МРНТИ 52.47.27

ANALYSIS OF CONDITIONS FOR INCREASING THE INTENSITY OF VISCOUS OIL PRODUCTION

KAINENOVA T.S[1[0000-0001-8750-5703]*], **SULTANOVA D.D**[1[0000-0002-9707-3884]], **ZHANABAYEV M.A**[1[0000-0001-8522-3454]], **KOSMBAEVA G.T**[1 [0000-0001-5797-9676]]

[1] K. Zhubanov Aktobe Regional University, Aktobe, Kazakhstan

[*]kaynenova83@mail.ru

Abstract. Since oil and gas products currently act as the main source of fuel in energy consumption, promising approaches to the development of reservoir heavy oil play an important role. Many existing traditional oil production methods do not give the desired results in the production of viscous oils, and in some cases are unacceptable.

A sharp decrease in extracted oil reserves is caused by an increase in the volume of difficult - to-extract oil, an increase in fields with complex geophysical conditions, and an increase in carbonate reservoirs with high viscosity. In order to increase the technical and economic indicators of the oil being developed under such conditions, the main task is to find new equipment and technologies for influencing the formation, its introduction into production.

The study of the geological and physical properties of the treated layer allows us to consider new highly cost-effective technologies for increasing the productivity of high-viscosity oil by paying attention to the factors involved in the production process.

The article discusses studies of increasing productivity through the use of carbon dioxide in viscous oil fields, features of the described method, changes due to various parameters.

Key words: high-viscosity oil, production, enhanced oil recovery, carbon dioxide, solubility coefficient, field development, technologies.

Introduction. Due to the depletion of easily extracted oil reserves, it is becoming increasingly important to improve technologies and development methods that allow the production of hydrocarbons in difficult conditions. In connection with such trends, engineers are studying and introducing innovative, promising approaches to intensifying oil production into production. In connection with such trends, engineers are increasing the intensity of oil production, studying and introducing innovative, promising approaches to production. One such method is to move the oil by injecting carbon dioxide (CO_2) into the layer. On the basis of the method, the mechanisms of Physico-Chemical interaction of carbon dioxide with water, oil and rock are studied and the features of increasing the intensity of oil production at the research stages are determined in comparison with other methods [1,2].

Material and research methodology. The peculiarity of using carbon dioxide injection technology is that in comparison with other gases, CO2 is more soluble in oil and reservoir water, and carbon dioxide contributes to an increase in the volume of oil, which, in turn, contributes to the

displacement of stationary, residual oil in the reservoir, as well as a decrease in the interphase voltage at the oil-water border [3].

The ability of carbon dioxide to dissolve in oil is higher than the ability to dissolve in water, and during the process, this ability allows the bulk of CO2 to pass into the oil. By comparing the solubility values of CO2 in water and hydrocarbons, the following data were achieved.

Table 1.

Solubility capacity of carbon dioxide in oil and water

Gas name	Solubility coefficient value ($37\ ^0C$; 1 KgF / cm^2), cm^3 / cm^3		Distribution coefficient
	In Hydrocarbons	In Water	
Carbon dioxide	1,28	0,57	2,2

Results and discussion of it. The higher the carbon dioxide content in the water, the greater the oil displacement. In addition, the degree of solubility of carbon dioxide in water is also influenced by the mineralization of water, that is, the solubility of CO2 in water decreases with increasing degree of mineralization. The main parameters for solubility are also influenced by pressure and temperature. A change in the solubility of carbon dioxide in water, which depends on various technological parameters, is clearly observed in the following diagrams (Figure 1, 2) [4].

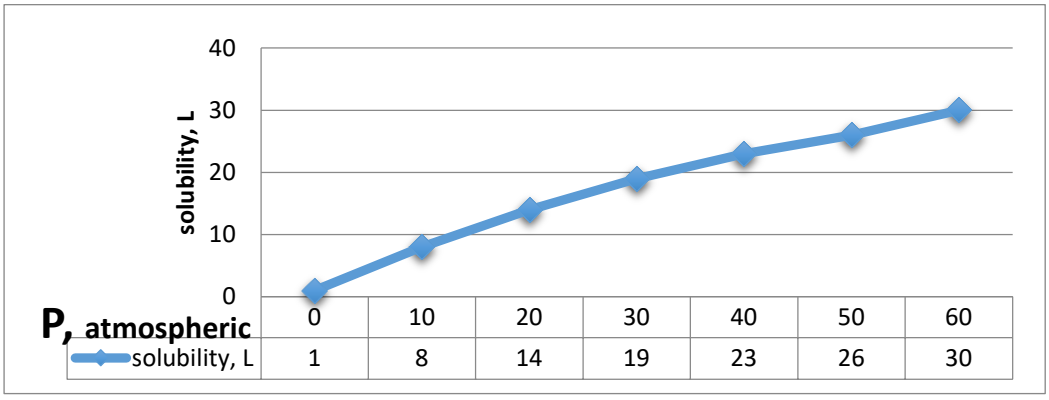

Figure 1. The ability of carbon dioxide to dissolve in water due to pressure changes.

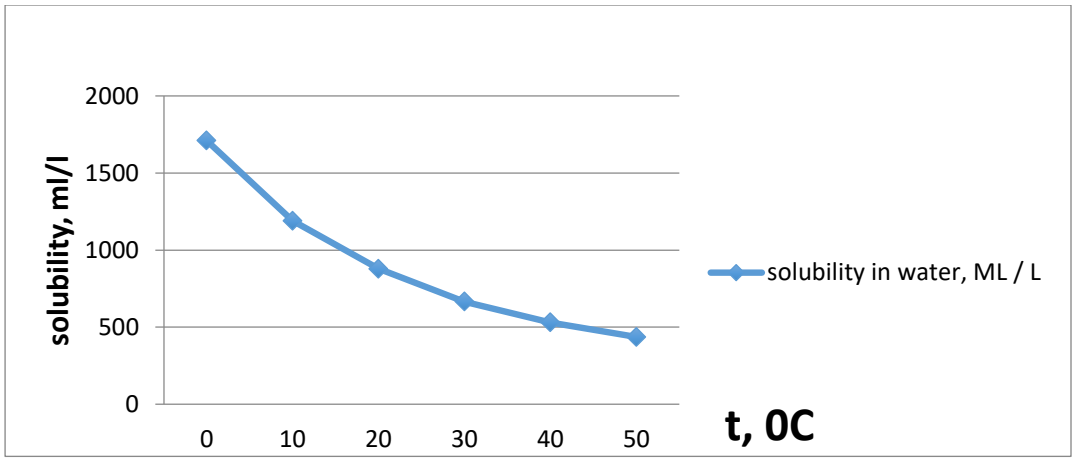

Figure 2. The ability of carbon dioxide to dissolve in water according to temperature changes.

It is to increase the mobility of the oil by pumping carbon dioxide into the productive layer, a phenomenon based on the laws of thermodynamics that, due to the expansion of the oil, part of the adsorption layer of the oil is released from the higher pores and the viscosity decreases due to the dissolved gas. This effect is most manifested when interacting with oil with a high viscosity. According to laboratory studies, the higher the initial viscosity value, the stronger its decrease (Table 2) [5].

Table 2.

Changes in the physical indicators of oil and CO2 saturated oil

Name	High viscosity, MPa*c	Viscous, MPa*c	Medium viscous, MPa*c	Less viscous, MPa*c
Oil	9000	1000	100	1
CO2 saturated oil	160	15	3	0,5

The displacement of oil by carbon dioxide is a very complex process that exhibits mass transfer, capillary and gravitational effects. In the process of mixing carbon dioxide with oil, its rheological properties change, affecting the saturation state, which contributes to the development of previously unused oil, displacing it from the reservoir [4, 5].

In order to explore the technology of pumping carbon dioxide into the reservoir, increase the intensity of the oil production coefficient at the research stage, it is proposed to study the technologies of carbon water injection, continuous CO_2 injection, alternating water and CO_2 injection, combined CO_2 and chemical reagent injection, and use a rational approach. The advantage of the carbon water injection approach is that it consumes relatively little carbon dioxide when injected into the reservoir compared to other forms of use. According to estimates in various laboratory experiments and literature, it has been established that the distillation of carbonized water with a CO_2 concentration of 5.3% allows you to increase the oil yield by 14% compared to the method of displacement by wastewater in oil production [5].

Conclusion. The peculiarity of continuous distillation of carbon dioxide makes it possible to achieve a high displacement coefficient in comparison with other options for using the technology. However, with continuous CO_2 distillation, viscosity instability is observed. In the technology of alternating distillation of water and CO_2, efficiency is observed for inhomogeneous layers due to the ratio of CO_2 to H_2O [5, 6].

Direct quantitative modeling is carried out taking into account the phase changes in the CO_2-layered liquid-water system, geochemical processes in the interaction of CO_2 with the reservoir water and the Collector rock in order to reliably predict the consequences, the result of carbon dioxide injection, after studying the order of the formation in the field and analyzing other optimal approaches [6].

References:

1. Ishmukhametov A.V., Mingulov Sh.G., Bulchaev N.D. Operation of wells with viscous paraffin oil. St. Petersburg: Nedra, 2017. 311 p.

2. Trukhina O.S., Sintsov I.A. The experience of using carbon dioxide to increase oil recovery of reservoirs // Successes of modern natural science. – 2016. – No. 3. – pp. 205-209; URL: https://natural-sciences.ru/ru/article/view?id=35849 (accessed: 04.10.2022).

3. Experience in modeling carbon dioxide injection to increase oil recovery Authors: Shamsutdinova Gulnaz Fagimovna, Indrupsky Ilya Mikhailovich Heading: Geology Published in Young Scientist No. 18 (308) May 2020 Date of publication: 03.05.2020.

4. Khromykh L.N., Litvin A.T., Nikitin A.V. The use of carbon dioxide in the processes of enhanced oil recovery // Bulletin of the Eurasian National Academy of Sciences.

5. Sh.G. Mingulov (Branch of Ufa State Petroleum Technical University in Oktyabrsky, Oktyabrsky, Republic of Bashkortostan, Russian Federation), I.Sh. Mingulov (Bashneft - Dobycha LLC, Ufa, Russian Federation). ON THE CLASSIFICATION OF HEAVY HIGH-VISCOSITY OILS., DOI: 10.17122/ntj-oil-2020-5-32–39., http://ntj-oil.ru/files/ntj/2020/5/ntj-5-2020-p32-39.pdf

Әдебиеттер тізімі

1. Ишмухаметов А.В., Мингулов Ш.Г., Булчаев Н.Д. Эксплуатация скважин с вязкими парафинистыми нефтями. СПб.: Недра, 2017. 311 с.

2. Трухина О.С., Синцов И.А. Опыт применения углекислого газа для повышения нефтеотдачи пластов // Успехи современного естествознания. –2016. – № 3. – С. 205-209; URL: https://natural-sciences.ru/ru/article/view?id=35849 (дата обращения: 04.10.2022).

3. Опыт моделирования закачки углекислого газа для повышения нефтеотдачи пласта Авторы: Шамсутдинова Гульназ Фагимовна, Индрупский Илья Михайлович Рубрика: Геология Опубликовано в Молодой учёный №18 (308) май 2020 г. Дата публикации: 03.05.2020

4. Хромых Л.Н., Литвин А.Т., Никитин А.В. Применение углекислого газа в процессах повышения нефтеотдачи пластов // Вестник Евразийской науки, 2018 №5 https://esj.today/PDF/06NZVN518.pdf

5. Ш.Г. Мингулов (Филиал Уфимского государственного нефтяного технического университета в г. Октябрьском, г. Октябрьский, Республика Башкортостан, Российская Федерация), И.Ш. Мингулов (ООО «Башнефть - Добыча», г. Уфа, Российская Федерация). К ВОПРОСУ О КЛАССИФИКАЦИИ ТЯЖЕЛЫХ ВЫСОКОВЯЗКИХ НЕФТЕЙ., DOI: 10.17122/ntj-oil-2020-5-32–39., http://ntj-oil.ru/files/ntj/2020/5/ntj-5-2020-p32-39.pdf.

ТҰТҚЫР МҰНАЙ ӨНДІРУДІҢ ҚАРҚЫНДЫЛЫҒЫН АРТТЫРУ ШАРТТАРЫН ТАЛДАУ

Т.С. КАЙНЕНОВА [1*], Д.Д.СУЛТАНОВА[1],
М.А. ЖАНАБАЕВ[1], Г.Т.КОСМБАЕВА [1]

[1]Қ.Жұбанов атындағы Ақтөбе өңірлік университеті, Ақтөбе, Қазақстан

*kaynenova83@mail.ru

Аннотация. Қазіргі уақытта мұнай-газ өнімдері энергияны тұтынуда отынның негізгі көзі ретінде әрекет ететіндіктен, қабаттың ауыр мұнайын игерудің перспективалық тәсілдері маңызды рөл атқарады. Көп қолданыстағы дәстүрлі мұнай өндіру әдістері тұтқыр мұнайларды өндіруде қажетті нәтиже бермейді, ал кейбір жағдайларда қолайсыз болып келеді.

Өндірілетін мұнай қорларының күрт төмендеуі- өндірілуі қиын мұнай көлемінің өсу салдарынан, геофизикалық жағдайлары күрделі кен орындарының ұлғаюынан және де тұтқырлығы жоғары карбонатты коллекторлардың артуынан туындап отыр. Осындай жағдайлардағы игерілетін мұнайдың техникалық-экономикалық көрсеткіштерін жоғарылату мақсатында, қабатқа әсер етудің жаңа жабдықтары мен технологияларын іздестіру, оны өндіріске енгізу негізгі міндет болып табылады.

Өңделетін қабаттың геологиялық-физикалық қасиеттерін зерттеу, өндіру процесіне қатысатын факторларға көңіл бөлу арқылы тұтқырлығы жоғары мұнайдың өнімділігін арттырудың жаңа жоғары тиімді экономикалық тиімді технологияларын қарастыруға мүмкіндік береді.

Мақалада тұтқыр мұнайлы кен орындарда көмірқышқыл газын пайдалану арқылы өнімділікті арттыру зерттеулері, сипатталған әдістің ерекшеліктері, әртүрлі параметрлерге байланысты өзгерістері қарастырылады.

Кілт сөздер: тұтқырлығы жоғары мұнай, өндіру, қабаттардың мұнай бергіштігін арттыру, көмірқышқыл газы, ерігіштік коэффициенті, кен орындарын игеру, технологиялар.

АНАЛИЗ УСЛОВИЙ ПОВЫШЕНИЯ ИНТЕНСИВНОСТИ ДОБЫЧИ ВЯЗКОЙ НЕФТИ

Т.С. КАЙНЕНОВА [1*], Д.Д.СУЛТАНОВА[1],
М.А. ЖАНАБАЕВ[1], Г.Т.КОСМБАЕВА [1]

[1]Актюбинский региональный университет имени К.Жубанова, Актобе, Казахстан

[*]kaynenova83@mail.ru

Аннотация. В настоящее время, поскольку нефтегазовые продукты выступают в качестве основного источника топлива при потреблении энергии, важную роль играют перспективные подходы к разработке пластовой тяжелой нефти. Существующие традиционные методы добычи нефти не дают желаемых результатов при добыче вязкой нефти, а в некоторых случаях становятся неприемлемыми.

Резкое снижение добываемых запасов нефти-вследствие роста объемов труднопроизводимой нефти, увеличения месторождений со сложными геофизическими условиями и увеличения высоковязких карбонатных коллекторов. В целях повышения технико-экономических показателей разрабатываемой нефти в таких условиях основной задачей является поиск нового оборудования и технологий воздействия на пласт, внедрение его в производство.

Изучение геолого-физических свойств обрабатываемого пласта позволяет рассмотреть новые высокоэффективные экономически эффективные технологии повышения производительности высоковязкой нефти путем сосредоточения внимания на факторах, участвующих в процессе добычи.

В статье рассматриваются исследования повышения производительности за счет использования углекислого газа в месторождениях вязкой нефти, особенности описываемого метода, изменения в зависимости от различных параметров.

Ключевые слова: высоковязкая нефть, добыча, повышение нефтеотдачи пластов, углекислый газ, коэффициент растворимости, разработка месторождений, технологии.