

## ANNOTATION

dissertation work of Bekbayeva Raushan Askarovna on the topic:  
«Improving the efficiency of development of oil fields in Western Kazakhstan  
using the method of simultaneous and separate exploitation of reservoirs»  
submitted for degree of Doctor of Philosophy (PhD) degrees in the educational  
program 8D07210 (6D070800) – Oil and Gas Business

### **The relevance of research:**

The oil and gas industry of the Republic of Kazakhstan is experiencing an active period of its development. However, the problems of the irreplaceability of the resources of the oil and gas industry require a wide and intensive search for ways to successfully overcome them.

The world community is actively seeking alternative solutions to this problem, and in these conditions, the responsibility for the need to successfully solve problems in the oil and gas industry is increasing many times over.

In the recent past, multi-layer deposits with different physical and geological conditions in the layers were developed by sequentially putting them into production according to the “bottom-up” scheme. Such a system slows down the development of deposits, is accompanied by the loss of a significant amount of products remaining in low-power formations and areas.

The beginning of the spread of the technology of simultaneous and separate operation of reservoirs (SSE) – is a powerful means of increasing the technical and economic efficiency of the development of oil and gas fields.

The issues of creating a methodology for clarifying the separation of mined products in the joint development of formations and on its basis the choice and justification of the selection regime and the selection of equipment for the SSE are highlighted as paramount tasks. In addition, the exploration of individual formations for the influx and determination of its hydrodynamic characteristics, as a rule, in fishing conditions are often incomplete. In accordance with this, the tasks of the author’s research include determining the effectiveness of oil selection from a multi-plast deposit by assessing current reserves and calculating the selection regimes for each layer from the effect of changes in reservoir energy using the example of Western fields Kazakhstan.

### **Rationale for the need for this research work:**

The use of technologies for the separate operation of reservoirs in Kazakhstan when selecting products from a multi-plast deposit is increasingly used, as it allows one grid of wells to select oil from several layers at the same time, which allows to accelerate the production of oil reserves. However, when selecting from several layers, the problems of accounting and the state of stock generation have not yet been completely resolved. No less problematic are the issues of determining the criteria for choosing wells for the SSE based on the existing geological and physical characteristics of the oil field, with its filtration and capacitive properties, the state of production of reserves by formations.

**The purpose of the dissertation:** Improving the efficiency of simultaneous selection of oil from a multi-plast deposit.

**Research objectives:**

- analysis of the current development of a multi-layer field in Western Kazakhstan with productive layers of Jurassic deposits.
- allocation of operational areas for the application of SSE technology;
- for the successful application of SSE technology, organize the use of types of equipment and tools, develop technology for installation, operation and research of SSE well equipment;
- consider the advantages of SSE technology;
- justify design development options and their initial characteristics;
- carry out pilot work for the introduction of SSE in the horizons under consideration to achieve the effectiveness of application.

**Object of study** - multi-plast deposits in the fields of Western Kazakhstan.

**Subject of study** - well that drains several productive formations with special equipment in different technological regimes.

**Research methods:** The solution of the tasks is based on analytical and field studies using modern methods of processing source information and their analysis.

**Basic provisions for defense:**

1. Classification of SSE technology schemes for the fields under consideration.
2. Methodology for conducting thermohydrodynamic studies in wells with an SSE to determine the filtration and capacitive properties of each of the layers of a multi-plast object, as well as to determine the share of the contribution of each formation to the total well production during joint operation.
3. Criteria for choosing candidate wells for SSE technologies.
4. Methodology for clarifying the separation of mined products from a multi-plast deposit based on determining the utilization rate of potential oil recovery coefficient.
5. Assessment of the technological and economic efficiency of the implementation of the SSE technology at the Arystan field.

**Scientific novelty of the work.**

1. The effectiveness of the introduction of the method of simultaneous-separate operation in the development of Jurassic deposits of the Ayrankol field is substantiated.
2. The values of the criteria for the application of simultaneous-separate operation are scientifically substantiated and obtained.
3. A method for clarifying the separation of extracted products from a multi-layer deposit during joint development of formations has been created, including determining the coefficient of use of the potential oil recovery coefficient (ORC) over time with a certain degree of opening of layers, their conductivity (kh), has been created, calculated by dividing the accumulated production by the product of geological reserves and potential ORC for the well in question by formations.

4. It is revealed that the proposed arrangement of wells at the same time-separate operation of the fields under consideration allows to ensure the maximum flow rate of the well.

**The practical significance of the work:**

The results of the dissertation work are used in the development of multi-layer deposits by using a methodology for assessing and calculating the current depletion of oil reservoirs and selecting equipment for extracting oil from the reservoirs.

The introduction of a set of measures, including work on optimizing selection modes with SSE technologies at the Ayrankol field made it possible to increase well flow rates by an average of 29 tons/day, at the Arystanovskoye field - 23 tons/day and increase the level of oil production.

**Compliance with the directions of scientific development or state programs:** The dissertation corresponds to the priority direction of scientific development, approved by the Higher Scientific and Technical Commission under the Government of the Republic of Kazakhstan in direction 1. Ecology, environment and rational use of natural resources: incl. 21) Development and operation of oil and gas fields.

**The author's personal contribution** consists of conducting experimental and theoretical research, processing measurement results and their analysis, as well as participating in writing publications and discussing research results at scientific conferences and exhibitions. The formulation of the problem and discussion of the results were carried out jointly with scientific consultants.

**Reliability of the results:** The reliability of the scientific provisions and conclusions of the dissertation work is justified by the use of modern mathematical methods of data processing and information analysis, the consistency of the results of theoretical and experimental studies with evaluation using appropriate criteria.

**Description of the main research results:** Based on the results of the research, the following main conclusions can be drawn:

1. An analysis of the operating parameters of existing wells using the technology of simultaneous-separate exploitation at the Airankol field was performed. The analysis showed that, in general, the integrated energy production technology being implemented in the field is characterized by the coordinated operation of carefully selected pumping equipment and productive formations, combined for simultaneous and separate oil production. This picture indicates a uniform development of reserves, eliminating inter-layer flows and other problems of joint development.

2. Based on the study of the hydrodynamic characteristics and reserves of jointly developed formations, a new method has been created for determining the depletion of oil reserves by formation based on the known geological and physical characteristics of reservoir systems and the physicochemical properties of the pumped product, including determining the utilization factor of the potential oil recovery coefficient (ORC) over time at a known degree of penetration formations, their conductivity (kh), calculated by dividing the accumulated

production by the product of geological reserves and the potential ORC for the well in question by formation.

3. Numerical values of the criteria for selecting wells for the use of simultaneous-separate exploitation at the Airankol field were obtained. Using the methodology of well selection criteria, priority candidates were selected for further implementation of simultaneous-separate exploitation technology.

4. Developed scientifically based methods ensure control of the filtration and reservoir properties of productive reservoirs, regulation of the rate of development of reserves of objects, which generally increases the efficiency of development of multi-layer fields.

5. A technology has been proposed for productive characteristics and reservoir properties in the SSE using formations with cut-off layers, which consists of simultaneous studies in a steady state for one layer and studies in a non-steady state for the second layer. The results of the study determine the parameters of the filtration system, which make it possible to further model the inflow, optimize the method of oil production, plan and evaluate the effectiveness of geological and technological measures.

6. Based on a study of the state of the SSE in comparison with the separate development of production facilities at the Airankol field, the main factors determining the effectiveness of this technology have been established; expressed in reducing capital costs for drilling and infrastructure for well development; in reducing operating costs; in reducing the time for development and development of a multi-layer field, as well as in increasing the period of profitable operation of wells. According to forecast indicators, the daily efficiency of the further implementation of SSE at the wells of the Airankol field for eleven selected wells was 322,1 tons/day, the average payback for converting one well to electronic energy production technology was 0,65 months.

7. For the first time, the economic efficiency of using technologies at the Arystanovskoye field has been substantiated. Development indicators were calculated, a comparison was made between the classic version and the option with simultaneous separate development of layers. As a result, the option when using SSE technologies is the most appropriate in terms of technical and economic indicators. When calculating forecast indicators using the history of well production data, the increase in well production rate averaged 23,0 tons/day.

8. A methodology for selecting SSE wells in multilayer fields has been developed, based on an analysis of existing equipment. Using the SSE equipment selection algorithm, the equipment layout for the fields under consideration was selected.

**Approbation of work results:** The results of the dissertation and its main points were reported and discussed at the International Scientific and Practical Conference « Development of science and technology in the development of the

bowels of Kazakhstan ». dedicated to 90 – the anniversary of Academician Sh. Yesenov. Aktau, 2017; at the International Scientific and Practical Conference « Methods for increasing oil recovery and intensifying oil production », JSC « KazNIPIneftegaz ». Aktau, 2018.; International Scientific and Practical Online Conference « Modern Technologies in Science and Education». Aktau, 04/28/2021; at the Ith International Forum « Transport. Development horizons ». Nizhny Novgorod, May 25-28, 2021; at the International Scientific and Practical Conference « Advances in Oil and Gas Geology and Geotechnologies ». Baku, May 23-26, 2023.

**Publications:**

The main results of the dissertation are published in 12 scientific works, including in the leading peer-reviewed scientific journals recommended by Committee for Control in the Sphere of Education and Science of the Republic of Kazakhstan, as well as on the basis of foreign scientific materials Scopus.

**Volume and structure of the dissertation work:** The dissertation consists of an introduction, three chapters, main conclusions and recommendations, a list of used literature, including 100 titles and 4 applications. The work contains 103 pages of text, 9 tables and 31 drawings.