THE ESSENCE AND METHODS OF CALLING THE INFLUX OF FLUIDS FROM WELLS

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A well development is a set of works that is carried out after the completion of drilling a well in order to obtain gas inflow from the reservoir and further study it.

The development of reservoirs must be carried out in the presence of an act on the readiness of the well to perform these works.

For each prospecting or exploration well, a development plan is drawn up, which is approved by the head of the geological services of a higher organization.

After perforation, in order to induce inflow from the reservoir, tubing pipes (tubing pipes) are lowered into the well, the lower part of which is equipped with a funnel, the wellhead is equipped with X-mas trees. The installation depth of the tubing shoe is determined by the characteristics of the well operation and the stability of the reservoirs. In all cases, it is necessary to install the tubing shoe as close as possible to the bottom of the gas-bearing formation (lower filter openings or 3-5 m above). The installation of a tubing shoe above the specified interval should, in each case, have a geological and technical justification.

After lowering the necessary equipment into the well, installing and tying wellhead fittings, you can begin to develop the well. First, the well should be thoroughly flushed with the maximum possible intensity, and then proceed to call the inflow.

Calling inflow is the main operation of the development of production wells. After perforation, the productive stratum of the formation is under repression of the liquid or solution column. This can be pure water or a specially formulated surfactant solution or drilling fluid. Well-filling solutions (fluids) must be inert to the metal of the casing string and downhole equipment and must not reduce the permeability of the formation rock in the near-wellbore zone, since the time period between perforation and development can be calculated in days, weeks or even months.

The scheme of a vertical well filled with some kind of driving agent (slurry, water) and awaiting development is shown in fig. 1. The value of bottomhole pressure (P_{bot}) of such a well is determined by the formula:

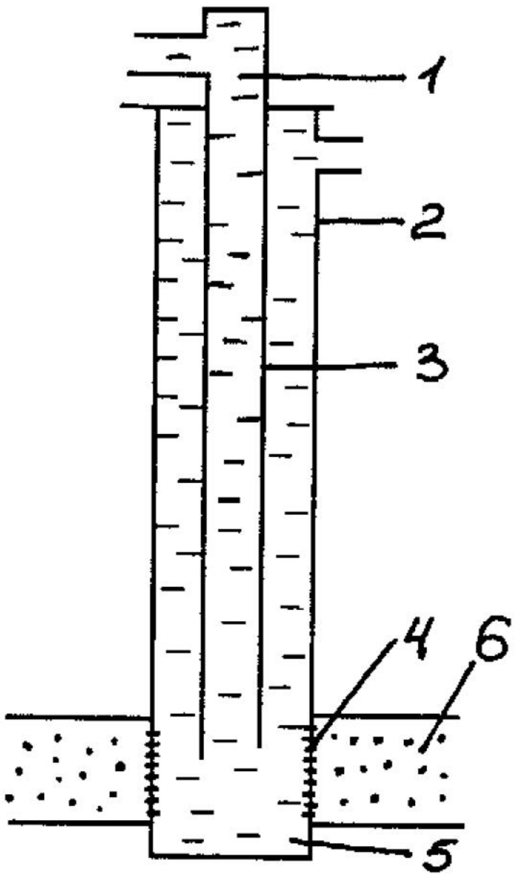
$$P_{bot} = \rho_p \cdot g \cdot H_{st} , \quad (1)$$

where ρ_p is the density of the solution filling the well, kg/m^3;

g is the free fall acceleration, m/s^2;

H_{st} is the value of the solution column, m.

If the well has a complex profile (inclined, horizontal, etc.), then the value of the column should be taken as the difference between the absolute marks of the depth of the bottomhole position and the depth of the mud level in the well. The bottomhole depth is understood here as the absolute mark of the plane taken within the perforation interval.



1 - wellhead equipment; 2 – production casing string; 3 – tubing string;
4 - perforated bottomhole; 5 - sump; 6 - productive layer
Figure 1. Schematic representation of a well prior to influx stimulation

The application of all methods of inducing inflow is based on the principle of lowering the pressure at the bottom of the well below the formation pressure, as well as creating such a minimum drawdown value at which inflow from the formation into the well begins. This is the essence of the inflow call.

From formula (1) it follows that the decrease in pressure at the bottom of the well can be achieved in two ways: either by reducing the density of the solution filling the well; or lowering the mud level in the production casing string (decreasing mud column).

The conditions for inducing inflow from the reservoir significantly affect both the success of development and the further technological mode of operation, the efficiency and reliability of the well. Reservoir pressure value, the nature and degree of decrease in the permeability of the BFZ rock, the composition and properties of productive rocks, the degree of rock cementation, the degree of formation heterogeneity, the composition and properties of fluids, the presence or absence of a gas cap, bottom and extraneous high-pressure waters, the technical condition of the production casing string and cement stone - these are the main factors that should be carefully considered when deciding on the choice of method and technology for influx stimulation.

Extremely important should also be given to the solution of the question of the magnitude and rate of change (dynamics) of depressions when the inflow is triggered. The magnitude of the depression and its dynamics should be determined by the type of pore space (granular, fractured) of the reservoir, the composition and properties of fluids, reservoir stability, filtration properties of the formation rock, the nature and degree of decrease in the permeability of the rock in the bottomhole zone, as well as some other factors. Under otherwise identical conditions, in stable reservoirs, the drawdown value can be greater and be achieved more quickly, in weakly cemented or fractured reservoirs, it can be small and slowly increasing. For gas reservoirs, the drawdown value should be significantly less than in the case of oil reservoirs. Large drawdowns often cause a significant deterioration in the adhesion of cement stone to the production casing string and to the formation rock, especially in shale and sandstone intervals eroded during drilling.

In field practice, there is an opinion that the consequences of rock pollution in the bottomhole zone due to irrational technology of primary and secondary opening of the productive formation can be easily eliminated, creating large drawdowns during well development. Indeed, it cannot be denied that under certain conditions (for example, in the case of weakly deformable rock), large drawdowns can, to one degree or another, restore the degraded rock permeability of the near-bottom zone. However, comprehension of the fishery information, a comprehensive consideration of the mechanism of influence of high depressions indicate the fallacy of this approach. The fact is that due to high drawdowns, the inflow occurs, as a rule, from the most permeable intervals of the exposed reservoir, which contain relatively large filtration channels without significant narrowing, and in which the molecular surface and mechanical fixation of the penetrated solid particles did not occur. Thus, already at the first stage of well development, conditions are laid for uneven development of the reservoir in thickness. At the same time, these same high depressions create favorable conditions for many, often irreversible, complications, the negative impact of which will fully manifest itself later, i.e. during well operation.

It is paradoxical, but it is technologically easier to implement changes that are practically uncontrollable in magnitude and speed (large and sharp) depressions than those controlled with a smooth increase in their magnitude. This factor, obviously, had a great influence on the fact that during the development of wells drawdowns are often applied that exceed the optimal values. Thus, it is preferable to induce flow into producing wells at low drawdown values. It is also recommended to hold exposures of one or another duration at small drawdowns in order to monitor the reaction of the reservoir and the well. Based on the results of these observations, it will be possible to promptly make adjustments to the further well development technology.

References

1. Biletsky, M.T., Ratov, B.T., Khomenko, V.L., Korovyaka, E.A., Borash, B.R. (2022). Improvement of technology for drilling large diameter wells with reverse circulation. Наукові праці Донецького національного технічного університету. Серія: «Гірничо-геологічна», 1(27)-2(28), 18-25. https://doi.org/10.31474/2073-9575-2022-1(27)-2(28)-18-25.