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Annaguly Deryaev*
Doctor of Technical Sciences, Principal Researcher
Scientific Research Institute of Natural Gas of the State Concern "Turkmengas"
744036, 58 Archabil Ave., Ashgabat, Turkmenistan
https://orcid.org/0009-0004-8569-6277

Dual completion operation technology for two gas condensate reservoirs with production lifting by one column of pumping and compressor pipes

Abstract. In the context of the active development of gas condensate fields with several reservoirs in the Gogrendag-Ekerem Upland (Korpedje, South Gamyshlja), the study of its technologies is an important area of work. The study aims to optimise the technology of simultaneously separating two gas condensate reservoirs by lifting products with one tubing string to increase hydrocarbon production efficiency. The methods used include the analytical method, functional method, statistical method, synthesis method, and others. In the course of the study, an innovative methodology was developed for the dual completion operation (DCO) of two gas condensate reservoirs, which involves lifting products with a single tubing string. The key element is the refinement of the calculations made. A detailed analysis of the equipment used in the Gogrendag-Ekerem area showed that it can also be effectively used in other regional fields, ensuring the proper functioning of each element above the packer level. At the same time, it is necessary to pay attention to the various individual characteristics of the field to achieve a truly effective configuration of this technology. The new technology incorporates optimised pressure, flow, and control parameters for each reservoir, resulting in increased production efficiency and reduced energy costs. A significant reduction in the negative impact on the environment and an increase in the overall sustainability of the production process have been identified. These features make the proposed technology an important contribution to the development of the oil and gas industry, contributing to more efficient and environmentally sustainable hydrocarbon production and highlighting its potential for application in modern field development. The practical significance of the research lies in the creation of a more efficient and sustainable hydrocarbon production technology, which not only helps to optimise production processes and reduce environmental impact but also provides the industry with a valuable tool to improve overall energy efficiency and sustainability in the face of ever-changing energy requirements and challenges

Keywords: hydrocarbon production; resource efficiency; environmental impact; improved methodology; sustainability of the production process

INTRODUCTION

The study of the technology of dual completion operation (DCO) of two gas condensate reservoirs using a single tubing string is undeniably important in today's energy industry. This technology promises significant benefits, including optimisation of hydrocarbon production processes, improved resource efficiency and reduced environmental impact. The development of an improved methodology incorporating optimised pressure, flow and control parameters not only improves production performance but also helps to reduce energy costs and enhance process sustainability. This research provides a valuable contribution to the oil and gas industry and its practical implications emphasise the relevance of these improved technologies in the pursuit of a more efficient and environmentally sustainable energy future.

The research problem is the need to develop and optimise a technology for the DCO of two gas condensate reservoirs using a single tubing string. Current hydrocarbon

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*Corresponding author

production methods face the challenges of effective management of multilayer reservoirs, which emphasises the need for a better understanding of the processes involved in lifting production. Developing optimal pressure, flow and control parameters for each reservoir is a key aspect, and successfully addressing this issue can significantly improve field stability and performance in today's energy resource recovery environment.

According to D.S. Akyev & T.B. Arazov (2022), the problem in hydrocarbon production is the inefficient use of existing technologies, which requires a new approach to DCO of gas condensate reservoirs. The study did not address the issue of implementing modern monitoring and data management systems. S.K. Veysov & G.O. Hamrayev (2023) stressed the importance of considering the geological features of the fields when developing improved extraction techniques to ensure optimal efficiency and sustainability of the processes. However, the impact of efficiency and sustainability of hydrocarbon extraction processes on the environment and environmental sustainability has not been assessed. According to the study by N. Ozbekov *et al.* (2023), DCO analysis is necessary for reducing the environmental impact of the oil and gas industry and ensuring the sustainability of the natural environment. The study is limited to assessing technological aspects and does not pay sufficient attention to social responsibility and interaction with local communities.

O.K. Abramovich & H.B. Hadzhigeldyev (2022) note that optimised pressure and flow parameters introduced in the new technology can lead to a significant reduction in energy consumption during hydrocarbon production. However, the impact of this technology on the quality of production and chemical composition of produced hydrocarbons was not considered. According to F.E. Safarov *et al.* (2022), the developed methodology of exploitation of two gas condensate reservoirs represents a significant step in the field of oil and gas technologies. However, the paper does not discuss in detail the issues of optimising the economic efficiency of this technique and its applicability to different geological and climatic conditions. E.A. Grinkova & G.I. Abaeva (2023) discuss the importance of optimised technologies for increasing resource efficiency in the context of hydrocarbon production. However, the interaction between different industry participants and oil and gas companies in the implementation of such technologies is not addressed.

The study aims to improve hydrocarbon recovery technology by optimising the DCO of two gas condensate reservoirs using a single tubing string to increase efficiency.

MATERIALS AND METHODS

The analytical method was used to identify the key parameters and factors that determine the effectiveness of the technology and to conduct a systematic analysis of the data, which helped in pinpointing the optimal conditions for implementing the improved technique. By applying a synthesis method, various aspects of DCO technology were combined to create an integrated approach to optimising hydrocarbon production processes. This method enabled the diverse elements of the system to be combined, providing synergy and overall efficiency in achieving the objectives of the study.

The abstraction method was used in the study to identify the main general principles and concepts underlying DCO technology. The abstraction simplified complex technical details by highlighting key aspects, which provided a deeper understanding of the basic principles of system operation and facilitated the development of generalised models for more effective optimisation.

The concretisation method was used to elaborate in detail the abstract ideas and concepts highlighted by the abstraction method. This method was used to move from generalised ideas to concrete technical solutions, defining the exact parameters and characteristics of the DCO technology. Thus, the concretisation method ensured the practical applicability of the identified principles, which became the basis for further successful implementation of the improved methodology in hydrocarbon production conditions.

The deduction method was substantially used to support the formation of valid conclusions and logical implications from the data collected. By applying this method, the general principles and laws underlying the effectiveness of DCOs were deduced. The deductive approach was used to clarify assumptions, conduct logical reasoning, and formulate precise conclusions, contributing to a deeper understanding of the mechanisms of system operation and optimisation of hydrocarbon production processes.

The induction method in this study was used to summarise specific results and experiences from practical experiments and observations of DCO. By investigating specific cases and data, the induction method was able to identify general trends, patterns, and effective approaches to improve hydrocarbon production processes. Thus, based on inductive findings, generalised principles were formulated that can be applied to optimise the technology in the broad context of the oil and gas industry.

The statistical method was used to systematically examine large volumes of data from experiments and observations of DCOs. This method allowed the identification of significant correlations, trends, and likely variations in hydrocarbon production processes. The statistical study provided an objective basis for decision-making and optimisation of the technology parameters, considering various conditions and factors, which helped to improve its efficiency and adapt it to a variety of application scenarios.

By applying the functional method, key functions and interrelationships within DCO were identified. This method provided a structured examination of the role of each element in the system, highlighting the essential components and their impact on overall performance. The functional approach provided an understanding of the internal dynamics of the system, which played a key role in optimising and improving each stage of the hydrocarbon production process while reflecting the overall objective of the study to improve the performance of this technology. The formulae used in this study were (1-8):

$$P_{l1} = P_{lf}(\bar{Q}_{g1}), \quad (1)$$

$$P_{c1} = \sqrt{P_1^2 P - (A_1 q_1 + B_1 q_1^2)}, \quad (2)$$

$$P_2 = e^{-Son}\sqrt{P_1^2 - 1.377\lambda_n \frac{Z^2T^2}{p_n d^5} Q_{m1}^2 (e^{2Son} - 1)}, \quad (3)$$

$$P_{c2} = P_3 + 3, \quad (4)$$

$$P_{l2} = f(Q_2), \quad (5)$$

$$q_1 = -\frac{A_2}{B_2} + \sqrt{(\frac{A_2}{B_2})^2 + \frac{P_{l2}^2 + P_{c2}^2}{B_2}}, \quad (6)$$

$$q = q_1 + q_2, \quad (7)$$

$$P_y = e^{-Son}\sqrt{P_3^2 - 1.377\lambda_m \frac{Z^2T^2}{p_m d^5} Q_l^2 (e^{2Son} - 1)}, \quad (8)$$

where: P_{l1} – lower reservoir pressure; P_{l2} – upper reservoir pressure; P_{c1} – lower reservoir wellbore pressure; P_{c2} – upper reservoir wellbore pressure; P_2 – pre-packer pressure; P_2 – after-packer pressure, P_3 – upper reservoir tubing pressure: P_w – wellhead pressure. Q_m, Q_l, Q_g – volume flow rate of the gas-liquid mixture, liquid flow rate and gas flow rate, thousand m^3/day.

This multidisciplinary approach has contributed to an integrated methodology that considers technical, environmental and energy aspects and has been the basis for the development of improved methodology in hydrocarbon production in the oil and gas industry.

RESULTS

In recent years in the process of development of multilayer horizons of gas-condensate fields of the Gogrendag-Ekerem zone of upland (Korpedje, South Gamyshlja) is applied development and design of technology of DCO of two gas-condensate horizons, with leaving production in the tubing string. Well depth and small diameter of production strings significantly limit the possibility of using downhole equipment that meets all the requirements of DCO methods (Deryaev, 2022). The task of analysing the set of equipment available for DCO was to determine the real option of development of gas condensate fields of the area under consideration. The detailed analysis of the equipment set allows us to conclude that it can be used in regional fields at the performance of the functions of each element (above packer) of the equipment complex independently from other elements. Calculations of parameters of DCO of gas-condensate well separately are carried out in the case when in one tubing string the production corresponding to the set of equipment of CGS type is made. The use of DCO technology reduces the number of drilling wells, as well as material and technical costs associated with drilling and development of the entire well in the field under development. In recent years in the process of development of gas condensate deposits at multilayer fields of the Gogrendag-Ekerem zone of rises (Korpedje, Gunorta Gamyshlydzha) design and application of DCO technology of two reservoirs by the lifting of production by one tubing string is practised.

The selection of sites for DCO considers a variety of geological and technical characteristics of the fields (Kongar-Syuryun *et al.*, 2021). These factors include the coincidence of the main components of the productive areas of the horizons intended for DCO. The matching of the volume of gas recovered by an individual well and the absolute values of current reserves is also considered. The distance between the horizons intended for DCO technology and the level of reserves development in these horizons were investigated. Data on reservoir pressure, temperature, reservoir drainage regimes and productive characteristics of reservoirs were considered. In addition, the possibility of reducing the number of wells drilled when implementing this technology was assessed. All these factors were systematically considered to ensure the optimal selection of sites for the successful implementation of the DCO technology following the individual geological and technical characteristics of each field.

Calculation of the parameters of the gas condensate well DCO technology is assumed in the case of lifting the products of two reservoirs through a single tubing string, which corresponds to the use of specialised downhole equipment, such as a gas gathering complex (or gas collection complex, GCC). The sequence of calculations appears to be as follows (Fig. 1).

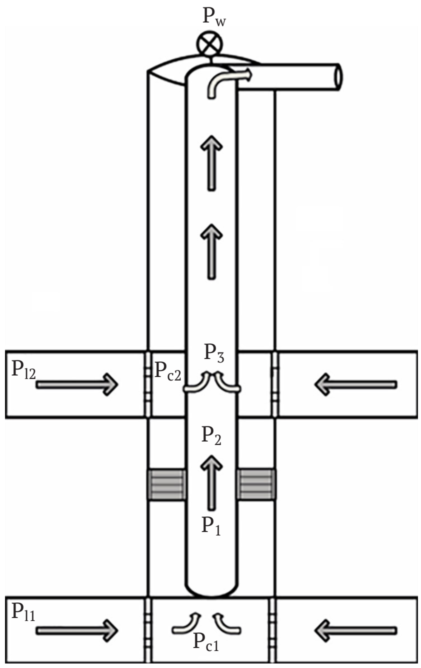

Figure 1. Calculated scheme of DCO technology for lifting the production of two reservoirs through a single tubing string

Note: P_{l1} – lower reservoir pressure; P_{l2} – upper reservoir pressure; P_{c1} – lower reservoir wellbore pressure; P_{c2} – upper reservoir wellbore pressure; P_2 – pre-packer pressure; P_2 – after-packer pressure, P_3 – upper reservoir tubing pressure: P_w – wellhead pressure

Source: developed by the author

It starts with a preliminary calculation of annual and cumulative gas production, as well as a determination of the average gas production rate (q1) of wells for the future for the lower reservoir development scenario using a stand-alone well grid. At known values of cumulative production (Q1), the dynamics of reservoir pressure in the lower reservoir are evaluated using the formula (1). By using filtration coefficients "A_1" and "B_1", at known gas flow rate q1 and reservoir pressure level P_1, wellbore pressure P_{c1} is determined (2). Due to the small size of the distance from the lower reservoir to the packer and from the packer to the upper reservoir, to simplify subsequent calculations, we assume $P_1 = P_{c1}$ and $P_3 = P_2$. In this case, the pressure P_2 is calculated using (3) formula. Considering the pressure loss during gas flow from the upper reservoir into the tubing in the amount of 3 atmospheres, the wellbore pressure P_{c2} is calculated according to the following formula (4). Pressure change in the upper horizon formation is regulated according to the dependence (5). At given values of formation and wellbore pressure, the flow rate of the well from the upper reservoir is determined using the formula (6). The total gas flow rate is (7). Calculation of wellhead pressure in case of gas-liquid mixture lifting from two formations through a single tubing string is carried out by formula (8), where (9):

$$\begin{gathered} S_0 = 0.03415\frac{\rho\rho L}{Z_{sr}T_{sr}}:\rho = \phi + (1-\phi)\frac{P_{zh}}{P_g}, \\ p = \frac{\rho_g P_{sr} T_{st}}{P_{at} T_{sr}}:\phi \leq \beta = \frac{Q_{zh}}{(Q_g Q_{zh})}, \\ Q_g = \frac{Q_g P_{at} T_{sr}}{P_{sr} T_{st}}:Q_{sm} = \frac{G_g + G_{zh}}{(\rho_g)}, \\ G_g = Q_g \rho_g; \overline{\rho} = \frac{g}{\rho_v}; T_{st} = 293^0 K, \\ \theta = 1.377\lambda \frac{(Z^2{}_{sr} T^2{}_{sr}}{d^5}(e^{2S} - 1). \end{gathered} \tag{9}$$

It is necessary to experimentally determine the true gas volume content as the ratio of the actual gas volume V_u in the well to the borehole volume . However, due to the difficulty of such measurements, it can be estimated based on the flowing gas content β according to formula (9). Since φ is always less than β, using β instead of φ may lead to underestimation of wellbore pressure, especially when the difference between the volume of fluid in the well and the volume of gas flowing out increases (Zou *et al.*, 2021). Differential condensation isotherms under reservoir conditions were used in the calculations, which were approximated in advance by polynomials for the convenience of computer calculations. The hydraulic resistance coefficient λ should be determined based on studies of wells under different regimes. If such data are not available, the value $\lambda = 0.025$ for the pipe and $\lambda p = 0.0815$ for the packer can be used. All parameters (Z_{sr}, ρ_g, Q_g, β), which depend on wellhead pressure P_{sr}, can be determined by using the iteration method. The parameter L included in formulas (9), when using formulas (3) and (8), denotes packer length and tubing length, respectively. The formation of proposals regarding the choice of DCO technology and optimal equipment set corresponds to the general criteria for this method of multilayer reservoir development (Zhou *et al.*, 2021).

According to general standards, DCO solutions should provide optimum flow rates for each of the footings used in the development project. The key factors are the ability to control the total well production rate quickly and with an acceptable ratio of individual footings, to conduct explorations to characterise each formation, and to efficiently perform development and killing operations for the footings and the entire well (Farsi *et al.*, 2021). The ability to perform remedial actions, the availability of devices to prevent the uncontrolled release of fluids from the well, and the ability to apply chemicals to both the fluid flow in the tubing and the production footings, including the use of hydrate inhibitors and other chemicals, are required. Engineering and technology solutions for gas condensate fields can vary considerably depending on the specific conditions (Abad *et al.*, 2022). Nevertheless, fully meeting all of these requirements can be challenging in certain scenarios, especially when considering well depth and casing diameter. Deep wells and small casing diameters can significantly limit the use of downhole equipment that fully meets the design requirements for DCO of gas reservoirs. The analysis of existing DCO equipment packages aimed to determine the best option for developing a gas condensate field in the region under consideration when applying the DCO method for two footings through one well. Different sets of equipment for wells were compared with the characteristics of the design of gas wells in the fields. The main parameters of the process equipment in the analysis were operating pressure, maximum gas withdrawal, pipe and string diameters, packer depth, media characteristics and packer dimensions (Aghbashlo *et al.*, 2021).

The analysis indicates the inapplicability of complexes Fountain Complex Control (FCC), Universal Submersible Gas Pump (USGP) and Gas Well Control (GWC) in the presented modifications for the equipment of gas wells of the fields of this region. This is due to the requirement for a larger diameter of the production string (more than 146-168 mm) and the purpose of these complexes for operation at much lower values of operating pressure. These parallel tubing and concentric tubing packages from various manufacturers available for the modifications under consideration are designed to operate at lower operating pressures and cannot be applied directly to the wells included in this field analysis. A thorough analysis of the GCC equipment suggests that its application to the fields in the region is possible with certain modifications to the overall configuration of the components (Watanabe & Ogata, 2021). This is acceptable as each element of the complex (above the packer) fulfils its functions independently of the other components. This statement is based on the fact that in a simplified implementation of the DCO technology, the known GCC-type equipment complex can effectively perform all its standard functions of gas production from the reservoir located in the sub-packer zone, with the possibility of regulating its flow rate employing a "deep" choke. Thus, the tubing string above the packer can be fed with production from the upper reservoir, provided there is an appropriate structural input unit. In this case, it is necessary to install a tubing string with one circulation valve in the upper reservoir area (for simultaneous development and killing of both reservoirs). Regulation of separate gas extraction from the two reservoirs is performed by changing the pressure in the tubing in the upper reservoir connection area, which provides flow rate control (Shingala *et al.*, 2022; Sargsyan *et al.*, 2023).

If the cross-sectional area of the choke holes (nozzles) at the upper horizon gas inlet to the tubing is known, the gas flow rate from the upper reservoir can be calculated. The lower reservoir flow rate is then calculated based on the total well flow rate measured at the gas gathering station. A key component of this equipment system is a check valve installed in the gas injection chamber from the upper horizon to the tubing string (Panov, 2023; Yazdani *et al.*, 2023). The use of a check valve is justified by the significant differences in reservoir pressures of facilities whose production is integrated into a single tubing string. In this DCO configuration, the ratio of predicted underpressures to active reservoirs becomes the defining technological aspect. Occasionally, raising the products of two footings in a well through a single tubing string can cause significant pressure changes between the filter zone and the wellhead. This requires well temperature calculations to identify possible conditions for hydrate formation at the wellhead. In such cases, known calculation methods can be applied, including the one described by Aarushi *et al.* (2021). If the results of calculations of the temperature regime of good operation indicate the possibility of hydrate formation in the near-wellhead zone, it is necessary to provide for the possibility of introducing a hydrate formation inhibitor into the tubing string, especially in the zone of connection of the upper formation.

When reservoirs have high flow rates and flow rates are highly dependent on small changes in reservoir pressure, wellbore pressure losses in wellbore pressure equipment must be considered. Packers and valves are the most common elements of downhole complexes that affect “additional” pressure losses compared to the total pressure drop in the tubing string. Practical methods exist for determining such wellbore pressure losses in wellbore equipment, as described by H. Gamal *et al.* (2021). Calculations performed using the methodology from the paper by A.R. Deryaev (2023) for the packer, which is part of the GCC complex, showed that the pressure losses do not exceed in the considered example. It was noted that the wellbore pressure losses in the wellbore equipment, compared to the reservoir underbalanced characteristic of the deep horizons of the lower red colour of Turkmenistan, are insignificant. Failure to consider these losses will practically not affect the adopted technical and technological decisions when introducing the option of DCO with the use of GCC complex. The introduction of DCO technology contributes to a significant reduction in the required number of wells drilling, which, in turn, leads to a reduction in material and technical costs associated with the exploration and development of the entire field.

DISCUSSION

DCO technology is a promising approach aimed at increasing the efficiency of gas condensate field development. Simultaneous production of two reservoirs through a single tubing string allows for optimising the operation process and using resources more efficiently. One of the key advantages of this technology is the reduction in the number of drilling wells, which entails a significant reduction in material and technical costs. This is especially relevant in conditions of complex geological formations. In selecting sites for the application of the EPR technology, it is necessary to consider several geological and technical conditions, such as the coincidence of productive areas of formations, quantitative parameters of reserves, temperature, and pressure characteristics, as well as peculiarities of reservoir drainage. Despite the significant advantages, the application of DCO can face certain challenges, such as the need to carefully control production parameters, adapt to the geological characteristics of each field and ensure the safety of operations. The experience of using DCO technology in practical fields and additional research may help to improve the methodology and expand the application of this technology. Assessment of the environmental impacts of the technology is also an important aspect, including the impact on groundwater, greenhouse gas emissions and other aspects that require close monitoring. DCO technology is a promising tool for the efficient development of gas condensate fields, and its implementation requires an integrated approach, consideration of geological and technical peculiarities, and constant monitoring to ensure safe and efficient operation.

According to the results of recent studies by K. Nurgalieva *et al.* (2021), improving the efficiency of oil and gas wells facing the problem of asphalt-smothered paraffin (ASP) deposits is an important issue in the oil and gas industry. ASP deposits can significantly reduce reservoir capacity and well flow rates, which adversely affects the overall productivity of the field. The use of chemicals to prevent and remove deposits has been proposed to address this problem. The development and application of effective inhibitors and dispersants specifically tailored to combat ASP formation play a key role in improving well performance. These chemicals must not only be effective in preventing deposits but also safe for the environment and equipment. Developing technologies to clean wells of already formed ASP deposits is also an important aspect. Effective mechanical and chemical cleaning methods will probably include the use of innovative reagents and techniques, as well as the development of intelligent monitoring systems to prevent future fouling. These findings are consistent with the theses presented in the previous section. The overall approach to solving the fouling problem must include a combination of chemical, mechanical and technological innovations, as well as strategies to keep wells clean and efficient throughout their life cycle.

Referring to the definition of X. Zheng *et al.* (2022), the development of oil and gas production technology in

China is a strategic direction to meet the growing energy demand in the country. As the largest energy consumer in the world, China is actively adopting innovative approaches and advanced technologies to optimise production and ensure energy security. Prospects for technological development include the intensive use of digital technologies and artificial intelligence to monitor and manage production processes. The introduction of smart solutions in drilling, equipment condition monitoring and predicting changes in underground geological structures can improve production efficiency and reduce costs. Overall, China's oil and gas technology development is aimed at balancing the country's growing energy needs, ensuring economic efficiency, and meeting environmental sustainability standards. These efforts also affect the global energy landscape as China plays a key role in the global energy system.

M.B. Sadr & A. Bozorgian (2021) determined that gaseous hydrates are crystalline structures formed under conditions of high pressure and low temperature where gas molecules are enclosed within a framework of water molecules. The study of gas flow in gaseous hydrates is key to effectively managing their formation and preventing problems associated with their formation in pipelines and wells. The intensity of gas transfer in gaseous hydrates varies significantly with environmental parameters, particularly temperature and pressure levels. Under conditions where temperature rises or pressure decreases, hydrates can undergo dehydration, releasing the trapped gas. The reverse process, namely the formation of gaseous hydrates, occurs when temperature is lowered, and pressure is increased. These results support the above study because understanding the mechanisms and parameters of gas flow in hydrates is important for the development of technologies to prevent their formation in pipelines and gas production infrastructure. It also has implications for the safety of operations in environments where gaseous hydrates can pose a risk to the stability and efficiency of gas pipelines and wells. Research is underway to develop innovative hydrate management techniques, such as the use of hydrate inhibitors and heat exchange systems to maintain optimal conditions.

E.H. Al Munif *et al.* (2023) determined that downhole gas-liquid separators are important equipment in the oil and gas industry designed to efficiently separate and treat the gas-liquid mixture produced from wells. In unconventional formations, such as shale or high-viscosity hydrocarbon formations, special solutions are required to ensure optimal separator performance. One of the key challenges in oil and gas production from unconventional reservoirs is the presence of large amounts of impurities such as sand, water, and other solids that can accompany high-viscosity oil and gas flows. Well, separators in this context must be designed to effectively remove such impurities to prevent their deposit in pipelines and equipment. Analyses of results and conclusions indicate that technological innovations in downhole separators for unconventional reservoirs include the development of more efficient filtration systems adapted to handle highly viscous fluids, as well as the application of advanced methods for controlling and monitoring separation processes. These improvements are aimed at improving well performance and ensuring the long-term sustainability of unconventional reservoir production.

As noted by C. Sahu *et al.* (2021), well operation completion, as well as mechanised gas extraction from natural gas hydrate deposits, represent important milestones in the development of methane extraction technology. Well completion operations are necessary to ensure safety, prevent gas leakage and minimise environmental impacts. A comprehensive review of such operations includes a thorough analysis of various well sealing and isolation techniques, as well as strategies for abandoning oil and gas equipment in the field. Mechanised gas production from hydrate reservoirs is a current area of research and development in the context of energy efficiency and environmental sustainability. Methods based on the use of heat, pressure, or chemicals to decompose hydrates and release methane are discussed in detail in this context. However, an important aspect is the optimisation of processes to improve extraction efficiency and reduce costs, which becomes key when addressing the technological and economic challenges in methane hydrate extraction.

T. Van *et al.* (2022) noted the formation of paraffin deposits in gas lift wells is a serious technological and operational challenge. To prevent this phenomenon, an integrated approach involving various technologies and chemicals is required. One of the key methods to prevent wax formation is the use of specialised wax inhibitors. These chemical additives prevent paraffins from crystallising at lower temperatures, thus preventing their deposition in the well. In addition, the use of enriched gases and the introduction of heat transfer fluids into the system can also help reduce the risk of fouling. Additional methods include the use of ultrasound to prevent aggregation of paraffin particles and regular mechanical cleaning of wellbores. An important aspect is to monitor the temperature regime and fluid characteristics of the well to identify potential fouling threats promptly. It is possible to agree with the opinion that the combined approach to the problem of paraffin deposit formation in gaslift wells allows the creation of an effective system providing stable and reliable operation of wells while minimising the risk of technological problems.

CONCLUSIONS

The technology of DCO of two gas condensate reservoirs by lifting products through a single tubing string is an innovative method of developing multilayer fields, which can significantly increase the efficiency of hydrocarbon production. An important advantage of this technology is the possibility of reducing the number of drilling wells and, consequently, reducing overall operating costs. The basic idea behind the DCO is to use a single string of tubing to simultaneously lift production from two gas condensate reservoirs. This is achieved through the use of specialised downhole equipment, such as a GCC-type complex. This approach makes it possible to optimise gas and condensate production, manage the flow rates of individual reservoirs and carry out research work efficiently.

The benefits of this technology cover several key aspects. It reduces the ecological impact on the environment. By reducing the number of drilling wells used for field development, the overall footprint of the oil and gas industry on natural ecosystems is reduced. This is in line with modern requirements for sustainable development and compliance with environmental standards. The DCO technology improves the manageability of the production process. Specialised equipment used in this technology allows for more efficient monitoring and regulation of gas and condensate flow rates from each reservoir. This makes it possible to respond quickly to changes in field conditions and maximise hydrocarbon production. However, despite these advantages, the selection of the optimal DCO configuration must consider a variety of field characteristics. Well depths and diameters, geological and technical features require a tailored approach to ensure the best results and efficient use of the technology.

In general, ORE technology is a promising solution for rational and efficient exploitation of gas condensate fields, reducing operating costs and ensuring more efficient use of resources. To better understand and optimise the technology of DCO of gas condensate reservoirs by lifting production through a single string of tubing, additional research could be aimed at analysing the influence of geological and technical parameters of the field on the efficiency of this technique.

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CONFLICT OF INTEREST

None.

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Аннагули Реджепович Деряєв
Доктор технічних наук, головний науковий співробітник
Науково-дослідний інститут природного газу державного концерну "Туркменгаз"
744036, просп. Арчабіл, 58, м. Ашхабад, Туркменістан
https://orcid.org/0009-0004-8569-6277

Технологія одночасно-роздільної експлуатації двох газоконденсатних пластів підйомом продукції однією колоною насосно-компресорних труб

Анотація. В умовах активного розвитку газоконденсатних родовищ з кількома пластами в районі височини Гогрендаг-Екерем (Корпедже, Південний Гамишлджа), дослідження його технологій є важливим напрямом роботи. Метою даного дослідження є оптимізація технології одночасно-роздільної експлуатації двох газоконденсатних пластів підйомом продукції однією колоною насосно-компресорних труб з підвищенням ефективності видобутку вуглеводнів. Серед використаних методів слід зазначити аналітичний метод, функціональний метод, статистичний метод, метод синтезу та інші. У ході проведеного дослідження було розроблено інноваційну методику одночасно-роздільної експлуатації двох газоконденсатних пластів, що передбачає підйом продукції єдиною колоною насосно-компресорних труб. Ключовим елементом є уточнення здійснених розрахунків. В результаті детального аналізу обладнання, що використовується в зоні Гогрендаг-Екерем, було зазначено, що воно також може бути ефективно застосоване і на інших регіональних родовищах, забезпечуючи справне функціонування кожного елемента вище рівня пакера. При цьому необхідно звертати увагу на різноманітні індивідуальні характеристики родовища для залучення дійсно ефективної конфігурації цієї технології. Нова технологія включає оптимізовані параметри тиску, витрати і контролю для кожного пласта, що в результаті призводить до збільшення ефективності видобутку і зниження енерговитрат. Було виявлено значне скорочення негативного впливу на довкілля та підвищення загальної стійкості виробничого процесу. Ці особливості роблять запропоновану технологію важливим внеском у розвиток нафтогазової промисловості, сприяючи більш ефективному та екологічно стійкому видобутку вуглеводнів та підкреслюють її потенціал для застосування у сучасних умовах розробки родовищ. Практичне значення дослідження полягає у створенні більш ефективної та стійкої технології видобутку вуглеводнів, що не тільки сприяє оптимізації виробничих процесів та зниженню впливу на екологію, але також надає індустрії цінний інструмент для покращення загальної енергетичної ефективності та стійкості в умовах постійно мінливих вимог та викликів у галузі енергетики

Ключові слова: видобуток вуглеводнів; ефективність використання ресурсів; екологічний вплив; покращена методика; стійкість виробничого процесу