the high viscosity of oil and the presence of sand impurities. To ensure uniform production, it is customary to use a grid of wells with the same location at a distance of 200x200 meters and a nine-point area flooding system. The discharge pressure is set at 8 MPa.

For certain objects, an area nine-point inverted development system is used, while for others a focal system is used. The current oil recovery factor (ORF) for one of the facilities is 0.01, while the approved design oil recovery factor is 0.359. Chalk deposits are characterized by the lowest rates of selection.

Simple economic calculations were carried out to assess the effectiveness of geological and technical measures based on data from one well. It is worth noting that the costs of these activities are represented only by the cost of their implementation.

It is assumed that geological and technical activities will be carried out within 12 hours, which also takes into account the downtime of the well for major repairs. The mobilization of equipment and crew rates are also considered.

Table 2 - Efficiency of geological and technical measures

GTM parameters	We're standing.	Unit change	Col. Prov.
Cost of wire 1 geological and technical team	11500000	tg	2
Mobile equipment consumables	520000	tg	4
Cattle brigade	5000	Doll.	
Mobile Workover equipment	5000	Doll.	
Downtime 1 well	-410000	tg	2
Implementation 1 ton of oil	50000	tg/tn	
Profit from sales of products.	56305343.04	tg	
Net profit	35 395 343	tg.	

Conclusions. Based on the results of the analysis of the use of methods of physical impact on the field, the following conclusions can be drawn: these methods have the potential to destroy the structures of oil associates and reduce the viscosity of oil; they have a high technological level, which makes it possible to increase the oil recovery factor and reduce the

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volume of water during field development, especially in the later stages of development. The maximum efficiency of these methods is achieved in shallow multilayer fields (depth up to 2000 m). As a result of the application of physical impact, the viscosity of the oil decreased by almost half, from 700 cP to 480 cP, which led to an increase in oil production and a decrease in water content. Thanks to simple economic calculations, the effectiveness of this geological and technical measure was assessed based on data from one well.

REFERENCES

1. Apasov T.K., Apasov G.T., Sarancha A.V. Using vibration wave action to restore well productivity. Modern problems of science and education. – 2015. – No. 1-1;
2. Mullakaev MS, Abramov VO, Abramova AV Development of ultrasonic equipment and technology for well stimulation and enhanced oil recovery. Journal of Petroleum Science and Engineering. 2015. Vol. 125. P. 1-8.
3. MS Mullakaev, VO Abramov, AV Abramova. Ultrasonic piezoceramic module and technology for stimulating low-productivity wells. Journal of Petroleum Science and Engineering. 2017. Vol. 158. - P. 529 - 534.
4. V.E. Andreev, G.S. Dubinsky, A.V. Chibisov, R.T. Akhmetov, S.A. Yaskin, V.V. Mukhametshin, A.R. Khafizov. Grouping of development objects when designing measures to enhance oil recovery. Oil and gas business. - 2015. T. 13. -No. 4. -S. 89-96.
5. Report Oil and gas industry of the Republic of Kazakhstan. KASE. July, 2019
6. Gradov, O.M. Optimization of control of ultrasonic processing of oil reservoir material in the process of acoustic stimulation of wells. Materials Science. - 2015. - No. 4. - P. 11-17.
7. MS Mullakaev., GI Volkova. Sonochemical technology for reduction on the viscosity temperature properties of crude oils of various compositions. Journal of Petroleum Science and Engineering. 2018.
8. Lesin V.I., Klepikov I.A. Application of the fractal theory of viscosity of dispersed systems to the anomalous dependence of viscosity on shear rate. Oil industry. - 2015. No. 2. P. 38-41.

D.N. Musina, B.R. Vaganov, O.Yu. Sladovskaya. Modern technologies for enhanced oil recovery based on surfactants. Bulletin of Kazan Technological University. – 2016. – T. 19. – No. 12. – P.63-67

ЭФФЕКТИВНОСТЬ ПРИМЕНЕНИЯ ФИЗИЧЕСКОГО ВОЗДЕЙСТВИЯ НА ПРОДУКТИВНЫЙ ПЛАСТ ДЛЯ УВЕЛИЧЕНИЯ НЕФТЕОТДАЧИ ПЛАСТОВ

Аннотация. В данной статье была проведена оценка технико-экономической эффективности применения физического воздействия на продуктивный пласт в одном из месторождений Западного Казахстана. Мировой опыт использования данной технологии на месторождениях свидетельствует о её высокой технологической эффективности. Для оптимизации добычи нефти были проанализированы изменения вязкости нефти, увеличение объема добычи нефти и снижение содержания воды. Все меловые горизонты характеризуются хорошими коллекторскими свойствами. Однако высокая вязкость нефти и недостаточная сцементированность пород, образующих горизонты, ограничивают полное извлечение продукта. Определение фазовых проницаемостей в системе "нефть-вода" проводилось в лабораторных условиях при стационарной фильтрации. В результате применения физического воздействия вязкость нефти

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снизилась практически в два раза, с 700 сПз до 480 сПз, что способствует увеличению добычи нефти и снижению содержания воды в добываемой продукции.

Ключевые слова. физическое воздействие, вязкость, коэффициент извлечения нефти, технико-экономическая эффективность, технология физического воздействия, геолого-техническое мероприятие

МҰНАЙ ӨНДІРУДІ АРТТЫРУ ҮШІН ӨНІМДІ ҚАБАТҚА ФИЗИКАЛЫҚ ӘСЕР ЕТУДІҢ ТИІМДІЛІГІ

Аңдатпа. Бұл мақалада Батыс Қазақстан кен орындарының бірінде өнімді қабатқа физикалық әсерді қолданудың техникалық-экономикалық тиімділігіне бағалау жүргізілді. Бұл технологияны кен орындарында қолданудың әлемдік тәжірибесі оның жоғары технологиялық тиімділігін көрсетеді. Мұнай өндіруді оңтайландыру үшін мұнай тұтқырлығының өзгеруі, мұнай өндірісінің ұлғаюы және судың азаюы талданды. Барлық бор горизонттары жақсы коллекторлық қасиеттерімен сипатталады. Алайда, мұнайдың жоғары тұтқырлығы және Горизонт түзетін тау жыныстарының цементтелмеуі өнімнің толық өндірілуін шектейді. "Мұнай-су" жүйесіндегі фазалық өткізгіштіктерді анықтау стационарлық сүзу кезінде зертханалық жағдайда жүргізілді. Физикалық әсерді қолдану нәтижесінде мұнайдың тұтқырлығы іс жүзінде екі есе төмендеді, 700 сПз-ден 480 сПз-ке дейін, бұл мұнай өндіруді ұлғайтуға және өндірілетін өнімдегі су құрамын төмендетуге ықпал етті.

Кілт сөздер. физикалық әсер ету, тұтқырлық, мұнай алу коэффициенті, техникалық-экономикалық тиімділік, физикалық әсер ету технологиясы, геологиялық-техникалық іс-шара