IMPROVING THE EFFICIENCY OF OPERATION OF OPEN-HOLE WELLS

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ABSTRACT

This article is about the preparation of a well for operation and refers to all operations that are carried out from the moment the top of the formation is opened a bit until the well is put into operation. These works can be divided into the following stages: opening the reservoir, causing the well, and perforating and developing the well. Thus, well preparation for operation is the final stage of the good construction process.

KEYWORDS: *Reservoir Opening, Well Casing, Perforation, Well Completion.*

INTRODUCTION

Preparation of a well for operation refers to all operations that are carried out from the moment the top of the formation is opened a bit until the well is put into operation. These works can be divided into the following stages: opening the reservoir, causing the well, and perforating and developing the well. Thus, the preparation of a well for operation is the final stage of its construction process. Obtaining the initial flow of oil and gas from the reservoir to a large extent depends on drilling technology, the composition, and properties of drilling fluids, the duration of their impact on the productive formation, as well as the quality of work by separating this reservoir from other permeable horizons. High-quality opening of productive formations and development of wells is the most important condition for increasing the efficiency of the use of production and water injection wells. The urgency of this problem is now becoming even more important, since large productive capacities are involved in simultaneous operation, combined into a single filter. It is known that the poor quality of drilling in and development of wells negatively affects their productivity and leads to a decrease in the final value of the oil recovery factor. Before proceeding to the consideration of the main issue, let me remind you of the design of the well and its buttonhole.

The design of a production well is determined by the number of rows of pipes that are lowered into the well and cemented during the drilling process for successful good drilling, as well as its bottom hole equipment. In the choice of good design, the geometric dimensions of the equipment lowered into the well to lift its production play an important role. The following rows of pipes are lowered into the well: direction, conductor, intermediate and production strings.

1-Direction - a pipe string lowered into the well to a certain depth (100-200 m), which is cemented from the wellhead along the entire length and serves to securely fasten the upper intervals and prevent wellhead rupture.

2-Conductor - serves for fixing the upper unstable intervals of the section, isolating the upper aquifers from pollution, and also for the possibility of installing blowout prevention equipment at the mouth.

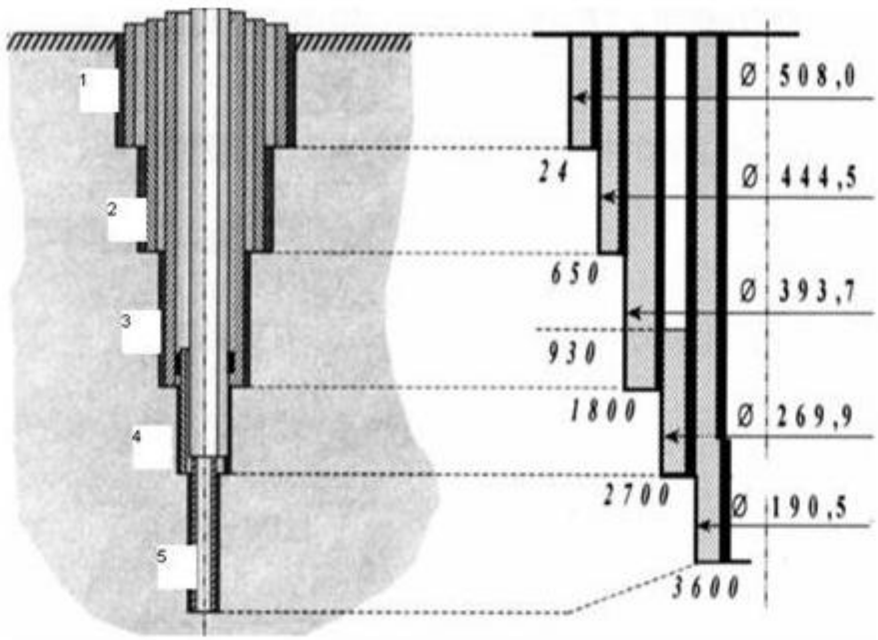

Figure. 1.1 - Well bottom design

3, 4 - Intermediate Casing String - designed for fixing and isolating the overlying zones that are incompatible with the drilling conditions with the underlying zones to prevent complications and accidents when drilling subsequent intervals.

5 - Production String - fastens and separates the productive formations and the overlying zones of the geological section from the productive formations and provides for the placement of equipment in it for lifting fluid or pumping the necessary agents into the formation. The production string is equipped with elements of the string and annular equipment (packers, shoe; check valve, centralizer, thrust ring, etc.). The diameter of the production string is selected depending on the size of the equipment used. In the fields of our country, pipes with a diameter of 140,146,168 mm are most often used for the production string.

An important element of the good design is the design of the bottom hole zone (see Fig. 1.2 a, b, c, d) Where: a - open hole; b –bottom hole with perforated pipes; in - slaughter with a filter; g - perforated bottom hole.

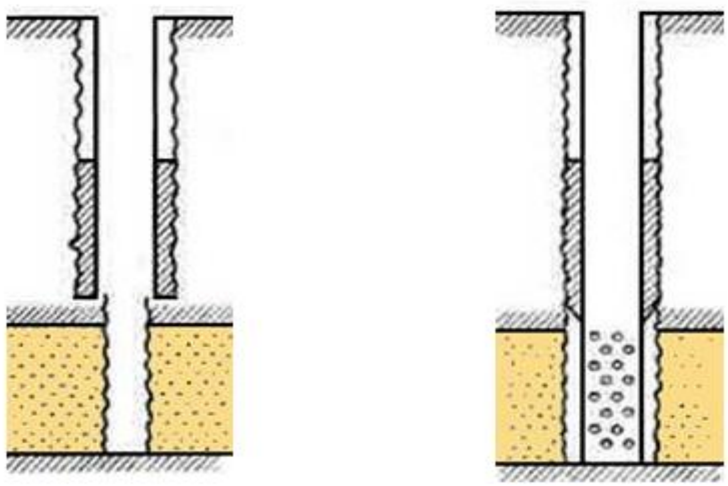

Figure 1.2 a, b – bottom hole zone design

In an open hole (Figure 1.2a), the casing shoe is cemented in front of the formation top. Then the reservoir is opened with a bit smaller diameter, and the wellbore against the productive formation is left open. An essential advantage of an open face is its hydrodynamic efficiency. An open-hole well is taken as a standard and its coefficient of hydrodynamic perfection is taken as equal to one. At the same time, the impossibility of selective opening of the required interlayers and selective impact on them, together with the constant threat of collapses in the bottom hole zone when large depressions are created, greatly limits the possibilities of using an open pit.

Therefore, less than 5% of the total well stock has an open bottom hole.

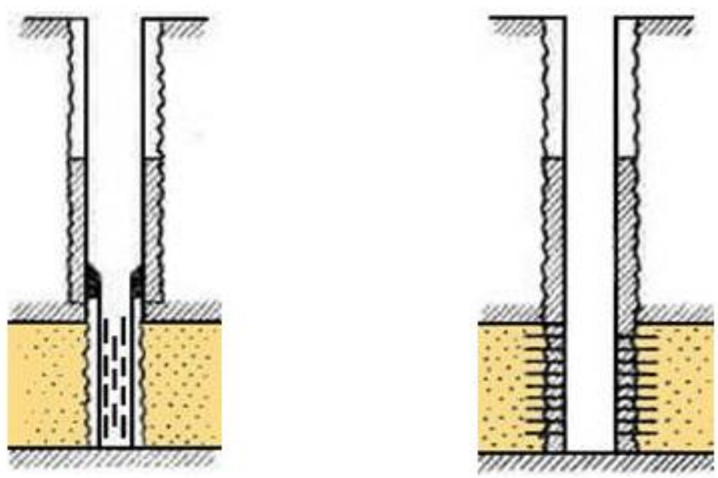

Figure. 1.2 c, d - design of the bottom hole zone

If the well bottom is equipped with a filter, then two design options are possible.

The first option (Fig. 1.2b): the well is drilled immediately to the bottom of the formation, is fixed with a casing string with pre-drilled holes in the lower part, falling against the productive stratum of the formation, then the column is cemented above the formation roof using the collar casting method.The space between the perforated part of the string and the exposed formation surface remains open.The conditions for the use of such a design are essentially the same as those for the use of an open hole. However, in this case, the fastening of the bottom hole is more reliable and it is guaranteed that the full diameter of the column is maintained until the bottom hole itself, even in cases of the partial collapse of rocks in the buttonhole part.

The second option (Fig. 1.2c): the casing shoe is run to the top of the reservoir and cemented. In the open part of the reservoir, there is a filter with small round or slit-like holes. The annular space between the top of the filter and the bottom of the casing string is sealed with a special stuffing box or packer. The main purpose of filters is to prevent sand from entering the well. At one time, filters with longitudinal slotted holes 50–80 mm long and 0.8–1.5 mm wide were widely used.

Perforated wells (Fig. 1.2d) are the most widespread (more than 90% of the stock). The wellbore is drilled to the design level. Before running the casing, the wellbore, and especially its lower part, is surveyed by geophysical means. The results of the research make it possible to clearly establish the oil-water-gas saturated intervals and outline the objects of operation. After that, a casing string is lowered into the well, which is cemented from the bottom to the desired mark, and then perforated at the scheduled intervals.Reservoir opening is a complex of operations carried out to communicate a productive formation with a well. Distinguish between primary and secondary formation opening.

The primary opening is the process of deepening (drilling) the bottom of a well from the roof to the bottom of the productive formation. A productive formation can be drilled out either together with the overlying formations or after fixing the well to its roof. In both cases, the bottom hole can be represented by an open (not cased) hole, a screen, or a perforated string.

The secondary is the creation of perforation channels after running and cementing the casing (production) string. After opening the reservoir, the well is developed, causing the flow of fluid from the reservoir, restoring (partially) productive characteristics of the bottom hole zone. The efficiency of drilling in a productive formation and well development depends on the amount of fluid inflow from the formation, i.e., the efficiency of subsequent good operation since when drilling in a formation, the flushing fluid enters the bottom hole zone and reduces the permeability of the rocks, which leads to a decrease in the good production rate.

The following requirements are imposed on technological processes for opening a productive formation:

1) Open flowing should be excluded;

2) The natural filtration properties of rocks in the bottom hole formation zone must be preserved;

3) Proper formation surface should be provided to ensure the long-term water-free operation and maximum facilitation of oil and gas flow to the bottom of the well.

Oil and gas reservoirs are reservoirs that are simultaneously saturated with oil, gas, and water at certain temperatures and pressures.

How are these requirements met?

To prevent open flowing, in the process of reservoir opening, back pressure is created on the reservoir, i.e. Bottom hole pressure should exceed the expected reservoir pressure by 5-10%. Changing the bottom hole pressure is possible by choosing the density of the drilling fluid. When opening productive formations with pressure above hydrostatic, it is recommended to use flushing solutions with a density of 2100 - 2200 kg/m3; Barite, hematite, magnetite concentrate, etc. are used to obtain weighted drilling fluids. The density of drilling fluids used to open productive formations is subject to refinement for each formation, taking into account its geological and physical features.

Classification of typical designs of good bottoms.

Depending on the significantly different properties of the reservoir and technologies for the development of hydrocarbon reserves, one of the following typical designs of good bottoms can be used:

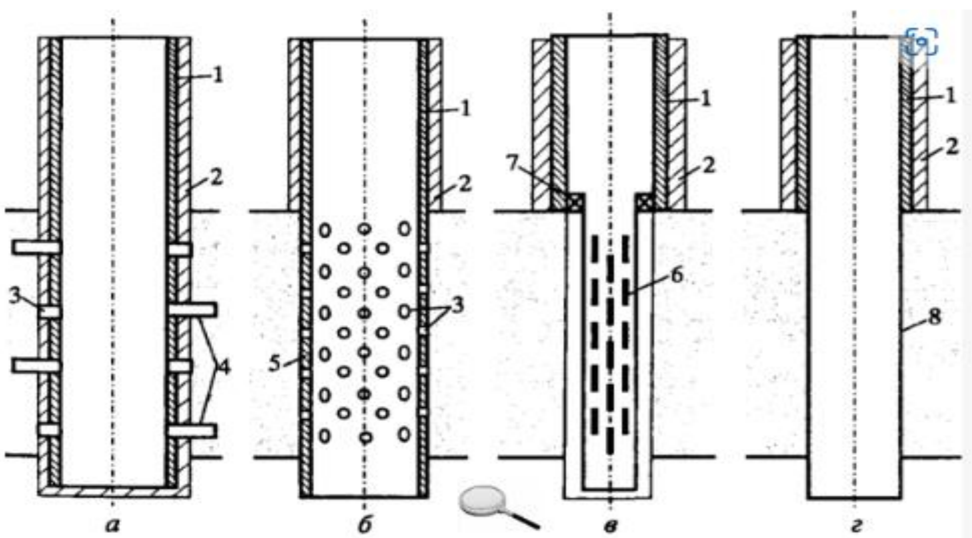

Figure 2

1. A well with a perforated bottom hole.
2. Well with a downhole liner.
3. Well with bottom hole filter.
4. Open the hole well.

Regardless of the design of the bottomhole, after opening the productive horizon, a cycle of geophysical studies is carried out in the well, and a cycle of hydrodynamic studies is also carried out in the productive horizon; based on the information received, a number of important tasks are solved.

Perforated wells are the most common in the oil industry due to a number of advantages, the main of which include:

- Reliable isolation of the passed rocks;
- The possibility of additional opening by perforation of temporarily mothballed oil-saturated intervals in the good section;
- Ease of interval impact on the bottom hole zone in case of its complex structure;
- Significant simplification of drilling technology, because drilling under the production string is carried out with a bit of the same size up to the design mark.

After the wellbore is drilled to the design mark, a casing string is lowered into the well, which is cemented and then perforated. In conditions of sufficiently strong reservoirs, such a bottom hole design is long-term stable.Wells with a bottom hole liner is designed for productive horizons represented by tightly cemented (very strong) reservoirs. The well is drilled to the design mark, and then a casing string is lowered into it, the lower part of which has drilled holes to the thickness of the productive horizon. After running the casing string, it is cemented above the top of the productive horizon; while the space between the wall and the casing for the thickness of the productive horizon remains free. The inflow into such a well is similar to that in a perfect well, but the bottom hole is fixed, which excludes a decrease in the diameter of the well even in the case of the partial collapse of the bottom hole zone.

Wells with a bottom hole filter is designed for weakly cemented (loose) reservoirs. To the top of the productive horizon, the well is drilled with a diameter corresponding to the diameter of the production string. Then casing pipes are lowered into the well and cementing is performed. The productive horizon is drilled with a bit smaller diameter to the bottom. Overlapping of the productive horizon is carried out by a filter fixed in the lower part of the casing string on a special stuffing box. The filter is designed to prevent sand from entering the well. A large number of filters are known, differing not only in design but also in the material from which they are made.

Open-hole wells are designed for homogeneous stable (strong) reservoirs. The lower part of the well (up to the top of the productive horizon) does not differ from that of wells with bottom hole filters. The productive horizon is also drilled with a bit of a smaller diameter to the bottom; while the wellbore against the productive formation remains open. It is quite obvious that such a design has the best hydrodynamic perfection, but has a limited distribution due to a number of disadvantages, the main of which are:

- Limited or even impossibility of exploitation of productive horizons of complex structure;
- The small thickness of the productive horizon;
- The impossibility of operating a well with sufficiently large drawdowns due to the destruction of the productive horizon (collapses of the bottom hole zone).

On the basis of the described typical designs of good bottoms, the possibility of creating their modifications in accordance with the characteristics of the productive horizon in each particular case is not excluded (i.e., the rationale for the design of the bottom of the well is individualized).

In addition, ring filters were used, in which slots were created between the ends of metal rings worn on a perforated pipe. Gaskets made of calibrated metal tape were installed between the ends of the rings at several points along the perimeter, which determined the width of the annular slots.

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