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DIFFERENT WAYS TO EXPLOIT GAS AND OIL FIELDS

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Abstract

Artificial waterflooding was also effectively carried out at the fields of the former Kyrgyzneft association, where by this time ten out of 13 developed oil reservoirs were covered by waterflooding.

A great deal of work on the introduction of waterflooding was carried out during this period by the teams of the Institute of Geology and Exploration of Oil and Gas Fields (IGEOF), the Department of Development and Operation of Oil and Gas Fields of the Tashkent Polytechnic Institute, the central research laboratories of the former Fergananeft, Andizhanneft oil field administrations and the Kyrgyzneft association.

Keywords. Development system, Oil recovery factor, Reservoir pressure, Well grid, Injection well, Multilayer object, Production regulation, Fergana Oil field, Waterflooding.

Introduction

The use of waterflooding has had a huge impact on the development of the oil industry. It allowed to:

- increase oil production rates;
- reduce the number of wells;
- extend the flowing period of their work;
- increase the oil recovery factor;
- reduce specific capital investments and operating costs;
- increase labor productivity.

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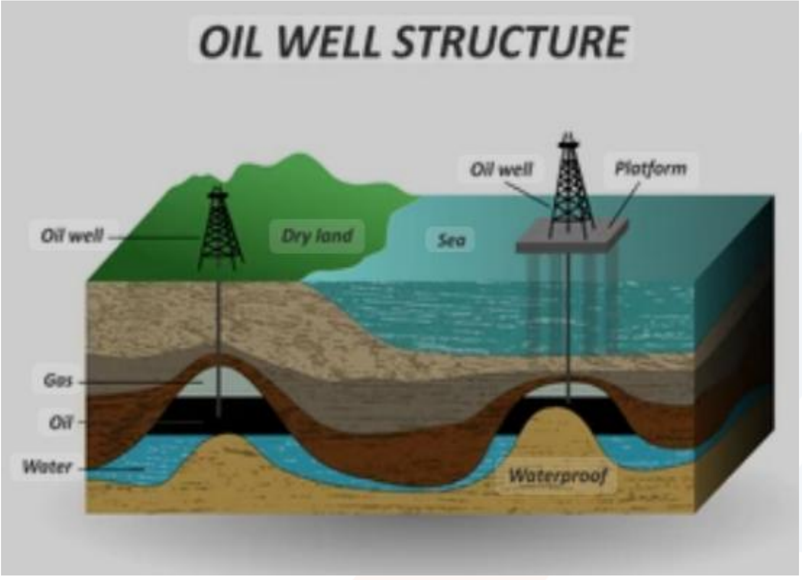
During this time, a huge amount of factual material has been collected, extensive experience in development using waterflooding has been accumulated, which requires critical analysis and generalization.

Development of waterflooding methods. Waterflooding was first applied in the Fergana oil fields in 1952, when pilot water injection was started into the peripheral part of the V+VI horizon reservoir of the Yuzhny Alamishik field. The positive effect of the pilot injection, expressed in a certain increase in the flow rate of wells in terms of oil and liquid, gave grounds to start industrial waterflooding of these horizons in 1953.

In 1954, waterflooding was started along the VIII horizon of the Khojaabad field and the VII horizon of the Yuzhny Alamishik field.

In the first years of the introduction of artificial waterflooding methods, the greatest preference was given to systems for injecting water into the peripheral parts of the reservoirs. However, the process of development and operation of these systems in Fergana faced serious difficulties, mainly due to the poor hydrodynamic connection between the peripheral and oil parts of the reservoir.

For this, as well as for a number of other objective reasons, by the beginning of 1960, peripheral waterflooding at many fields in Fergana began to be gradually supplemented or completely replaced by various intra-contour waterflooding systems. This made it possible to dramatically increase the efficiency of waterflooding and thereby gave grounds for its wider introduction at other Fergana facilities.



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Artificial waterflooding methods were particularly intensively introduced at the Fergana fields in the period 1960-1968. During this period, industrial water injection was mastered at the Andijan (III horizon), Yuzhny Alamishik (KKS and III horizons), Khojaabad (III and VII horizons), Severny Sokh (VIII horizon), Chongara-Galcha (IV horizon), Maili-Su-IV (V and VII horizons), Izbaskent (V and IX horizons) and a number of other fields.

By the end of 1968, 20 development facilities at eight fields were covered by peripheral, intra-contour and combined types of waterflooding only by the former Uzbekneft production association. The annual volume of water injection was more than 3.2 million m3. Along with the above listed traditional waterflooding systems, for the first time in the former USSR, such a combined method of impact was industrially mastered, in which peripheral waterflooding of the reservoir and the transfer of high-pressure gas to its arch part were simultaneously carried out. This method of influence was used in the development of the VIII horizon of the Severny Sokh field and the IV horizon of the Chongara-Galcha field (Galcha area).

Waterflooding and high-pressure gas transfer allowed the Uzbekneft association to produce an additional 200,000 tons of oil in 1968 alone.

Artificial waterflooding was also effectively carried out at the fields of the former Kyrgyzneft association, where by this time ten out of 13 developed oil reservoirs were covered by waterflooding.

A great deal of work on the introduction of waterflooding was carried out during this period by the teams of the Institute of Geology and Exploration of Oil and Gas Fields (IGEOF), the Department of Development and Operation of Oil and Gas Fields of the Tashkent Polytechnic Institute, the central research laboratories of the former Fergananeft, Andizhanneft oil field administrations and the Kyrgyzneft association.

A significant contribution to the solution of problems related to the development of waterflooding at the Fergana fields was made by the works of P.K.Azimov, G.A.Alijanov, A.D.Djumagulov, M.R.Ibragimov, A.M.Khutorov, S.N.Nazarov, A.R.Mukhiddinov, A.A.Tomchani, Kh.M.Turgunov, A.V.Mavlyanov and others. Many issues of waterflooding technology were solved by the engineering and technical workers of the fields, including V.P.Akulov, A.M.Akramov,

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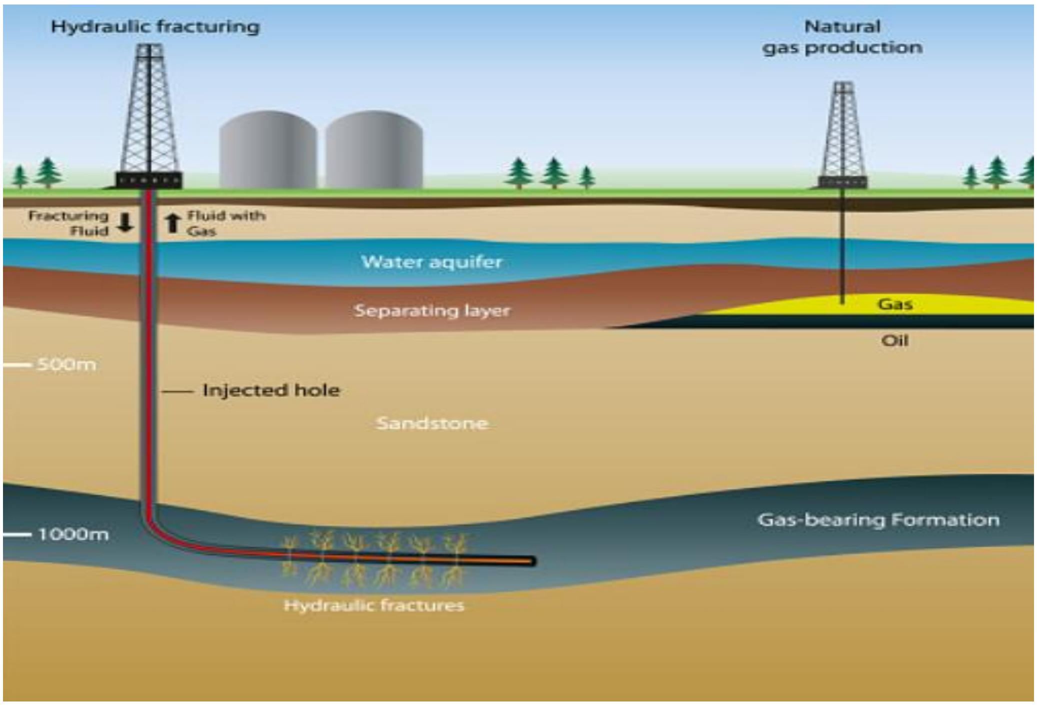
Z.V.Lyashevich, A.Kh.Khojimatov, L.I.Kalandarov, N.R.Rakhimov, I.N.Khristenko and others.

In subsequent years, V.N.Charushnikov, F.T.Adylov and others carried out a great deal of work on summarizing the experience of developing and waterflooding the Fergana oil fields, and are currently being carried out by N.V.Sipachev, E.K.Irmatov, B.Sh.Akramov, A.G.Posevich, A.Kh.Agzamov, O.A.Kayumov and others [1, 2, 3, 4, 5].



Currently, almost all Fergana oil fields are in the late and final stages of development. Artificial waterflooding methods cover about 90% of the objects under development, from which more than 80% of the total annual oil production in Fergana is extracted.

The expected ultimate oil recovery factor for waterflooded facilities varies widely - from 25-40% to 60-70%, and sometimes even higher.

Thus, it can be concluded that almost all waterflooding systems known to date have been tested at the Fergana fields.

Waterflooding will remain the main method of development in the coming years.

Ways to improve development systems. The oil field being developed, especially a large one, is a very complex system. Its main elements are reserves with all the diversity of their natural physical and geological features and technical and technological means of development and impact, including production and injection wells, technical means for oil production and water injection, collection and treatment of all well products, and control means.

Obviously, the main condition for rational development is the correct combination of all these main elements of the system.

Recommendations for development that are not tied to specific geological and physical conditions become meaningless. The features of specific fields and reservoirs are extremely diverse, but the main, defining ones include the size of the field, specific reserves per unit area, type of reservoir, permeability, reservoir stratification, oil viscosity, pressure, and regime.

An important and to a certain extent generalizing indicator for sand reservoirs is the ratio of permeability to viscosity.

It is these features that we will use when considering ways to further improve waterflooding development methods.

Improving methods should ensure:

- increase in the rate of oil production from explored reserves with the general goal of meeting the needs of the national economy;
- all-round increase in the final oil recovery, i.e. maximum use of natural resources;
- improving the economic efficiency of costs for the development of the oil production industry.

These are, of course, general and well-known provisions, but now it is worth recalling them, since we cannot be completely satisfied with the state and practical results of the application of waterflooding development methods [3, 6].

On the density of production well grids. This problem is one of the most difficult in the technology of oil field development. The complexity is due to the fact that, along with the grid density, the development indicators are also affected by the width of the strips, the distance of the first rows from the injection line, the pressure drop, etc. For a long time, in order to search for optimal solutions, grids

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were used in a wide range - mainly from 64 to 16 ha/well in fields with different characteristics and in different combinations with other development elements.

Grids of the order of 60-40 ha are accepted for reservoirs in terrigenous monolithic formations with very favorable geological and physical characteristics of reservoirs, as well as at great depths of formations, when drilling a large number of wells is economically inexpedient. In the latter case, rare grids must be combined with active impact on the reservoirs - with cutting into narrow strips or with the use of areal and selective waterflooding.

Grids of the order of 30-16 ha are used in the development of reservoirs characterized by average values of reservoir and fluid parameters and significant heterogeneity of reservoirs.

The densest grids - less than 16 ha/well - are used in the development of reservoirs with high oil viscosity, sharp heterogeneity of reservoirs, as well as reservoirs that require limiting fluid withdrawal from wells [5, 8].

The problem of choosing optimal well grids for certain conditions has not been solved.

On the pressure drop between the injection line and the production zone. Creating high pressure drops is one of the conditions for obtaining high development rates. In all possible cases, it is advisable to reduce the bottomhole pressure in production wells by 20-30% below the saturation pressure. It is also advisable to increase the pressure on the injection lines above the initial reservoir pressure, especially with reduced reservoir productivity. For low-permeability terrigenous formations, a water injection pressure of 150-180 kgf/cm² should be used.

From the very beginning of the field operation, it is necessary to correctly justify the value of the injection pressure and build waterflooding facilities for this pressure, avoiding major reconstruction work.

Some caution in choosing the injection pressure is needed when developing reservoirs associated with carbonate reservoirs. Cases of very rapid waterflooding of wells have been noted due to the movement of water along fractures. Since carbonate reservoirs have a very diverse structure of the porous medium, the permissible injection pressure must be established for each specific reservoir based on the results of pilot-industrial water injection into wells that have undergone acid treatment.

Approach to the development of water-oil zones. In the first period of waterflooding application, it was assumed that water-oil zones may not be drilled and that peripheral waterflooding in all cases will ensure the displacement of oil to production wells drilled in the inner oil-bearing contour.

1. Waterflooding of oil reservoirs will remain the main method of developing oil fields in our country for a long time. In almost all geological conditions, waterflooding ensures a significant national economic effect.
2. When choosing a waterflooding system and its main elements, the determining geological and physical factors are the size of the reservoirs, the ratio of the viscosity of oil and water in reservoir conditions, and the nature of the reservoirs.
3. The implemented development systems should ensure the highest possible coverage of the production facility with waterflooding - in terms of area and capacity.
4. When developing oil fields, in order to increase the efficiency of the adopted waterflooding systems, it is necessary to widely and systematically implement measures to regulate the process in order to increase the coverage of the reservoirs with impact and ensure the most favorable economic indicators of development.
5. The optimal ratio of Ртек.з/Рнас, at which it is advisable to start waterflooding, which ensures the greatest final oil recovery for the Fergana fields, is in the range of 60-80%. The established fact of the significant influence of the Ртек.з/Рнас parameter on the final oil recovery should be taken into account when designing energy-saving systems for the development of oil reservoirs with waterflooding. This will allow more rational use of the natural reservoir energy of the reservoir, reduce the consumption of injected water and electrical energy, and, consequently, the cost of produced oil.
6. Significant prospects for increasing the efficiency of waterflooding are associated with the introduction of cyclic methods and changing the direction of fluid flows in the reservoirs, as well as with the use of physicochemical methods to improve the properties of injected water. Along with this, it is necessary to intensify research on the search for fundamentally new additives to water and other ways to increase the efficiency of waterflooding.

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7. Research institutes need to take measures to intensify research on the development of deposits of high-viscosity and high-paraffin oils, oil and gas deposits, on the development of principles for regulating development, on improving the development of deposits at a late stage, methods for justifying design oil recovery, and on solving economic problems of developing oil fields.

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