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CHARACTERISTICS OF RESEARCH IN GAS WELLS

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ABSTRACT

Investigation characteristics of underground gas storages, gas wells

In the article it has been mentioned that research methods of underground gas storages (UGS) gas wells in the decided regimes have more distinguishing features than analogous research methods of pure gas and gas condensate fields wells. Besides the parameters defined on the research results of gas fields wells it is necessary to determine a and b coefficients of UGS wells accepting ability during gas injecting.

It has been shown the accuracy of determination of layer pressure average value in UGS is very significant, because this index is used as reliability (surface layers) value of UGS cap of gas injection. Otherwise UGS will put out of order and all gas reserve in the storage mixing with atmosphere will lose.

Herein distinguishing features between UGS and pure gas and gas condensate fields have been shown and well № 415 of UGS has been analyzed, indicator diagram has been set up and values of a and b coefficients (during gas injection) have been determined.

Key words: underground gas storage, pure gas fold, gas-condensate field, research features, gas injection, gas production.

Qaz quyularında tədqiqatın aparılması xassələri

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XÜLASƏ

Məqalədə, yeraltı qaz anbarları qaz quyularının qərarlaşmış rejimlərdə tədqiqat üsullarının təmiz qaz və qaz-kondensat yataqları quyularının analoji tədqiqat üsullarına nisbətən müəyyən fərqli xüsusiyyətlərinin olduğu qeyd olunmuşdur. Qaz yataqları quyularının tədqiqat nəticələri üzrə təyin edilən parametrlərindən başqa YQA quyularının qəbul etmə qabiliyyətini və qaz vurma zamanı, a və b əmsallarını təyin etmək lazımdır. Bu əmsallar qazın hasil olunması prosesində tədqiqatın nəticələrinə əsasən alınmış a və b əmsallarından xeyli fərqlənirlər. Göstərilmişdir ki, YQA-da lay təzyiqinin orta qiymətinin təyin edilməsinin dəqiqliyi daha çox əhəmiyyət kəsb edir, çünki bu göstərici qaza vurulmasının sonuna YQA örtüyünün (pokrışkasının), (yer səthindəki yerləşmiş layların) etibarlılıq meyarı kimi istifadə edilir. Əks təqdirdə YQA sıradan çıxar və anbardakı qaz ehtiyatının hamısı atmosferə qarışaraq itər.

Burada, YQA-ları ilə təmiz qaz və qaz-kondensat yataqları arasındakı fərqli xüsusiyyətlər şərh edilmişdir və buna misal olaraq YQA-nın 415 saylı quyusu tədqiq edilmiş, indikator diaqramı qurulmuş və a və b əmsallarının (qazvurma zamanı) qiymətləri təyin edilmişdir.

Açar sözlər: yeraltı qaz anbarı, qazkondensat yatağı, qazın vurulması, yeraltı qaz anbarı, təmiz qaz yatağı, tədqiqat xüsusiyyətləri, qazın hasil edilməsi.

Исследовательские особенности газовых скважин подземные хранилища газа

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АННОТАЦИЯ

В статье отмечено наличие определенных отличительных особенностей способов исследования газовых скважин ПХГ на установившихся режимах по сравнению с аналогичными исследовательскими способами исследования скважин чисто газовых и газоконденсатных месторождений. Кроме определяемых параметров по результатам исследования скважин

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газового месторождения, необходимо также определить приемистость газовых скважин ПХГ и значений коэффициентов a и b, при закачке газа в ПХГ. Эти коэффициенты резко отличаются от значений коэффициентов a и b, полученных на основе результатов исследования при проведении процесса добычи газа из подземные хранилища газа.

Показано, что точность определения среднего значения пластового давления имеет большое значение, потому что, этот показатель в конце закачки газа в подземный амбар используется как критерий надежности покрытия ПХГ (покрышки), (пластов, залегаемых на поверхности земли). В противном случае ПХГ может выйти из строя и запасы газа в амбаре могут уйти в атмосферу.

Здесь изложены отличительные особенности ПХГ и чисто газовых и газоконденсатных месторождений и в качестве примера исследована скважина 415, построена индикаторная диаграмма и определены значения коэффициентов a и b, при закачке газа в амбар.

Ключевые слова: подземные хранилища газа, чисто газовое месторождение, газоконденсатное месторождение, исследовательские особенности, закачка газа, добыча газа.

It is necessary to determine the capacity of receiving gas injected into the gas wells of the Underground Gas Reservoirs created in depleted gas condensate deposits and the coefficients a and b during gas injection. These coefficients are significantly different from the a and b coefficients obtained based on the results of research in the process of gas production. It has become clear that the accuracy of determining the average value of formation pressure of Underground Gas Reservoirs wells is more important. Because this indicator is used as a criterion of reliability of the cover of the Underground Gas Storage at the end of the gas injection. For this, studying the research characteristics of gas wells of Underground Gas Storages is of great importance.

In underground gas reservoirs, the accuracy of determining the average value of the reservoir pressure is more important. If the upper layer of the underground gas reservoir does not sustain the indefinite pressure, the underground gas reservoirs will collapse and fail, and all the gas reserves there will be mixed into the atmosphere and lost.

The existing properties of the studies were determined by the UGR and various functional purposes of the gas fields. Research of UGR gas wells should be done without releasing the gas to the atmosphere. This condition requires that research work is carried out during the period of gas injection of most of the total volume of the reservoir and the wellbore zone. However, research work on determining the parameters of the technological operation mode of the wells should be carried out during the period of gas injection into the well and extraction from the well.

Research methods of wells in underground gas reservoirs (UGR) essentially do not differ from research methods of gas field wells. The research issues of the gas wells of UGR created in depleted gas condensate, oil fields and water structures are identical to the research issues of gas field wells with the application of the fixed purchases method in the period of gas purchase and in the neutral period [1,4].

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During the testing of the gas wells of the underground gas reservoirs, it is necessary to determine the receiving capacity of the wells of UGR, in addition to the parameters determined by the method of the research results of the wells of gas fields, and the coefficients a and b of the seepage resistance during gas injection should be determined. These coefficients can be significantly different from the similar a and b coefficients obtained based on the results of testing in the gas production process [2,3].

The formation pressure of underground gas reservoirs changes from maximum to minimum in a relatively small (compared to gas fields) time interval. Therefore, during the relatively long-term stabilization of the pressure and discharge of UGR wells, it is necessary to take into account the possible changes of the formation pressure.

If the UGR is divided into hydrodynamically screened inhomogeneous blocks, then accurate values of reservoir pressure sufficient for practice should be determined separately for each block averaged.

Depending on the location of the establishment of the UGR (spent gas condensate, oil fields and water structures), the necessary scope and issues of the research of its gas wells arise.

If Underground Gas Storages are created in Depleted Gas Condensate Fields, then:
1. It is necessary to carry out studies according to gas-condensation;
2. It is necessary to conduct stationary and non-stationary researches in wells.
3. It is necessary to take into account the results of the studies conducted during the development of the beds;
4. In most cases, the volume of research works on determining formation pressure in wells is 1.5 to 2 times greater than that of UGR created in water structures, which is related to their inhomogeneity.

The difference between underground gas storages and pure gas and gas condensate deposits is as follows:

- in some cases, due to the need, gas is produced from one or more wells of the storage and sent to the customers, in which case the storage is used as a gas deposit. , i.e. the reservoir is exploited, such wells become production wells, and the remaining wells are hermetically sealed;

- in underground gas reservoirs, gas is never pumped into the reservoir from some wells, and gas is not produced from the reservoir from other wells at the same time, i.e. at the same time both gas injection and gas production wells do not work in the reservoir, because there is no need to do such work in the reservoirs;

- underground gas reservoirs, in most cases, dry hydrocarbon gas is injected from their wells, not for the purpose of maintaining formation pressure, but to accumulate gas reserves in the reservoir they do, in this case those wells become gas injection wells. The process of injecting gas into the reservoir is carried out in one or more wells, the rest of the wells are hermetically sealed;

- gas and condensate producing wells are operated until the end of development in gas condensate fields, but when the reservoir pressure drops, the condensate falls, and in order to prevent it, the productive layer is drained from some well's hydrocarbon gas is injected, this process is called the cycling process. In gas condensate deposits, the phenomenon of counter condensation occurs due to the drop in formation pressure, which is called retrograde condensation;
- in clean gas fields, gas-producing wells are always operated until the end of development.

If underground gas reservoirs are created in water structures (as a rule, in relatively homogeneous and high-permeability layers), then take into account the results of hydro exploration and the limited possibility of using non-stationary research methods of wells necessary.

The procedure for testing gas wells of Underground Gas Storages and processing the results is identical to those for gas field wells. Conducting research is similar to the research of gas wells, in which the extracted gas is delivered to the gas measurement distribution point of the mine.

Different technological modes of operation of the wells are created with adjustable plugs. Gas consumption is determined based on the data of the differential manometer at the measuring point. The range of gas consumption changes depends on the reservoir's absorption capacity and the pressure in the reservoir, etc. is limited. Below is an example of research data processing in the gas injection process [5].

$$P_q^2 - P_{lqy}^2 = aQ + bQ^2$$

Here P_q, P_{lay} – are the wellbore and formation pressures, kQ/cm2, respectively; Q-is gas consumption, min m3/day; a,b- are the coefficients of seepage resistance.

The research results of well No. 415 of the Underground Gas Storage are given. Here, it should be $P_q > P_{lay}$ so that the injected gas can enter the UGR.

Primary $P_{st} = 54,7kQ/sm^2; \overline{Q} = 0,745$; the depth of the well is L=247m. According to the test data, the injection mode was determined with a flow rate of Q = 218min.m3/day. According to table 1, the values of $\alpha = 0,84$ and $b = 0,016$ values of seepage resistance coefficients were found graphically.

Regime	$P_{b.a}$, kQ/sm^2	$t_{q.a}$, ^{0}C	Q, min m^{3}day	P_q, kQ/sm^2	P_q^2, kQ/sm^2	$\Delta P^2 = P_q^2 - P_{lqy}^2$ (Mpa)^2	$\frac{P_q^2 - P_{lqy}^2}{Q}$
-	54,7	24	-	57,6	3323	-	-
1	59,3	27	80	58,3	3399	76	0,95
2	59,5	29	100	58,5	3422	99	0,99
3	59,7	30	128	58,8	3454	131	1,02
4	56,1	33	157	59,1	3499	172	1,09
5	56,3	34	178	59,3	3521	198	1,11
6	56,4	36	196	59,5	3949	222	1,13
7	56,8	39	218	59,8	3582	299	1,18
8	68,4	41	226	61,6	3889	465	2,08

If we substitute the values of these coefficients in formula (1), we will get the binomial flow equation for specific well No. 415:

$$P_q^2 - P_{lay}^2 = \Delta P^2 = 0,84Q + 0,0016Q^2$$

If we write P_{q_1} – the pressure of the well bottom, that is, the pressure that can be released instead of Pq, then we solve equation $P_{q_1}^2 - P_{lqy}^2 = \Delta P_1^2 = 0,84 \cdot Q_{nor} + 0,0016Q_{nor}^2$ according to Q_{nor} to find the rate of consumption of the gas injected from the well into the URG.

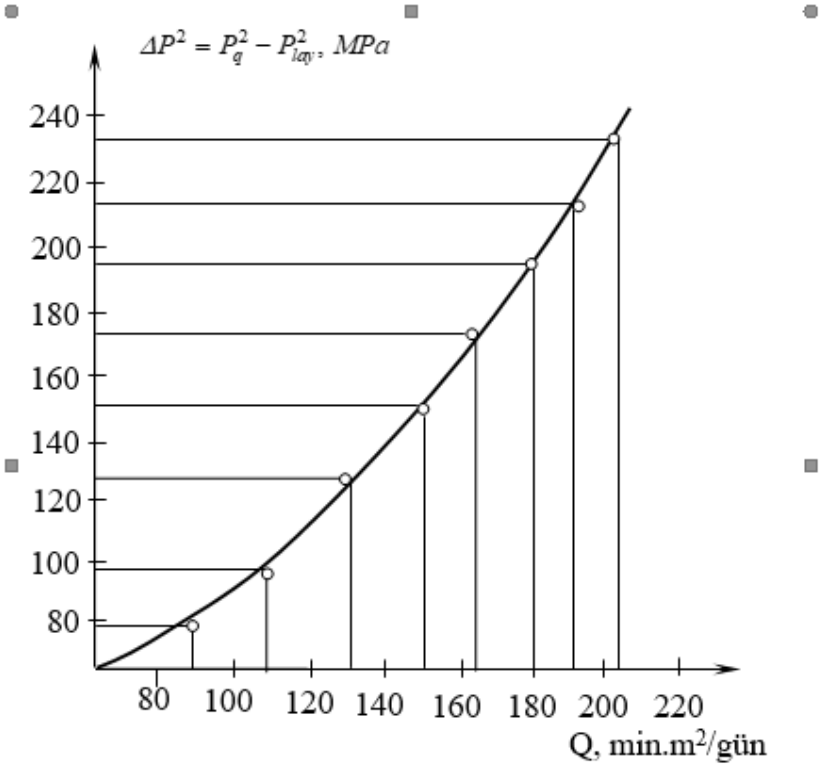

Fig. Underground gas storage gas well No. 415 indicator diagram

If $P_{q_q} = 100at = 10MPa;\ P_{lay} = 70at = 7MPa$

$$100 - \gamma q = 0{,}84\, Q_{nor} + 0{,}0016\, Q_{nor}^2$$

$$0{,}0016\, Q_{nor}^2 + 0{,}84\, Q_{nor} - 51 = 0$$

$$Q_{nor_{1,2}} = \frac{-0{,}84 \pm \sqrt{0{,}84^2 + 4 \cdot 0{,}0016 \cdot 51}}{2 \cdot 0{,}0016} = 5{,}5 \text{ min } .m^3/gün$$

$$Q_{nor} = 5{,}5 \text{ min.m}^3\text{/day}$$

So, if the research results are processed using a binomial equation, then the coefficients a and b of the equation are determined by the least squares method with the following formulas:

$$a = \frac{\sum \frac{\Delta P^2}{q} \sum q^2 - \sum q \sum \Delta p^2}{N \sum q^2 - \left(\sum q\right)^2} \qquad (3)$$

$$b = \frac{n \sum \Delta p^2 - \sum q \sum \frac{\Delta P^2}{q}}{N \sum q^2 - \left(\sum q\right)^2} \qquad (4)$$

Here N is the number of different working modes.

The values of coefficients a and b calculated by formulas (3) and (4) will be equal to 0.84 and 0.0016 in equation (2).

If the gas reservoir is created in a depleted gas condensate field, then there is a certain amount of residual condensate in its pores, and in this case, the condensate of the gas reservoir, i.e., the condensate saturation coefficient, is determined.

Conclusion

It has been noted that the research methods of underground gas storage gas wells in fixed regimes have certain different characteristics compared to the similar research methods of pure gas and gas-condensate wells. In addition to the parameters determined by the research results of gas field wells, it is necessary to determine the absorption capacity of UGR wells and the coefficients a and b during gas injection. These coefficients are significantly different from the coefficients a and b obtained based on the results of research in the gas production process. It has been shown that the accuracy of determining the average value of the formation pressure in the UGR is more important, because this indicator is used as a criterion of reliability of the UGR cover (cover), (layers located on the surface of the earth) at the end of gas injection. Otherwise, the UGR will fail and all the gas reserves in the reservoir will be mixed into the atmosphere. diagram was constructed and the values of coefficients a and b (during gas injection) were determined.

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