

## ANNOTATION

**General characteristics of the dissertation research.** This work is devoted to the study and improvement of the methods of the development process of the high-viscosity Zaburunye deposit, to achieve high efficiency of the oil recovery coefficient (KIN), flooding systems, with examples of the application of tertiary methods of increasing oil recovery. The research carried out offers a theoretical solution and the development of a model of the process of dynamics of pressure changes in the reservoir, which will significantly affect the improvement of field development. Also, the study of reducing the viscosity of oil by electrophysical exposure is considered.

**The relevance of the study** lies in the fact that, despite the success of the development of oil fields, it is determined by how correctly the development system will be chosen. The high efficiency of flooding systems is due to the fact that reservoir pressure is increased by means of water injection, as a result of which oil is squeezed more efficiently from the pore space to production wells. The main advantage of such systems is that when flooding increases the intensity of oil extraction from the reservoir. On the other hand, such methods of maintaining reservoir pressure pose a danger of flooding productive formations. A situation may arise when the injected water "outstrips" the oil, moving along the most permeable areas. In this case, part of the oil in the reservoir is isolated in the so-called "tseliki", which in turn will make it difficult to extract it. It is very important to be able to regulate the flooding processes. Regulation methods based on changes in the intake capacity of injection wells and oil extraction from producing wells require information about current changes in the reservoir. Exploration and improvement of field development is one of the most important and most difficult problems of oil field development in terms of flooding. In this regard, a new method for solving problems of pressure distribution patterns in the reservoir was considered in the research work and a new model for calculating the pressure distribution in the reservoir was created.

**The relevance** of making fundamental decisions at the stages of designing the development system and the initial arrangement of the field being put into operation is complicated, as a rule, by insufficient knowledge of the structure of oil deposits, the nature of changes in the properties of the host rocks and the fluids saturating them by area, the distribution of energy resources, including the distribution of pressure in the reservoir.

The results of the analysis will help to avoid mistakes in the design and development of oil and gas fields, and can also be used in regulating the development of facilities at later stages of field development.

The intensification of the production of residual oil reserves at the final stages of development requires the competent application of development methods, due to the inexpediency and economic unprofitability of drilling new wells at this stage.

In these conditions, the classification of existing flooding systems – polymer flooding, the results of generalizing the experience of implementing and developing the method are of great importance for improving the development of

the field, the development of the design of the development and planning of oil production.

One of the most important parameters affecting the efficiency of oil field development during flooding is the viscosity of oil saturating productive deposits. The study of the dependence of KIN on the viscosity of oil has become especially relevant in recent years, taking into account the decrease in the viscosity of oil to stimulate an increase in the production of high-viscosity oils.

**The purpose and objectives of the study.** Study and improvement of methods of the development process of the high-viscosity Zaburunye deposit.

**Within the framework of this study , the following tasks were set and solved**

1. Research methods of efficiency and improvement of the development of oil facilities based on numerous changing factors.

2. Assessment of the impact of the development system of the Zaburunye oil field on the efficiency of reserves production.

3. Development of a model of the process of changing the dynamics of pressure in the reservoir

4. Determination of the main patterns of changes in the phase composition of high-viscosity oil during processing by electrophysical methods

**Methods and solutions of problems.** The solution of the tasks was carried out by conducting theoretical, experimental and numerical studies, analyzing the results using software.

**The objects of the study** are heterogeneous layers of the Neocomian horizon of the Zaburunye deposit.

Scientific novelty of the work

1 In the dissertation work, a new model of pressure distribution in the reservoir was proposed for the first time, taking into account the angle of change in the pressure distribution in a circle, a two-dimensional problem was obtained from a one-dimensional problem, that is, the change in the dynamics of pressure distribution in the reservoir was brought to a new level by applying known solutions.

3 An experimental study of the pressure distribution in the reservoir was carried out, which made it possible to remove the characteristics of the pressure distribution along the axis of the segment of the oil reservoir under variable boundary conditions

3 A three-dimensional hydrodynamic model has been created for the distribution of pressure in the formation, taking into account the porosity and permeability of the formation.

4 The dependence of the change in oil viscosity on the type and parameters of electrophysical effects is established. The main patterns of changes in the chemical and phase composition of high-viscosity oils during processing by electrophysical methods are revealed.

**Scientific and practical significance of the study**

A mathematical model of the dynamics distribution processes in the near-enclosed space is proposed, taking into account changes in the pressure distribution

along the angle of inclination, which allows calculating the efficiency of flooding, will improve the prediction of pressure distribution over injection and production wells, which leads to improved methods of control and regulation of development in oil fields.

On the topic "Research and improvement of methods for the development of the high-viscosity Zaburunye deposit", methods for reducing the viscosity of oil are considered, the scientific and technical justification for reducing the viscosity of oil is analyzed, the dependence of changes in the viscosity of oil on the type and parameters of electrophysical influences is established.

**The theoretical significance of the study** lies in the fact that the pressure distribution in an inhomogeneous reservoir was taken into account by means of development regulation. A feature of the work is the solution of a practice-oriented fundamental problem associated with problems at the late stages of field development, uneven promotion of agents injected for the purpose of PPD, to increase the KIN.

#### **The main provisions submitted for protection**

1 Position to be taken out for protection. An integrated approach to the study of the effectiveness of polymer flooding technology is largely determined by the properties of the reagents used and the selection of reagents should be carried out taking into account individual characteristics and the state of development of a particular deposit.

2. Solving pressure distribution problems in circular deposits. Considering circular deposits as a source and drain is reduced to solving the internal and external Dirichlet problem and is shown for any value of  $r < R$  and  $-\pi \leq \varphi \leq \pi$ , it is possible to calculate the dynamics of the pressure distribution inside the circle and outside the circle by taking a given value at the boundary of the circle. A two-dimensional mathematical model of the dynamics of pressure distribution in a circular deposit is constructed.

3. The main patterns of changes in the chemical and phase composition of high-viscosity oils during processing by electrophysical methods have been identified, which makes it possible to create various methods of influence in order to change the properties of oil.

**The personal contribution** of the author consists in the practical performance of the work on the literature review on the topic of the dissertation, the formulation of tasks, analytical research to identify the theoretical solutions of the proposed mathematical model, conducting experimental research, processing and interpretation of the results obtained, numerical research in the construction of hydrodynamic models, and the economic effect of the proposed work.

Theoretical studies and field experiments of the tertiary MUN method on the example of a deposit in Western Kazakhstan are considered.

The effectiveness of polymer flooding technology is largely determined by the properties of the reagents used and the selection of reagents should be carried out taking into account individual characteristics and the state of development of a particular deposit.

Promising types of polymers for the conditions of high-viscosity oils have been studied, which have hydrophilic and hydrophobic macromolecule links in their structure and consist of a long hydrophilic chain with a small number of hydrophobic groups located along the main chain or at its ends.

The basic information about the methodology and methods of constructing hydrodynamic modeling of an oil field is investigated.

A two-dimensional mathematical model of the dynamics of pressure distribution in a circular deposit is constructed. Considering circular deposits as a source and drain is reduced to solving the internal and external Dirichlet problem and is shown for any value of  $r < R$  and  $-\pi \leq \varphi \leq \pi$ , it is possible to calculate the dynamics of the pressure distribution inside the circle and outside the circle by taking a given value at the boundary of the circle.

An experimental study was carried out aimed at studying the pressure distribution in the reservoir, which made it possible to remove the characteristics of the pressure distribution along the axis of the segment of the oil reservoir under variable boundary conditions. To carry out the necessary research, an experimental installation was constructed, consisting of three layers with different physical characteristics. The main reservoir was designed with special pressure sensors, which will allow to record the pressure along the axis of the segment. By selecting the necessary porous media of the formation, parameters close to the study of the pressure distribution in the formation under variable boundary conditions were obtained.

For the effective application of this method of reducing the viscosity of oil, it is necessary to carefully select the optimal mode of wave processing. With the improvement of existing technologies, this method in combination with others can be used to develop hard-to-recover reserves.

The established dependence of changes in oil viscosity on the type and parameters of electrophysical effects. The main patterns of changes in the chemical and phase composition of high-viscosity oils during processing by electrophysical methods are revealed.

It is recommended for use in many fields of Western Kazakhstan. Since the creation of new combined effective technologies for increasing KIN, for example, as electrophysical effects will ensure an increase in oil production, at the same time, it will allow to obtain a sufficient effect on reducing viscosity, as well. they will reduce the environmental burden on the environment.

According to the results of a laboratory experiment, it was found that after ultrasonic exposure, the oil heats up by 3-4 ° C, resulting in a decrease in viscosity by 30%, the viscosity was studied in the range of 138-257. 82 MPa \* S. During these works, the effect of phase separation was also observed without the addition of a demulsifier and without additional heating. Thus, the main patterns of changes in the chemical and phase composition of high-viscosity oil during processing by electrophysical methods were identified, which allowed the development of various methods of exposure to change the properties of oil.

The research results are presented as a patent for a utility model. The calculation of technical and economic indicators for development options is based

on the accepted standards of technological indicators and operating costs, capital investments, as well as the tax system of the Republic of Kazakhstan.

When studying the economic efficiency of the proposed method, which takes into account all costs, the cost of oil decreased, and the annual economic effect increased. The proposed methods are effective. The annual economic effect amounted to 17,581,121,74833 tenge.

**According to the dissertation work**, scientific literature sources and modern advanced technology of the field development system, geological and technical measures in formations with heterogeneous permeability were studied in order to select the most rational technology of methods for increasing oil recovery.

Approbation of the work. The materials of the dissertation were reported and discussed at international conferences :

- International scientific and practical conference Satpayev Readings 2019 "Innovative technologies – the key to the successful solution of fundamental and applied problems in the ore and oil and gas sectors of the economy of the Republic of Kazakhstan" (Almaty, Kazakhstan, 2019)

- VIII International Scientific and Technical Conference of students, postgraduates and young scientists "Water supply, sanitation and environmental protection" (Ufa, Russia, 2019)

- XVII International Scientific and Practical Conference "International Trends in Science and Technology" (Poland, Warsaw, 2019)

- III International Conference – Symposium "Introduction of scientific achievements into practice and elimination of corruption activities in it" (Tashkent, Uzbekistan, 2019)

- International scientific and Practical conference "Kazakhstan oil: past, present and future" dedicated to the 120th anniversary of Kazakhstan oil (Atyrau, Kazakhstan, 2019)

- International scientific and practical conference Satpayev Readings 2020 "Innovative technologies – the key to the successful solution of fundamental and applied problems in the ore and oil and gas sectors of the economy of the Republic of Kazakhstan" SECTION "SCIENTIFIC RESEARCH AND INNOVATION IN GEOLOGICAL EXPLORATION – THE KEY TO THE EFFECTIVE REPLENISHMENT OF THE MINERAL RESOURCE BASE of the Republic of Kazakhstan", (Almaty, Kazakhstan, 2020)

- International scientific and Practical conference Satpayev readings 2021 "Modern technologies in the processes of drilling, production, collection and transportation of oil and gas" (Almaty, Kazakhstan, 2021)

### **Publications**

The main results of the study are presented in 3 articles from the list approved by the Committee for Control in the Field of Education and Science of the Republic of Kazakhstan, 4 journal included in the database "Scopus", 2 articles in the journals of the RSCI of the Russian Federation, 9 journals of the near abroad.

### **Volume and structure of the dissertation**

The dissertation work is presented on 93 pages of computer text, consists of an introduction, 4 sections, a conclusion, a list of references from 122 titles, contains 60 figures, 14 tables and 3 appendices.

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