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HISTORY AND BASIC PRINCIPLES OF OIL FLOODING

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ABSTRACT

Although water has been a companion of oil since its formation, the appearance of water in production wells was considered an emergency and the wells were stopped. And only in the late 20s - early 30s of the 20th century it was noticed that more oil was extracted from wells in which water appeared and production was more stable than in waterless wells. In 1932, a commission led by academician. THEM. Gubkin, when analyzing the state of development of fields in the Staro-Groznensky region, established the possibility and effectiveness of displacing oil from reservoirs by contour formation waters. The natural water pressure regime for developing oil deposits was recognized as the most effective.

KEYWORDS

Introduction

Since the 30s of the 20th century, the theory of the oil reservoir, the water pressure regime of development and the interference of wells began to develop (M. S. Leibenzon, M. Masket, V. N. Shchelkachev, etc.). However, the idea of replenishing reservoir energy spent on displacing oil by injecting water into reservoirs through wells from the surface was first put forward and implemented in the CIS only in the post-war years under the leadership of Academician. A.P. Krylov on a small scale at the depleted Shirokaya Balka deposit. In 1948, contour flooding was carried out on a large industrial scale at the Tuymazinskoye field from the beginning of development [1, 2]. In the USA, until the 19-20s of the 20th century, reservoir flooding was not used. Separate five-point elements of areal flooding were carried out in the late 20s at the depleted Bradford field. It was only in the 1940s, in connection with the increased demand for oil, that artificial flooding of oil deposits began to be seriously used, and the Texas Railroad Commission, which controls field development, ceased to prohibit flooding of oil deposits [3, 4]

Waterflooding of oil deposits has become widespread in other oil-producing countries of the world - Canada, Great Britain, Saudi Arabia, Romania, etc.

Waterflooding of oil deposits in Uzbekistan began to be used starting in the 1950s in the fields of the Fergana Depression.

The popularity of artificial waterflooding of oil deposits in all countries is due to its following indisputable advantages:

• availability and low cost of water;

• relatively high efficiency of oil displacement by water.

Currently, conventional waterflooding of oil reservoirs is the most generally accepted and most effective method for increasing oil recovery. This method will be widely used for a long time precisely because of these advantages.

Waterflooding, aimed at replenishing reservoir energy resources and improving the viscosity ratio of the displaced (oil) and displacing (water) fluids, although it does not eliminate the negative impact of formation heterogeneity and the action of capillary and gravitational forces, is nevertheless a highly potential method. The development of oil flooding systems, technology and methods in different countries took different paths. As a result, various principles for waterflooding oil fields have emerged.

The main principles of waterflooding oil deposits include:

- time of the start of artificial flooding;
- well placement system;
- density of the well network;
- procedure for drilling wells;
- flooding system;
- flooding technology;
- shutdown of wells;
- pace of development;
- oil recovery (recoverable reserves);
- development of water-oil zones;
- development of multi-layer fields;
- area of application of flooding;
- water for flooding.

Questions about the feasibility of artificial waterflooding and the timing and start of water injection into the formations were especially carefully considered in the first oil field development projects. They assessed the possibility of using and the reserve of natural energy of deposits, and determined the proportion of oil reserves that can be extracted using natural reservoir energy. In the practice of developing US oil fields, waterflooding was usually used only at the very late stages of development. At first, the fields were developed for depletion (until the extraction of 5-10% of geological oil reserves) without artificial impact on the formations, and then, as a rule, areal artificial flooding systems were introduced. In the practice of developing oil fields in Russia, they tried to use waterflooding from the beginning of their development.

Development of fields to deplete reservoir energy initially ensures high development rates and rapid return on capital investments, allows one to study the structure of reservoirs, determine the mechanism of oil movement in reservoirs and use reservoir energy.

The disadvantages of the waterflooding method from the beginning of development, i.e. when the reservoir pressure is higher than the saturation pressure, compared to waterflooding after some degassing of the oil in the reservoir, include the fact that this requires higher injection pressures for water injection and capital investments are required in the arrangement of the system waterflooding in

an earlier, initial period of field development. In recent years, in the United States (the Prudhoe Bay field in Alaska and offshore fields, Forties in the UK, etc.), waterflooding of fields begins to be used immediately after they are put into commercial operation. This is due to the fact that expensive wells require high flow rates, and the fact that many years of experience in developing oil fields has proven the effectiveness of early flooding.

In the fields of Uzbekistan, waterflooding was introduced both in the early and late stages of development of objects.

Initially, the use of waterflooding was associated mainly with the injection of water into injection wells located in the edge part of the field (edge flooding). However, development experience has shown certain shortcomings of the edge flooding system. Due to the poor properties of the formations in the marginal zones and the increased viscosity of oil, many extra injection wells had to be drilled in them. For large fields, the use of contour flooding led to the conservation of significant oil reserves in the central parts of the fields; for example, with purely contour flooding, it was not possible to extract more than 2.5% of the oil per year from the initial recoverable reserves. Contour flooding is also characterized by significant water outflows (from 40 to 70% of the injection volume) beyond the oil-bearing contour of the deposits. The principles of edge flooding - multi-stage development, transfer of injection, shutdown of low-water wells and others - have not become widespread.

The development of contour flooding was the creation of an intra-circuit flooding system. In this case, the field is “cut” by rows of injection wells into separate strips, blocks or areas of independent development, and oil is displaced by injected water.

The experience of using in-line waterflooding shows that current development indicators improve and the final oil recovery from reservoirs increases by no less than 5% compared to in-line waterflooding /5,6,7,8/.

The variety of natural conditions in which oil accumulations are located, the desire for the most complete consideration of the geological and physical characteristics of production facilities in order to increase the coverage of reservoirs by flooding served as the basis for improving and modifying development systems. Other flooding systems and technologies were justified and widely introduced into industry: peripheral, block, axial, areal, focal-selective, barrier, etc.

In conclusion, it should be noted that on the main fundamental issues of waterflooding of oil fields, over the long history of its implementation, ideas have changed. Therefore, improving the efficiency of waterflooding is an important direction for increasing the ultimate oil recovery of reservoirs. The main problem with waterflooding is to increase the coverage of formations by drainage and waterflooding. It can be solved by improving the placement of wells, injection technology, etc.

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