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Improving the Design of Development of USTYURT Hydrocarbons Deposits

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ABSTRACT: The aim of the study is to improve methodological approaches to designing the development of gas condensate fields in the USTYURT region of Uzbekistan. As a result of a systematic analysis of the data on the operation of the USTYURT fields, geological and production features were identified that are not taken into account when designing the development using traditional methods. Approaches to designing the development of the fields under consideration are proposed, taking into account their geological and production features, which led to an increase in gas production when implementing these proposals.

KEY WORDS: multilayer field, increased initial water saturation, well, low-pressure booster compressor station

I.INTRODUCTION

The purpose of this study is to improve methodological approaches to the design of multi-layer hydrocarbon fields. Much attention is paid to these studies by both foreign and domestic researchers [1, 2].
Traditional methodological approaches to designing the development of multi-layer fields mainly come down to the following:
- stage-by-stage commissioning of facilities “bottom-up”;
- exploitation of each gas-saturated formation with independent well networks;
- exploitation of two or more formations simultaneously by one well using a single filter.

II.METHODOLOGY

The implementation of the above approaches to designing the development of multi-layer fields in practice is often accompanied by various complications. For example, during the development of the Gubkinskoye multilayer field in Russia, a phased “bottom-up” commissioning of facilities was adopted. The transition to exploitation of the upper deposits was planned to be carried out after reaching the design values of the gas recovery coefficients for the lower reservoirs. But, the early commissioning of upper deposits, due to economic factors, negatively affected the operation of wells exploiting lower formations: the wells became low-pressure and went out of operation prematurely, which caused a decrease in gas recovery from developed objects [1].
The operation of two or more formations simultaneously with a single filter in one well is practiced in order to save capital costs when drilling production wells. The disadvantage of this development system is the premature watering of the production of all layers in the event of water ingress in one of them and, accordingly, a decrease in gas recovery from the field as a whole. Another disadvantage is the inability to control the development of each layer separately.
The technical and economic advantages of WEM, as in the previous case, are: reduction in the total number of production wells; reducing the length of field gas collection networks; accelerating the commissioning of new productive formations. As a result, capital investments in the construction of wells and, accordingly, their field development are reduced, and the number of service personnel is reduced [3]. Along with this, in the case of the electronic reservoir, it is possible to control the development of each layer separately. Despite the listed advantages, the limited use of electronic electronics in the fields of Uzbekistan is due to the complexity of regulating the parameters of technological operating modes of wells in compatible

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formations. In addition, the electrical energy survey makes it difficult to: carry out hydrodynamic and geophysical studies of individual layers; impact on the bottomhole zone in order to increase their productivity, repair work in the well [2, 3].
In addition to the complications noted above, the development of Ustyurt hydrocarbon fields is accompanied by additional difficulties due to their specific geological and field characteristics.
As a result of a systematic analysis of materials from geological exploration work (GRR) of the Ustyurt fields, an extremely uneven distribution over the area and section of reservoirs was revealed , represented by poorly correlated sandstone bodies with the predominant presence of thin layers and lenses with a thickness of tens of centimeters to several meters, most of which are characterized by limited area of distribution and separation along the section by intervals of reservoir rocks [3].
For example, the breakdown of the lens-shaped structure of the deposit and the construction of a geological model of the Shimoliy Berdak field showed (Figure 1) that in general its productive horizons belong to the structural-lithological type of traps belonging to unconventional hydrocarbon deposits, characterized by lenticularity in area, small amplitudes of dip of the wings and, which is important to note from a hydrodynamic point of view, undersaturation with natural gas (initial gas saturation - 55%) [2].

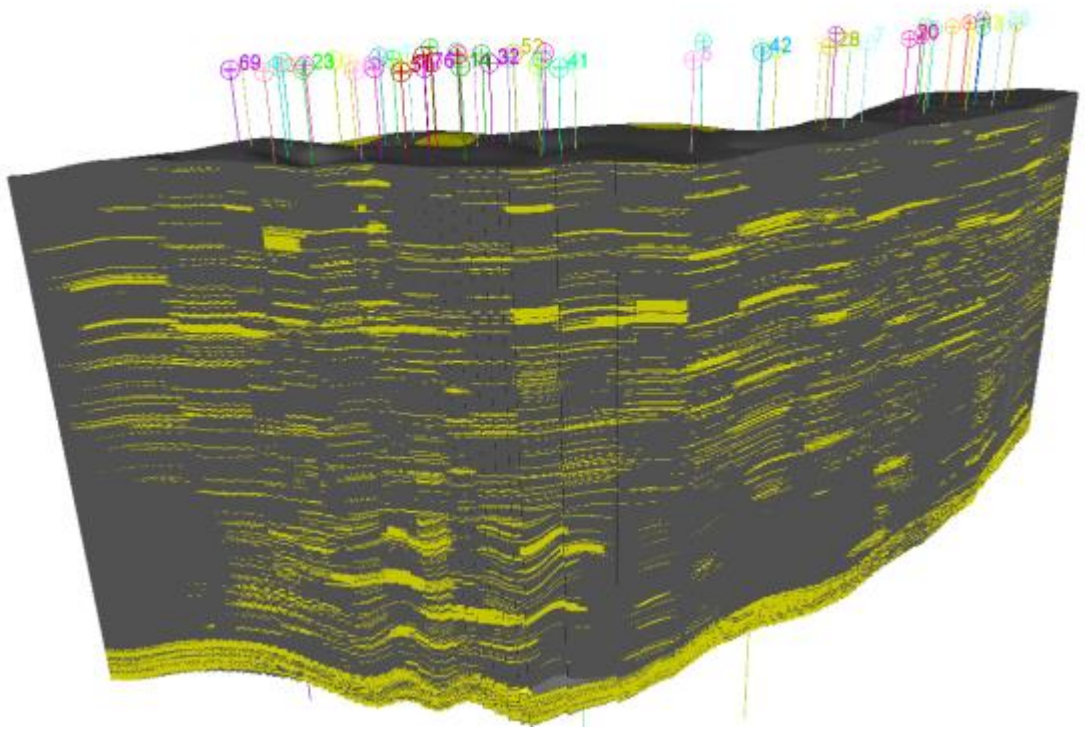

Figure 1 – Section of the lithological cube of the Shimoliy Berdak gas condensate field

As a result of the correlation of well sections, comparison of materials from the GIS complex with sampling data in work [3] The possibility of combining selected reservoir layers into so-called “packs” was established, the effective thickness of which varies over the area.
The design of development systems for the Ustyurt natural gas fields, taking into account their geological and field features listed above, was improved as experience in their operation was accumulated.
The development of hydrocarbon deposits in Ustyurt began in 1971 with the commissioning of the Shakhpakhty gas field. At this multi-layer field, for the first time in Uzbekistan, simultaneous and separate operation of two layers in three wells was designed and implemented. The wells were operated for a short time due to leaks in the packer devices installed in them. Subsequent operation of the Shakhpakhty field wells was carried out using a single filter of two or three layers simultaneously. As a result, a single production object was formed from the upper layers (horizons I , II , III , III a), which was drained as an independent deposit by a common network of wells. To date, the Shakhpakhty field has been developed at 90% of its approved gas reserves, the production of which continues, which was facilitated by the

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compressor operation of wells from the very beginning of development due to the significant distance (240 km) of the field from the main gas pipeline.

The next object for the development of Ustyurt hydrocarbon reserves was the Urga gas and condensate field, which was put into operation in 1995. The wells of the field exploited two or more layers with a single filter and were quickly watered due to active water influxes and a delay in the commissioning of a booster compressor station. Under these conditions, over almost 30 years of development of the Urga gas condensate field, only 35% of its reserves have been recovered [2, 3].

The gas condensate fields (GCF) Sharkiy Berdak and Shimoliy Berdak, which were put into pilot production operation (PEC) in 2002 and 2005, respectively, were the next in time for the start of development.

Of interest is the experience of design and development of the Shimoliy Berdak field, which until 2012 was exploited according to the OPE project (2006), carried out for the operational gas reserves of two formations J_2^{2b} and J_3^9 [3].

In connection with the continuation of geological exploration in the period 2006-2010, in 2012 the geological model of the Shimoliy Berdak gas condensate field was updated with the conditional identification of 12 productive formations and an assessment of their operational reserves. Taking into account the dynamics of reserve clarification, adjustments were made to the OPE project (2011), a development project was drawn up in 2017 and adjustments were made to it in 2020 and 2022. Adjustments to the design indicators of the Shimoliy Berdak gas and condensate field are due to a noticeable deviation of the well flow rate from the design ones indicators, which, in turn, required making adjustments to the project operating fund in order to implement the project gas production volumes.

The dynamics of the working flow rates of the field's wells is due to their accelerated watering as a result of the initially increased water content of the produced gas, which is a specific feature of the Ustyurt fields with low initial gas saturation of the formations [2]. Under these conditions, watered wells were transferred to other gas-saturated formations where there were industrial gas reserves, leaving the gas reserves of previous production facilities under-recovered [3].

Based on the analysis of the experience of operating wells in the fields of the Ustyurt region, the authors propose to design their compressor operation already at the initial stage of development [2]. This approach determines the extension of the operation of water producing wells due to their connection to a booster compressor station with low inlet pressure (LPCS), which facilitates the effective removal of liquid from their bottoms by increasing the flow rate and, thereby, achieving a higher final gas recovery of the field as a whole.

The installation of the NDCS and the modernization of the field gas collection and transportation system in accordance with the recommendations of the development project (2017 y.) led to additional gas production in the amount of 9.6 billion cubic meters at the Shimoliy Berdak gas condensate field for 2017-2021.

III.CONCLUSION

In conclusion, we note the following:

- current approaches to designing the development of multi-layer hydrocarbon fields do not allow taking into account the specific geological and field features of gas condensate fields of the Ustyurt region;
- the main geological and commercial features of the Ustyurt fields are: uneven distribution over the area and section of reservoirs, represented by thin layers and lenses; initially low gas saturation of the formations, causing water ingress in wells from the beginning of their operation;
- when designing the development of Ustyurt natural gas fields, it is necessary to provide for the commissioning of a low-pressure booster compressor station from the very beginning of well operation.
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