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Improving operational performance at the Sharky Berdak gas condensate field

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ABSTRACT: The article considers the prospects for the growth of hydrocarbon reserves in Uzbekistan on the example of the Ustyurt region, where a significant part of the resources is concentrated in сложнопостроенныхcomplex multi-layer deposits. It is shown that a high degree of depletion of existing reserves requires the activation of geological exploration, development of new fields and increasing the productivity of the existing well stock. The efficiency of using low-pressure booster compressor stations (LBCS), which provide an increase in the gas recovery coefficient and extend the life of deposits, is justified. The experience of development of the Sharkiy Berdak and Surgildeposits is presented, which confirms the expediency of combining the early stage of operation with the continuation of geological exploration and the introduction of innovative technologies for production intensification.

KEY WORDS: Ustyurt region, hydrocarbon reserves, gas condensate field, gas recovery factor, LBCS, geological exploration, production intensification, Sharkiy Berdak, Surgil.

I. INTRODUCTION

Prospects for further growth of Uzbekistan's hydrocarbon resources are largely determined by the intensification of geological exploration and increasing the efficiency of field development in the Ustyurt region [1]. A significant part of the reserves here are concentrated in complex multi-layer deposits, which necessitates the use of innovative technological solutions. At the same time, the high degree of depletion of existing reserves (an average of 77.5 %) [5] and the projected decrease in production at the main fields to 43.9% by 2030 actualize the task of developing new facilities[6] and increasing the productivity of the existing well stock

In modern conditions, methods aimed at comprehensive development of deposits, combining geological exploration with an early stage of commercial operation, as well as the introduction of technologies that increase the efficiency of production under difficult geological and field conditions are of particular importance [4]. The experience of operating the Sharkiy Berdak and Surgil fields confirms that the use of low-pressure booster compressor stations, geophysical monitoring and innovative solutions for production intensification can ensure the stability of production, reduce the risks of premature flooding and create prerequisites for the sustainable development of gas production in the country[9].

II. SIGNIFICANCE OF THE SYSTEM

The developed system for the development and intensification of hydrocarbon production in the Ustyurt region, based on the introduction of low-pressure booster compressor stations, is of strategic importance for ensuring the energy security of Uzbekistan. It allows us to stabilize production against the background of a high degree of depletion of reserves, increase the gas recovery rate and extend the operational life of deposits. The system also helps to reduce the water content of extracted products, minimize corrosion and technical and economic risks, and the introduction of modern methods of geophysical and hydrodynamic control ensures more accurate delineation of deposits. In addition, the use of energy-efficient technologies and automated control systems increases the economic sustainability of the development and creates prerequisites for the long-term development of the country's gas production industry.

III. METHODOLOGY AND DISCUSSION

Based on the conducted research aimed at solving the problems of the dissertation work, new approaches to increasing the productivity of existing and newly drilled wells are formulated. Their essence is as follows:

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- organization of a complex of control geophysical studies in accordance with the requirements of geological and hydrodynamic monitoring of the development with the use of modern radioactive methods to identify interplastic horizons, clarify the displacement of the gas-water contact (GWC) and identify potentially productive reservoirs, which makes it possible to more effectively delineate locally shielded zones of deposits;
- clarification of the current position of the GWC and determination of the optimal perforation thickness, which ensures the possibility of anhydrous gas production in the presence of bottom water and allows achieving the expected effect from compaction of the well grid and operation with the use of LBCS;
- use of production intensification technologies, including the removal of liquid from the face by dispersing, the use of surfactants, as well as optimization of product collection and preparation systems with the introduction of LBCS at the current stage of development;
- planning of a set of measures to maintain a stable level of hydrocarbon production (ZBS, hydraulic fracturing, surfactants, LBCS), taking into account the actual or calculated parameters of the GWC displacement and the formation of a water cone;
- reduction of geological and technological and technical and economic risks by increasing the maximum waterless flow rate of gas wells by creating an artificial impenetrable screen [2, 3].

IV. EXPERIMENTAL RESULTS

ГКМ The Sharkiy Berdak gas field is characterized by complex geological and field conditions associated with the multi-layer structure of reservoirs and the active pull-up of bottom waters, which significantly complicates the process of hydrocarbon production. Traditional development methods are not sufficient to ensure high gas and condensate recovery, so the introduction of innovative technological solutions is required. In particular, the experience of operating fields in the Ustyurt region has shown the need to drill additional wells, optimize the technological modes of water-revealing wells, carry out major repairs and improve the field development system, which is aimed at increasing the efficiency of gas extraction and extending the life of the well stock.

While the number of producing wells will increase to 80 by 2024, further densification of the grid does not guarantee an increase in efficiency. The main complicating factors remain a decrease in reservoir pressure, inter-reservoir flows of mineralized water, and accelerated wear of equipment due to corrosion. To minimize the negative consequences, it is recommended to carry out cattle breeding using special silencing fluids and introduce low-pressure booster compressor stations (LBCS), which reduce wellhead pressure and increase well flow rates. Such a set of measures contributes to the stabilization of production, reduction of water content and more rational development of the field's potential [4, 5].

Studies conducted on the example of the Kuyi Sharkiy Berdak fieldhave shown (Figure 1) that in the absence of the NDCS in the period 2023-2031, annual gas production is expected to decrease until it is completely stopped by 2031, with a gas recovery factor (GCI) of only 36.1%. At the same time, the introduction of the LBCS makes it possible to achieve a significant increase in gas production, followed by a gradual reduction in its volumes until 2039. At the same time, the final GEC reaches 77.1%, which is almost twice as high as compared to the development option without the use of LBCS [6].

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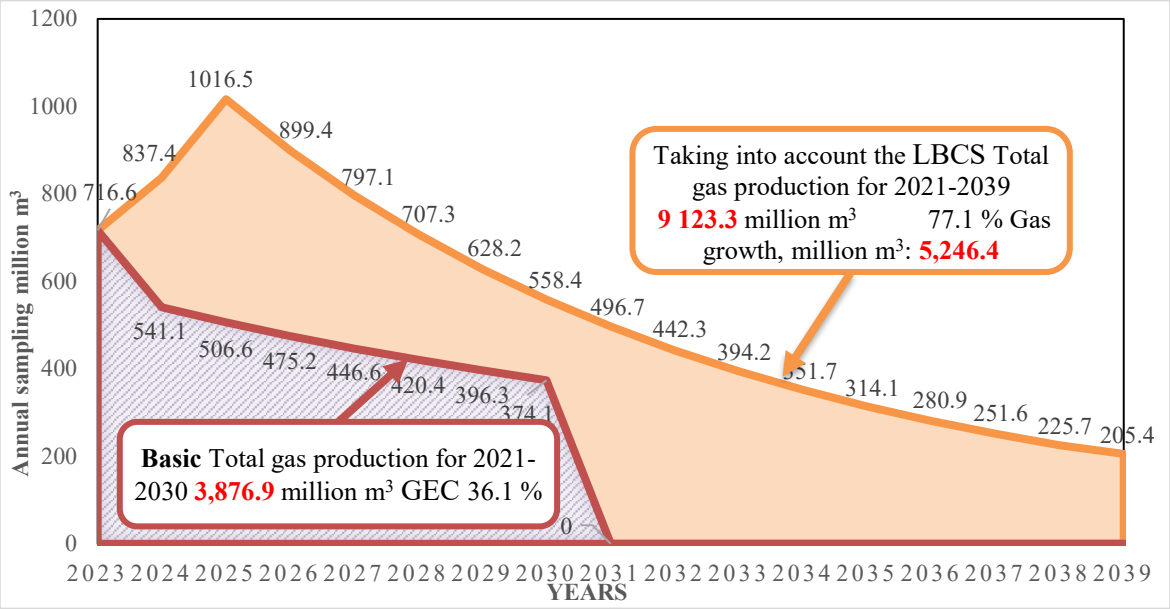

Figure 1-Rates of production opportunities associated with the construction of the Kuyi Sharkiy Berdak mining and Processing complex (compiled by Bekov B. Kh., 2024)

A similar calculation method based on the example of the Sharkiy Berdak field showed (Figure 2) that without the introduction of the LBCS in the period 2022-2150, annual gas production is projected to fall until its complete cessation in 2150 at GEC =80.7%. Let's pay attention to the period of 129 years and the absence of risks of premature flooding and stopping production wells. With the introduction of the LBCS at the field, a sharp increase in gas production is predicted, then until 2028, its gradual decline until 2064, and a more intensive decline in production until 2075 due to the failure of well facilities. At the same time, for the period under consideration, i.e. 2022-2075, the final GEC =80.8%, i.e. by 0.1% 2.5 times less than the development period without LBCS [7].

As a result of the dissertation research, the main components of the gas compression system are recommended in the case of arranging the gas production system of the LBCS: Recommended parameters of LBCS compressors:

Reciprocating compressors are ideal for high pressures and relatively small gas volumes. They are characterized by high reliability and durability, which is especially important in remote areas of the Ustyurt region.

Centrifugal compressors are used to compress large volumes of gas at low pressure. They provide high productivity and low operating costs, which makes them cost-effective for operation in large fields.

Process pipelines:

Pipelines for transporting produced gas from wells to compressor stations must be made of materials that are resistant to corrosion and high pressures. For this purpose, modern composite materials are used to ensure durability and reliability.

Given the long distances and difficult climatic conditions of the Ustyurt region, it is important to ensure proper insulation of pipelines to minimize heat loss and ensure stable operation of the system.

Cooling systems:

Cooling systems play an important role in the gas compression process. They prevent overheating of compressors and increase their efficiency.

In the Ustyurt region, both air and water cooling systems are used, which are adapted to work in different climatic conditions.

Innovative solutions and technologies

Automation and digitalization:

The introduction of automated control systems improves the accuracy and efficiency of the compressor station operation. State-of-the-art monitoring and control systems provide constant monitoring of equipment operation parameters and allow you to quickly respond to any changes.

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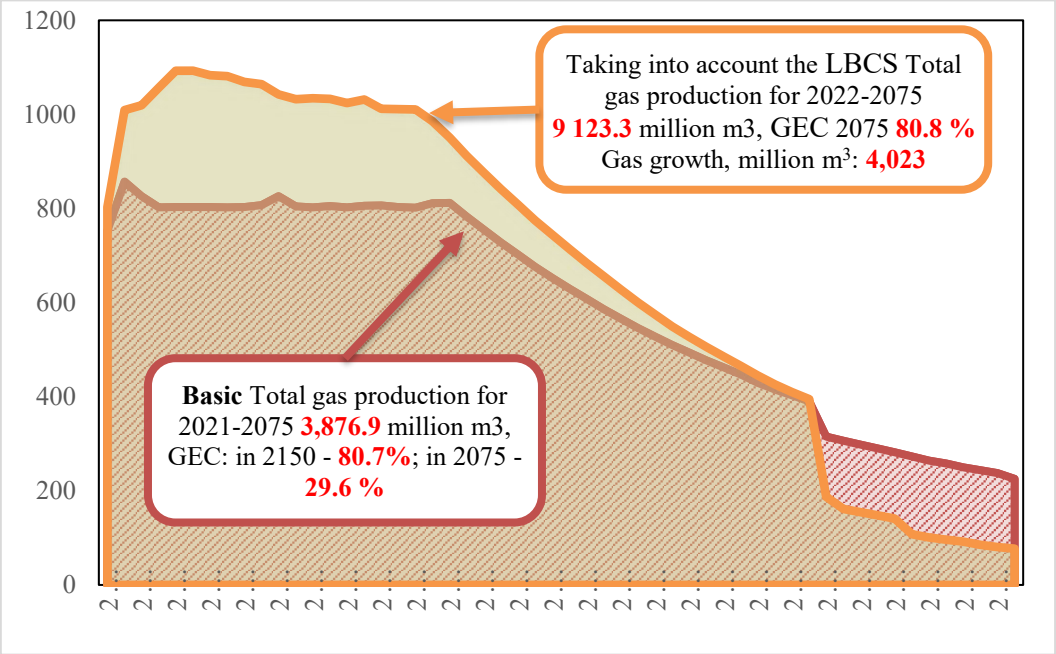

Figure 2-Rates of production opportunities associated with the construction of the Sharkiy Berdak mining Бердак and Processing Complex (compiled by A. A. Madreimov, 2025)

The use of digital twins of compressor units makes it possible to simulate and optimize their operation, which helps to increase the overall efficiency of the system operation and minimize the risks of its failure.

Energy-efficient technologies:

The use of energy-efficient compressors and systems can significantly reduce energy costs, which is especially important in conditions of high energy consumption in remote fields.

Heat recovery technologies allow the use of excess heat to heat the gas before compression, which increases the overall energy efficiency of the system and reduces the cost of compressor operation of the field.

Despite the effectiveness of implementing the technology for operating wells with LBCS, it should be noted that it is necessary to take into account the specific properties Шаркий of the Sharkiy Berdak gas condensate field, which is expressed in the presence of bottom water and their active pulling up from the first days of operation of gas-producing wells. This, in turn, indicates an undoubted displacement of the gas-water contact in all the productive horizons covered by the development [8, 9].

- Calculations and analysis have shown that the introduction of low-pressure booster compressor stations is one of the key factors for improving the efficiency of field exploitation in the Ustyurt region. In particular, for Kuya Sharkiy Berdak, it is established that in the absence of the LBCS, gas production will stop by 2031 with a final gas recovery rate (GCI) of 36.1%. At the same time, the use of NDCS provides an almost twofold increase in production and allows us to reach the final GEC at the level of 77.1%.
- Similar results were obtained for the Sharkiy Berdak field. Without the introduction of LBCS, production is projected to reach 2150 with a final GEC of 80.7%, while the use of LBCS leads to accelerated recovery of reserves while maintaining the final GEC of 80.8%, which makes it possible to achieve the same indicators 2.5 times faster. Additionally, the effectiveness of a set of technologies for increasing well productivity was confirmed: clarifying the position of the gas-water contact (GWC), optimizing perforation, using surfactants and bottom-hole liquid removal systems [10].

V. CONCLUSION AND FUTURE WORK

The growth of Uzbekistan's hydrocarbon reserves is determined by the intensification of geological exploration in the Ustyurt region and the introduction of modern technologies for the development of complex deposits. The high degree of depletion of existing reserves makes it necessary to develop new facilities and increase the productivity of existing wells. The use of low-pressure booster compressor stations provides an almost twofold increase in the gas recovery

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coefficient and extends the field's service life. The combination of geophysical monitoring, well operation optimization and production intensification technologies contributes to maintaining a stable level of gas production. The experience of the Sharkiy Berdak and Surgil deposits confirms the effectiveness of an integrated approach combining early operation and geological exploration.

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