

## Eureka Journal of Geoscience, Materials & Resource Engineering (EJGMRE)

ISSN 2760-4985 (Online) Volume 02, Issue 05, May 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaoa.com/index.php/9>

# APPLICATION OF VARIOUS WELL RESEARCH METHODS IN THE DEVELOPMENT OF A HYDRODYNAMIC MODEL OF A FIELD (ON THE EXAMPLE OF THE WESTERN KHODZHAOSMON FIELD)

Makhmudov N. N.<sup>1</sup>

Akhmedova N. A.<sup>1</sup>

Murodov S. N.<sup>1</sup>

Agzamova S.<sup>1</sup>

Kalesheva G.<sup>1</sup>

<sup>1</sup> Tashkent State Technical University,  
Universitetskaya Street 2, Tashkent, Uzbekistan  
axmedovan38@gmail.com

### Abstract

This article presents all hydrodynamic well research methods used in field practice, which are divided into two groups: the steady-state withdrawal method and the pressure recovery method. The steady-state withdrawal method is applied in production and injection wells and is most effective in wells equipped with electric submersible pumps (ESPs). The essence of this method is to establish, through field measurements, the relationship between flow rate and bottomhole pressure.

Hydrodynamic studies at the Western Khodzhaosmon field were carried out using the methods of steady-state withdrawals (SSW) and pressure recovery (PR). Steady-state withdrawal studies were performed under five operating regimes. The measurements included bottomhole pressure and temperature at a depth of 2474 meters, tubing and annular pressures, liquid and gas flow rates using a full-

## Eureka Journal of Geoscience, Materials & Resource Engineering (EJGMRE)

ISSN 2760-4985 (Online) Volume 02, Issue 05, May 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaoa.com/index.php/9>

flow separation unit (FSU). Gas condensate studies were conducted under a single regime using a 12 mm choke during direct flow. Gas and condensate flow rates were measured.

The second method of well research is the unsteady-state filtration method. In flowing wells, bottomhole pressure is measured with a downhole manometer, well flow rate is measured, and reservoir permeability, piezoconductivity, hydraulic conductivity, productivity index, and skin factor are determined by calculation. In mechanized wells, the method of sequential change of steady-state conditions (SCSC) is applied. High-quality data is obtained when the fluid level rises from pump intake depth to the wellhead.

Field gas-condensate studies were conducted based on a methodology that prescribes phase separation of the entire produced gas-liquid mixture in a separator.

**Keywords:** Separator, hydraulic conductivity, piezoconductivity, choke, manometer, productivity coefficient, steady-state withdrawal method.

### Introduction

Hydrodynamic (field) studies of formations and wells are among the most important sources of information for reservoir evaluation. Improvement of oil field development systems is closely connected with field interventions aimed at intensifying oil production. Therefore, hydrodynamic studies of wells and formations play a vital role as a tool for evaluating the effectiveness of applied activities. During the operation of reservoirs and wells, studies are mainly conducted using hydrodynamic methods, while reservoir characteristics are refined, and the effectiveness of measures to influence the bottomhole zone of the reservoir is identified.

All hydrodynamic research methods used in field practice are divided into two groups: the steady-state withdrawal method and the pressure recovery method.

## Eureka Journal of Geoscience, Materials & Resource Engineering (EJGMRE)

ISSN 2760-4985 (Online) Volume 02, Issue 05, May 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaoa.com/index.php/9>

**The steady-state withdrawal method** is applied in production and injection wells. It is most effective in wells equipped with ESPs. The essence of this method lies in establishing the relationship between flow rate and bottomhole pressure through field measurements. The optimal investigation involves three operating regimes, changing casing pressure at 24-hour intervals.

Based on these measurements, an indicative diagram (relationship between well flow rate and bottomhole pressure) is created to determine the well's productivity index and current reservoir pressure. These data are used for calculating reservoir permeability and other hydrodynamic properties.

The same method is also used in flowing wells, which must be equipped with a lubricator and a dedicated research platform.

The second method is **the unsteady-state filtration method**.

In flowing wells, bottomhole pressure is measured with a downhole manometer, well flow rate is measured, and reservoir permeability, piezoconductivity, hydraulic conductivity, productivity index, and skin factor are determined by calculation.

For mechanized wells, the method of sequential change of steady-state conditions (SCSC) is used. High-quality information is obtained if the fluid level rises from pump intake depth to the wellhead.

The Western Khodzhaosmon field is located in the Markhamat district of Andijan region. Tectonically, it belongs to the Andijan zone of local uplifts of the southern step of the Fergana intermountain depression and lies southeast of the Palvantash field.

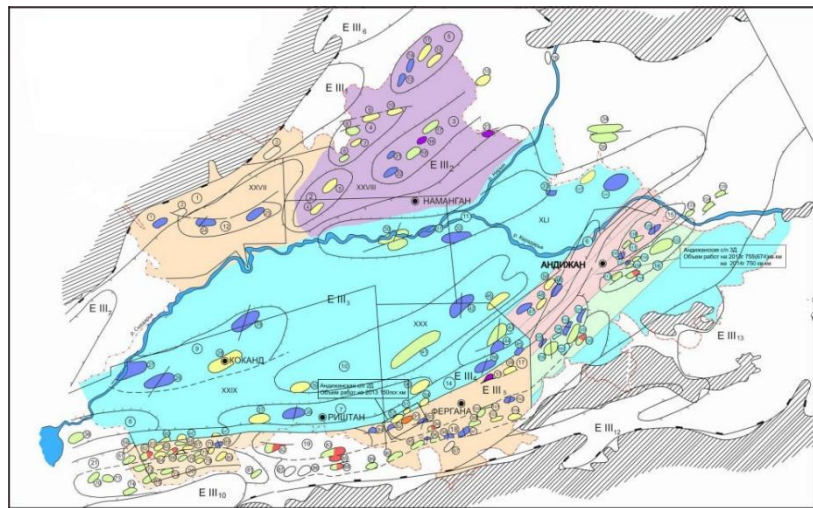
## Eureka Journal of Geoscience, Materials & Resource Engineering (EJGMRE)

ISSN 2760-4985 (Online) Volume 02, Issue 05, May 2026



This article/work is licensed under CC by 4.0 Attribution

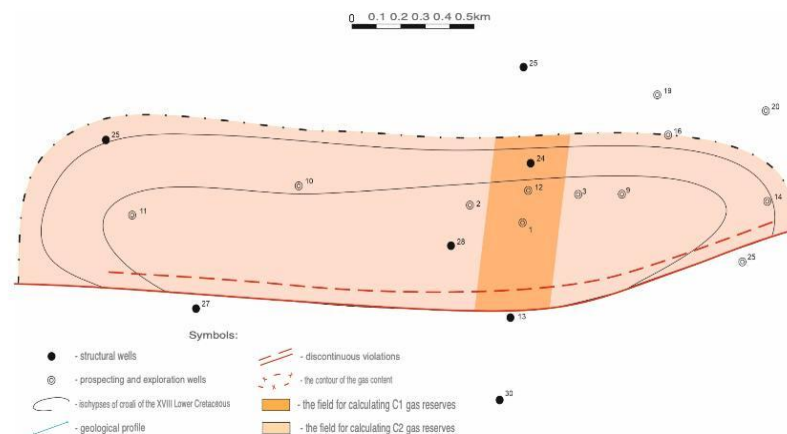
<https://eurekaopenaccess.com/index.php/9>



**Fig.1.** Administrative location of the GCM Western Khodzhaosmon

The structure of Western Khodzhaosmon was identified based on detailed analysis of structural and exploratory well drilling results.

On the structural map for the top of the XX reservoir in the Lower Cretaceous Muyan suite, the Garbiy Khodzhaosmon field represents an anticline of northeast strike. The southeast wing is disrupted by a fault with an amplitude of 80–90 meters.



**Fig.2.** Structural map of the XX horizon of the GCM Western Khodzhaosmon

## Eureka Journal of Geoscience, Materials & Resource Engineering (EJGMRE)

ISSN 2760-4985 (Online) Volume 02, Issue 05, May 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaoa.com/index.php/9>

Gas-hydrodynamic studies at the field were conducted using steady-state withdrawals (SSW) and pressure recovery (PR). The SSW study was performed under five regimes of direct flow ( $\emptyset$  chokes/washers: 4/10 mm, 6/18 mm, 8/22 mm, 10/30 mm, 12/34 mm). During the studies, measurements were taken of: bottomhole pressure and temperature at a depth of 2474 m (manometer-thermometer Foton 5564), tubing and annulus pressure (wellhead manometers-thermometers Foton 5570 and 5578, respectively), liquid and gas flow rates (using a full-flow separation unit – FSU). Gas-condensate studies were conducted on one regime – 12 mm choke of the direct course with a separation condition of 14.2 kgf/cm<sup>2</sup>. Measurements of gas and condensate flow rates were performed. Measurement of gas separation flow rate at the Western Khodzhaosmon field was carried out through a diaphragm critical flow meter (DCFM), which was installed after the FSU on the flare line. The separated liquid was drained from the FSU drain line into an open 5 m<sup>3</sup> measuring tank. From the 5 m<sup>3</sup> measuring tank, the liquid was pumped out using a 10 m<sup>3</sup> tank truck (quantity of tank trucks – 2 pcs to ensure continuous pumping of liquid for correct measurement). Then, as the tank truck was filled, the liquid was drained into an open 30 m<sup>3</sup> tank. In the open 30 m<sup>3</sup> measuring tank, final gravitational separation of condensate and water occurred. Condensate and water flow rates were determined by gauging the water level in the measuring tank using a measuring rod. Additionally, condensate samples were taken from the upper part of the tank to determine the content of emulsified water. Based on the results of analysis and interpretation of GHD and GCI, the following parameters were determined: reservoir pressure, reservoir FEC, skin factor, filtration resistance coefficients and absolute open-flow gas rate, component composition of reservoir gas (from C1 to C5+).

An uncharacteristic change in bottomhole pressure is also observed – with each well shutdown, the pressure began to decrease. Figure 3 shows the technological scheme of studies with pressure change. Such pressure behavior may be associated with a limited reservoir or with the influence of condensate dropout in

## Eureka Journal of Geoscience, Materials & Resource Engineering (EJGMRE)

ISSN 2760-4985 (Online) Volume 02, Issue 05, May 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaoa.com/index.php/9>

the bottomhole zone. During interpretation, to achieve better matching of the model curve with actual data, a model with the influence of boundary conditions was used – rectangular boundaries. With the above, during PR interpretation, the skin factor was determined as debit-dependent. PR interpretation was performed in the Saphir software of the integrated KAPPA-Workstation platform (v 5.30). During interpretation, the effective (gas-saturated) reservoir thickness of 4.5 m and reservoir porosity of 14.2% were adopted (data provided by the customer). Due to frequent absence of a measuring tank at the well on the fifth regime (12 mm choke) – measurements of condensate and water flow rates have low reliability, therefore, during interpretation, calculated values from the condensate-gas factor (CGF  $627.6 \text{ cm}^3/\text{m}^3$ ) of the 5th regime (12 mm choke) were used. The PR diagnostic plot shows the derivative after the influence of condensate dropout in the bottomhole zone of the wellbore, the derivative increases, the increase in the derivative is caused by pressure distortions described above and, possibly, a limited reservoir – rectangular boundaries.

In accordance with the above, during PR interpretation, a model of a homogeneous reservoir with the influence of rectangular boundaries was adopted. Reservoir pressure was determined by the model curve method at the beginning of the well operation history ( $P_i$ ) 26.09 MPa.

Field gas-condensate studies were performed according to the methodology for well research, which prescribes the separation of the entire productive flow of the gas-liquid mixture into phases in the separator. According to these documents, the entire gas flow was passed through a separation device, in which, at various separation regimes, the separation and measurement of the liquid phase quantity, namely gas condensate and formation water, were carried out. Field gas-condensate studies were performed according to the methodology for well research, which prescribes the separation of the entire productive flow of the gas-liquid mixture into phases in the separator. Gas-condensate studies were

## Eureka Journal of Geoscience, Materials & Resource Engineering (EJGMRE)

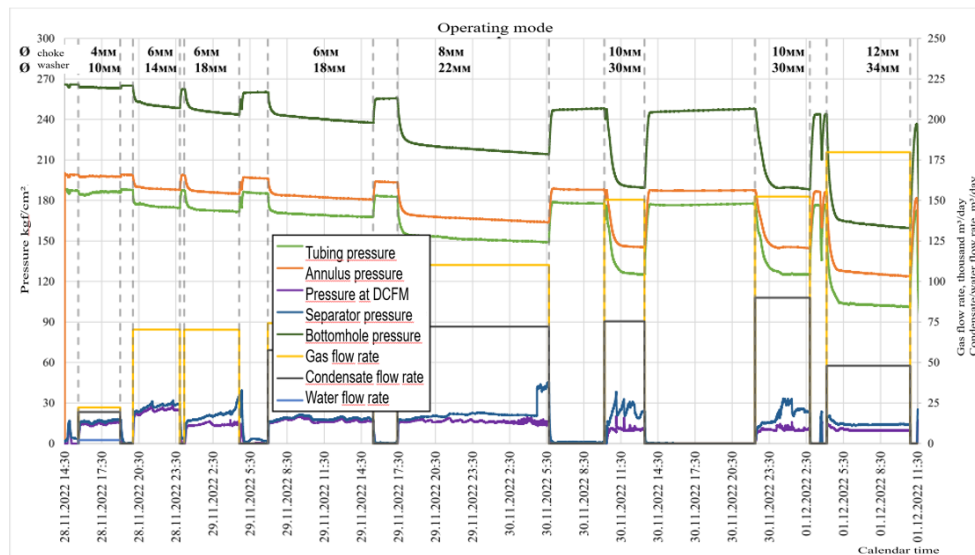
ISSN 2760-4985 (Online) Volume 02, Issue 05, May 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaopenaccess.com/index.php/9>

performed on one well operating regime on a 12 mm choke at one separation regime according to Table 6 at a pressure of 14.1 kgf/cm<sup>2</sup>.



**Fig.3.** Technological scheme of studies

### Conclusions

In a certain period (from 27.11.2022 to 01.12.2022), a complex of gas-hydrodynamic and gas-condensate studies was performed in the well. Gas-hydrodynamic studies were conducted using the method of steady-state withdrawals on 5 regimes of the direct course. Based on the results of development and testing of layer VII in the interval (2476-2490 m) when the well was operating through the maximum choke diameter of 12 mm and washer diameter of 34 mm, a gas inflow with a rate of 172.87 thousand m<sup>3</sup>/day was obtained, the condensate rate on the regime was 48 m<sup>3</sup>/day.

During PR interpretation, the effective (gas-saturated) reservoir thickness was adopted according to the customer's data – 4.5 m, reservoir porosity 14.2%.

## Eureka Journal of Geoscience, Materials & Resource Engineering (EJGMRE)

ISSN 2760-4985 (Online) Volume 02, Issue 05, May 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaoa.com/index.php/9>

Reservoir fluid parameters were set based on the results of analysis of wellhead samples.

The derivative after the influence of condensate dropout in the bottomhole zone of the wellbore increases the derivative, the increase in the derivative is caused by pressure distortions and possibly a limited reservoir – constant pressure boundaries.

In accordance with the above, during PR interpretation, a model of a homogeneous reservoir with the influence of a rectangular boundary was adopted. Based on the results of PR interpretation, the reservoir is characterized by the following FEC parameters:

- Hydraulic conductivity coefficient ( $kh/\mu$ ) – 2239.5 Darcy·cm/(mPa·sec).
- Permeability coefficient ( $k$ ) – 169.73 mD.
- Conductivity ( $kh$ ) – 763.8 mD·m.
- Debit-dependent skin factor ( $S$ ) – (-0.82) dimensionless.
- Total skin factor – (15.76) dimensionless.

The physical meaning of the high positive skin factor value (15.76 units) is explained by the fact that in the bottomhole zone of the reservoir under depression, two-phase filtration of gas and condensate took place. The condensate reduced the phase permeability for gas, hindering its filtration. In this case, the well productivity is determined mainly not by the physical permeability of the reservoir in the bottomhole zone, but by the value of phase permeabilities for fluids in this zone. Therefore, further impacts on the bottomhole zone of the reservoir to increase its productivity may be ineffective.

Based on the results of ID interpretation (studies using the method of steady-state withdrawals), filtration resistance coefficients of the reservoir and absolute open-flow gas rate were calculated.

Through a 12 mm choke, the following physicochemical characteristics were obtained:  $d_{ch.} = 12$  mm; at  $P_{sep} = 14.1$  kgf/cm<sup>2</sup>; – density of reservoir gas – 1.452

## Eureka Journal of Geoscience, Materials & Resource Engineering (EJGMRE)

ISSN 2760-4985 (Online) Volume 02, Issue 05, May 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaoa.com/index.php/9>

kg/m<sup>3</sup>; – molecular weight of reservoir gas – 34.91 g/mol; – calculated potential condensate content in reservoir gas – 363.91 g/m<sup>3</sup>.

Calculation of conditions for liquid carryover from the well bottom and conditions for corrosion of well equipment at different gas flow velocities was performed, operation of the well in regimes with a tubing pressure range  $P_{\text{tub}} = 149.1\text{-}153.4$  kgf/cm<sup>2</sup> is recommended.

### References

1. Ahmed T. Reservoir Engineering Handbook, 2nd ed. //Houston: Gulf Publishing Company. – 2001.
2. Makhmudov N. N., Akhmedova N. A. Assessment of technological factors influencing the increase in component recovery of gas condensate fields at a late stage of development.// EDUCATIONAL RESEARCH IN UNIVERSAL SCIENCES VOLUME 2, ISSUE 7, JULY, 2023.
3. A. Kh. Agzamov, N. N. Makhmudov, A. S. Mustafayev, N. A. Akhmedova. Development of effective technologies for well operation in oil and gas condensate fields. Monograph. Lesson Press, 2024.
4. Makhmudov, N.N., Akhmedova, N.A., Shoisae, A.A. "Results of Gas-Hydrodynamic Studies under Stationary and Non-Stationary Filtration Regimes Using the Kultak Field as an Example." Konchilik mashinlari va tekhnologialari, 2023, No. 3 (5).
5. Makhmudov N.N. Akhmedova N.A. Sulitanofu K.M. Intelligent approach to power system management during well drilling in terms of environmental impact. E3S Web of Conferences 461, 01060 (2023) RSES 2023.
6. Khalismatov, R. Zokirov, A. Zakirov, B. Abdurakhmanov, N. Botirova, N. Akhmedova. Main types of reservoirs of pre-jurassic deposits in the Ustyurt region. E3S Web of Conferences 434, 02024 (2023) ICECAE 2023.
7. Methodological guidelines for calculating oil recovery factors from the subsoil using water-oil displacement characteristics.



## Eureka Journal of Geoscience, Materials & Resource Engineering (EJGMRE)

ISSN 2760-4985 (Online) Volume 02, Issue 05, May 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaoa.com/index.php/9>

8. Abbasova, S.A.; Makhmudov, N.N.; Akhmedova, N.A.; Nasimkhanov, L.N. Adaptation of the hydrodynamic model of fields in conditions of insufficient initial data on gas production in terms of gas-bearing area. “Primary tasks of oil and gas field mechanics and their solutions” international conference. 12/2023.
9. Bourdet D. Well Test Analysis: The Use of Advanced Interpretation Models //Amsterdam: Elsevier Science. – 2002. – 426 p.
10. Danesh A. PVT and Phase Behavior of Petroleum Reservoir Fluids //Amsterdam: Elsevier Science. – 1998. – 388 p.
11. McCain, Jr. W.D. The Properties of Petroleum Fluids, 2nd ed. //Tulsa: PennWell Publishing Company. – 1990. – 548 p.