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Increasing Oil and Gas Well Productivity in Offshore Conditions

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Abstract

In a situation where the demand for oil and gas is increasing day by day, there are reductions in production due to several reasons. As we know, the productivity of the well depends on several factors. These factors are examined and detailed information is provided in this article. Among the main issues, processes such as hydraulic fracturing and acid treatment have been investigated in order to improve the conductivity of the well bottom zone. In addition, the relationship between reducing the back resistance at the wellhead and choosing the optimal mode for increasing the flow rate of the well was also considered. Attention has been paid to the importance and possibility of taking preventive measures against the problems identified as a result of the research conducted in this direction. Among the preventive measures taken against the sand problem, which is one of these problems, gravel packing, metal strainer, and chemical hardening methods were investigated. In addition, attention has been paid to the issue of increasing the flow from the formation to the well by removing the fluid collected at the bottom of the well.

Keywords: increase in production, permeability, optimal mode, sand, filters, effect with acid.

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Dəniz yataqlarında neft və qaz quyularının məhsuldarlığının artırılması

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Xülasə

Məqalədə əsas məsələlərdən olan quyudibi zonanın keçiriciliyinin yaxşılaşdırılması istiqamətində hidravlik yarılma, turşu ilə işlənmə kimi proseslərin aparılması haqqında araşdırılmışdır. Bundan başqa quyunun debitinin artırılması üçün quyuağzında əks müqavimətin azaldılması və optimal rejimin seçilməsi arasında əlaqəyə də baxılmışdır. Bu istiqamətdə aparılan araşdırmaların nəticəsində müəyyən olunan problemlərə qarşı profilaktik tədbirlər görülməsinin vacibliyi və mümkünlüyünə diqqət ayrılmışdır. Bu problemlərdən biri olan qum probleminə qarşı görülən profilaktik tədbirlərdən çınqıllı süzgəc, metal süzgəclər və kimyəvi bərkidilmə metodları araşdırılmışdır. Bundan başqa quyudibinə toplanmış mayenin çıxarılması ilə laydan quyuya axının artırılması məsələsinə də diqqət ayrılmışdır.

Açar sözlər: hasilatın artırılması, keçiricilik, optimal rejim, qum, filtrlər, turşu ilə təsir üsulları.

Повышение производительности нефтяных и газовых скважин на морских месторождениях

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Аннотация

В статье исследованы такие процессы, как гидроразрыв пласта и кислотная обработка с целью улучшения проводимости призабойной зоны скважины. Рассматривается взаимосвязь между снижением обратного сопротивления на устье и выбором оптимального режима увеличения дебита скважины. Обращено внимание на важность и возможность принятия превентивных мер против проблем, выявленных в результате исследований, проведенных в этом направлении. Среди превентивных мер, предпринятых против одной из проблем – песка – исследованы гравийная набивка, металлическое сито и методы химического упрочнения. Кроме того, уделено внимание вопросу увеличения притока из пласта в скважину за счет отвода жидкости, собравшейся на забое скважины.

Ключевые слова: увеличение добычи, проницаемость, оптимальный режим, песок, фильтры, воздействие кислотой.

Introduction

Studies conducted on wells drilled in fields in the South Caspian Basin show that due to the decrease in flow into the well, its productivity decreases. The reason for this is the deterioration of permeability in the well bottom zone. This is called the Skin effect. The deterioration of the conductivity of the well bottom zone starts from the moment the well is drilled and increases gradually during the operation period. Measures are taken against this, the most effective of which is the treatment of the bottom zone with acid. A mixture of hydrochloric and hydrofluoric acids is used as an acid. This acid mixture allows us to ensure that the clay particles in the productive zone do not swell during the process. Because in this case, the conductivity can decrease even more. In general, our main goal is to open the conductive channels blocked by paraffin.

In addition, the sand coming into the well from the reservoir also causes a decrease in productivity. Thus, the sand forms a blockage both in the well bottom filter zone and inside the pipes in the well. By taking measures against sand, we increase the production of the well. Measures against sand are carried out in two directions. The first is the prevention of sand entering the well, and the second is the measures taken to remove the sand that has entered the well [1-5].

One of the things done in the direction of increasing the production is increasing the diameters of the flow regulators of the well. But the main thing here is to choose the right mode of operation. This mode will be used for a long time as the optimal mode for the well. Also, this process can be observed with the growth of mechanical particles in the well product. That is why all research conducted should be done very sensitively.

It is also known that hydraulic fracturing is used to increase production. With this method, we widen the cracks in the bottom zone of wells drilled in oil and gas fields, i.e., conductive channels or create new cracks. Thus, the rate of flow of oil and gas into the well increases, and, as a result, the productivity of the well increases [6, 7].

However, since all the measures taken are very complex and financial, the economic effect of the work to be carried out should be thoroughly investigated and a decision should be made after assessing the risk. Both economic and environmental risks should be considered in this matter.

Research method

Hydraulic fracturing of the formation is one of the effective methods of influencing the bottom zone in order to increase the permeability and current production. Hydraulic fracturing is also the best tool to increase the absorption capacity of injection wells [8-10].

The essence of the hydraulic fracturing method is that a viscous fluid with a large amount of suspended coarse sand is injected into the well. The fluid is pumped through the unit's large flows, which causes a rapid increase in the pressure in the wellbore. When the pressure at the bottom of the well is about 2 times higher than the hydraulic pressure, the formation is fractured. As a result, the layer is separated into layers, and cracks are formed there. The fracturing fluid, which contains sand grains, enters the formed cracks. After the hydraulic fracturing process is over, as the pressure in the well bottom decreases, the cracks try to be closed, but the sand grains

injected into the cracks prevent this. After the process is over, the fracturing fluid filled in the cracks is removed from the well using a swab.

When selecting objects for hydraulic fracturing, it is necessary to consider the degree of development of different tectonic areas or formation zones (residual oil reserves and formation pressure). Hydraulic fracturing should be performed first in layers with high residual oil reserves and relatively high formation pressure. As the layer thickness increases, the effect of hydraulic fracturing worsens. Therefore, in the layers with a thickness of less than 10 m, a one-time analysis can be enough. As the layer thickness increases, the effect of hydraulic fracturing worsens. Therefore, in the layers with a thickness of less than 10 m, a one-time analysis can be enough.

The acid is a mixture of hydrochloric acid and hydrofluoric acid. This acid is used to increase permeability in wells drilled into sandstones or sand-clay rocks. The amount of hydrochloric acid and hydrofluoric acid in the mixture is found by experiment. Usually, 3-6% hydrofluoric acid and 10-12% hydrochloric acid are used to process sandstones.

With this method, the well bottom zone is processed in three stages:

A hydrochloric acid bath is made in the well body in front of the interval to be worked in the first stage. If there is a cement crust in the well body, 1-1.5% hydrofluoric acid is added to the hydrochloric acid.

In the 2nd stage, 10-15% hydrochloric acid is injected into the layer to dissolve carbonates in the well bottom zone. The products obtained because of the reaction should be removed from the well bottom zone. In the third stage, they inject clay acid to dissolve the clay fraction and quartz sand.

Under the influence of clay acid, clays lose their plasticity and swelling ability. The storage time of clay acid in the well should not be less than 12 hours. After that, the bottom of the well should be cleaned of corrosion products. This method is widely used in the development of injection wells. The location of the equipment at the wellhead during acid treatment is shown in the fig. 1.

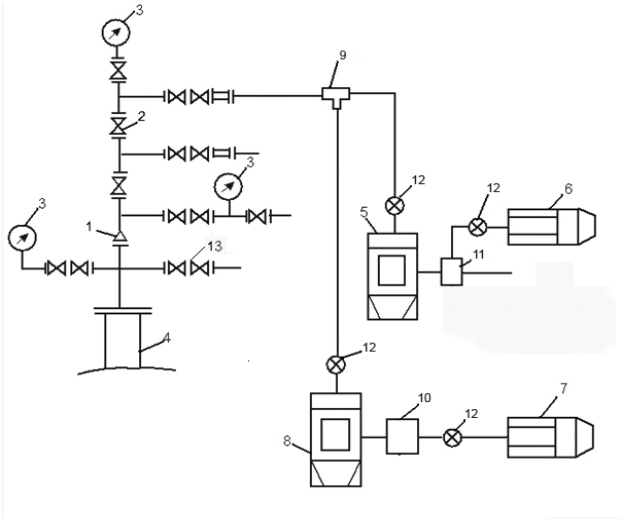

Figure 1 – The layout of the equipment in the treatment of the well bottom zone with a new composition of acid: 1- wellhead, 2- central drawer, 3- measuring monometers, 4- well, 5,8 - impact units, 6,7 - tank truck, 9 - three inlets, 10 - tank for acid solution, 11 - tank for pressure fluid, 12-drawers, 13 – drawer behind the tube

The most effective of the measures taken against the sand problem is the use of well-bottom filters. Filters are used in most of the wells in the offshore oil fields of Azerbaijan. In general, according to the completion of the well, different types of filters are shown in fig. 2.

Completion of the wellbore filter zone is the first and most effective method against sand occurrence. In the third method, 45-70% more is prevented from moving the well into

the well than the others. Considering this, it is suggested to use this method more in offshore oil and gas wells. It is also effective as it prevents financial losses as well.

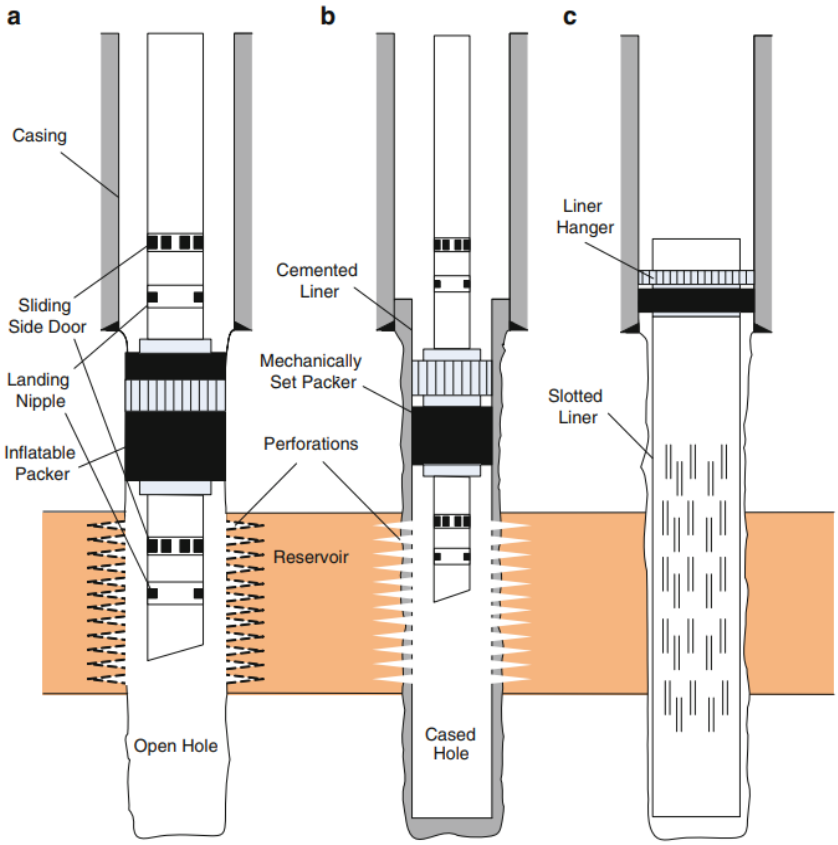

Figure 2 – Basic well completion designs:
a) Open hole completion, b) Cased hole completion, c) Slotted liner completion

Looking at the flow profile of each slot, it can be seen that sand is prevented from entering to the formation which are given in the figure 3.

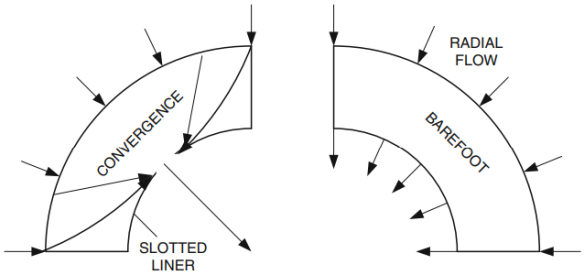

Figure 3 – Convergence of radial flow through liner slot (left) compared to barefoot radial flow (right)

In this regard, Weatherford filters have shown themselves better. Both the distance between the holes and the diameter of the holes are selected by special technology.

Conclusion

As a result of the chemical treatments in the wells, the permeability increased, and thanks to this, an increase in the productivity of the well was observed. The effectiveness of the action with acid was seen to be more than 85%. An increase in production was also observed as a result of hydraulic fracturing in the well bottom zone. This indicator showed

an increase of 5-20% per well. Thanks to the anti-sand measures, the period between repairs has increased by 100 days. This in turn has resulted in saving human labor and also economical.

Conflict of Interests

The authors declare there is no conflict of interests related to the publication of this article.

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