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# ANALYSIS OF ACID HYDRAULIC FRACTING PROCESS OF LAYER IN MINING CONDITIONS

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## АННОТАЦИЯ
Qatlamni gidravlik yorish sizilish-o‘tkazuvchanligi xususiyatlari past bo‘lgan qatlamlarga ishlov berib gazberaoluvchanlikni oshirishda birmuncha samarali usul hisoblanadi. Gidroyorish amalga oshirilgach quduq mahsuldorligi tezda o‘sadi. Ushbu usul neft va gazni odatdagi uslublar orqali olish imkonsiz yoki kamrentabelli bo‘lgan to‘xtab qolgan quduqlarni “tiriltirish” imkonini beradi.

## АННОТАЦИЯ
Гидравлический разрыв пласта – наиболее эффективный способ увеличения газоотдачи при разработке пластов с низкими филтрационно- емкостными свойствами. После проведения гидроразрыва дебит скважины, как правило, резко возрастает. Метод позволяет «оживит» простаивающие скважины, на которых добыча нефти или газа традиционными способами уже невозможна или малорентабелна.

## ANNOTATION
Hydraulic fracturing is the most effective way to increase gas recovery in the development of reservoirs with low reservoir properties.After hydraulic fracturing, the well flow rate, as a rule, increases sharply. The method allows to "revive" idle wells, where oil or gas production by traditional methods is no longer possible or unprofitable.

**Tayanchso'zlar:** qatlam, kon, kislota, gidravlik yorish, quduq, yoriq, bosim, eritma, oqim, suyuqlik.

**Ключевыеслова:** пласт, залежь, кислота, гидроразрыв пласта, скважина, трещина, давление, раствор, поток, жидкость.

**Keywords:** reservoir, reservoir, acid, hydraulic fracturing, well, fracture, pressure, solution, flow, fluid

## Introduction

In the development of our independent republic, the modern oil and gas industry has achieved great success in a short period of time, our republic has started to sell energy sources abroad in addition to providing its own needs for oil and gas products. With the commissioning of new oil and gas facilities, high-tech production facilities meeting world standards began to be used.

## Main Part

As a result of drilling, opening primary and secondary wells, improving the testing works, not polluting the productive layer and maintaining its natural permeability, opening the productive layer with effective methods, and ensuring that the wells will produce products for a long time is one of the most urgent issues today.
Hydraulic fracturing of the formation determines the flow rate (receptivity) in the QGY for the selected well, the bottom of the well and formation pressure, the amount of water in the well where the product will be extracted, and the gas factor. Cleaning of the bottom of the well and around the bottom of the formation is carried out.
In the method of hydraulic fracturing, liquid is pumped into the formation under pressure, and under the influence of pressure, the formation is opened and divided into layers. When the pressure is reduced, large sands are pumped together with the fluid to prevent the fractures from connecting to each other, the permeability is maintained, and the permeability of the fractured layer is improved up to 1000 times.
We use data from Ilonli mine №4 well to calculate acid hydraulic fracturing of the formation. The parameters of the well required for these calculation works are

sufficient for the calculation of KKGYo and the calculation of fractures and are presented in the table below.

Table 1. Parameters of Ilonli mine №4 well

| Indicators | Designation | Value | Unity |
|---|---|---|---|
| Well depth | $L_{skv}$ | 1902 | m |
| Internal diameter of the NKQ | $d_{nkt}$ | 0,072 | m |
| Determined layer thickness | H | 20 | m |
| Average permeability | K | $0{,}039 \cdot 10^{-12}$ | $m^2$ |
| Rock modulus of elasticity | E | $2 \cdot 10^{10}$ | Pa |
| Poisson's ratio | ν | 0,3 | |
| Average density of rocks above the productive layer | $\rho_p$ | 2400 | $kg/m^3$ |
| Yoruvchi suyuqlik zichligi | $P_{jr}$ | 1000 | $kg/m^3$ |
| Yoruvchi suyuqlik qovushqoqligi | μ | 150 | mPa*s |

We calculate the vertical component of rock pressure to the bottom of the well according to the following formula:

$$P_{в}=2400 \cdot 9{,}81 \cdot 1902 = 44{,}78 \text{ MPa}$$

According to this formula, we calculate the horizontal component of the rock pressure at the bottom of the well:

$$P_{г} = 44{,}78 \cdot \frac{0{,}3}{1-0{,}3} = 19{,}19 \text{ MPa}$$

In such conditions, vertical cracks will appear in the CKGYO, because the horizontal component of the rock pressure is somewhat smaller.

The NU-2250 aggregate is used to drive the explosive liquid and acid solution into the formation. The volume of fracturing fluid that should be pumped into the formation is $V_{talab}$ =30 m3. The time required to pump this amount of fracturing fluid into the formation is $t_{hay}$ =25 minutes. Accordingly, the driving speed should be ensured:

$$Q_{min} = \frac{V_{talab}}{t_{yay}} = \frac{30}{25 \cdot 60} = 0{,}02 \text{ m}^3/\text{c}$$

We use a water-based gel with a density $\rho_{j.r.}$= 930 kg/m3 and a viscosity $\mu_{j.r.}$=150 mPa*s as an explosive liquid.

The pressure required to crack the layer is calculated as follows:

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$$\frac{P_{qat.yor}}{19{,}19\cdot 10^6}\left(\frac{P_{qat.yor}}{19{,}19\cdot 10^6}-1\right)^3$$
$$= 5{,}25\cdot\frac{1}{(1-0{,}3^2)^2}\cdot\left(\frac{6{,}36\cdot 10^{10}}{19{,}19\cdot 10^6}\right)^2\cdot\frac{0{,}035\cdot 0{,}15}{19{,}19\cdot 10^6}$$

We have the following layer cracking $P_{qat.yor} = 20.58$ MPa.

The mode of flow of explosive liquid along the NKQ is calculated based on the relationship between the actual and critical flow velocities. The critical flow rate is calculated by the following formula:

$$\vartheta_{\text{крс}} = 25\sqrt{\frac{\tau_c}{\rho_c}} = 25\sqrt{\frac{1{,}5}{1000}} = 0{,}97$$

where is the $\tau_c$ – ultimate shear stress:

$$\tau_c = 8{,}5\cdot 10^{-3}\cdot\rho_c - 7 = 8{,}5\cdot 10^{-3}\cdot 1000 - 7 = 1{,}5 \text{ Pa}$$

The actual speed of the flammable liquid along the NKQ is calculated by the following formula:

$$\vartheta_c = \frac{Q}{F} = \frac{4\cdot 0{,}02}{3{,}14\cdot 0{,}072^2} = 4{,}9 \text{ m/c}$$

The flow regime is defined as follows, taking into account the friction loss when the pump moves along the compressor pipes:

$$\Delta P_c = 0{,}012\cdot\rho_c\cdot H_{\text{т}}\cdot\vartheta^2\cdot\frac{1}{d_{NKQ}} = 0{,}012\cdot 930\cdot 1902\cdot 4{,}9^2\cdot\frac{1}{0{,}072} = 18{,}3 \text{ MPa}$$

The upper pressure required for hydraulic fracturing of the formation is determined as follows:

$P_u = P_{\text{қат ёр}} - N_{qud}\rho_c g + \Delta P_c = \quad 20{,}58\cdot 10^6 - 1902\cdot 930\cdot 9{,}81 + 8{,}3\cdot 10^6 \quad = 22{,}5$ MPa.

If we look at the working description of the hydraulic fracturing pump, it can be seen that the maximum consumption under the working pressure of 22.5 MPa is 0.03 $m^3/s$. Then the number of pumps needed to implement the technological event:

$$N = \frac{Q_{min}}{Q} + 1 = \frac{0{,}02}{0{,}03} + 1 = 1{,}66\ .$$

If we round up the resulting number, 2 pump units will be needed to hold this event.

The crack length is calculated by this formula:

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$$l = \sqrt{\frac{63 \cdot 6{,}36 \cdot 10^{10}}{5{,}6 \cdot (1 - 0{,}3^2) \cdot 22 \cdot (20{,}06 - 19{,}04) \cdot 10^6}} = 84 \text{ m.}$$

The width of cracks is calculated as follows:

$$\omega = \frac{4(1 - 0{,}3^2) \cdot 158 \cdot (20{,}58 - 19{,}19) \cdot 10^6}{6{,}36 \cdot 10^{10}} = 6{,}7 \text{ mm}$$

**Summary**

After the formation of pores, acid is pumped cyclically under a pressure higher than the formation's bursting pressure, together with a retarder, and the rocks are eroded along the entire length of the pores. The amount of acid pumped into the layer is determined after a technical and economic analysis.

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