

## ISSUE OF DRILLING FLUID ABSORPTION IN THE ABSHERON FIELDS

**Eldar Suleymanov<sup>1</sup>, Anar Azimov<sup>2</sup>**

<sup>1,2</sup> Azerbaijan State Oil and Industry University

<sup>1,2</sup> Department of Oil and Gas engineering

<sup>1</sup>Professor, Doctor of Tech. Sc.; <sup>2</sup>Master student

E-mail: <sup>1</sup>eldar.suleymanov.1950@gmail.com,

<sup>2</sup>anarezimov56@gmail.com

### ABSTRACT

The hydrocarbon exploration industry faces a recurring and costly problem of drilling fluid absorption, particularly in difficult geological settings like Azerbaijan's Absheron fields. This diploma project explores the processes, factors, and mitigation measures related to high drilling fluid losses whilst building wells in different fields. The dissertation conducts geological analysis, field observations, laboratory trial investigations, and uses up-to-date technologies for an analysis of key absorption zones and for assessing the efficacy of existing fluid systems. Porous and fractured formations have identified as the primary factor causing unintentional absorption of fluid.

This study assesses the practicality and effectiveness of innovative methods and incorporating new technologies, such as managed pressure drilling (MPD), loss circulation materials (LCM), polymer-modulated fluid systems, nanomaterials, and real-time monitoring systems in the field of Absheron. In addition to providing comparisons of conventional and alternative methods, the study provides constructive advice on useful recommendations for reducing fluid loss and NPT, as well as improving well-bore stability. Ultimately, these outcomes are a step towards more secure operations in the difficult subsurface conditions of the region, improved drilling knowledge and performance as well as cost-reduction opportunities.

**Keywords:** drilling fluid absorption, well construction, drilling performance, polymer-enhanced fluids, managed pressure drilling (MPD), real-time monitoring.

### Introduction

Hydrocarbon exploration and production require effective drilling technologies that include environmental impact, safety, and efficiency. The uncontrolled absorption or loss of drilling fluids into subsurface formations is one of the most serious issues in drilling operations. It is commonly referred to as lost circulation or loss of drilling fluid. Such problems present serious operational and financial risks, especially in geologically complex parts of the world like Azerbaijan's Absheron fields.

The Absheron Peninsula covers portions of several geological formations, including unstable shales, high permeability sandstones, and fractured carbonates. These do often act as conduits for fluid loss, particularly if vugs or natural fractures occur. Uncontrolled absorption of drilling fluids can cause many issues, including decreases in hydrostatic pressure, blockages of pipes, damage to formation, increased non-productive time (NPT) and increased drilling costs. In the worst-case scenarios, it may compromise well integrity leading to well abandonment.

Despite improvements in well control techniques and drilling fluid technologies, seeking to address the issue of drilling fluid absorption remains a challenge in the Absheron region. The key to overcoming these difficulties lies in an understanding of the local geological situation, knowledge of how different drilling fluids perform in downhole conditions, and an understanding of and application of current preventative and remedial technologies. This diploma project intends to assess the effectiveness of several contemporary mitigation techniques and investigate the causes of drilling fluid absorption in the Absheron oilfield. The project includes a review of field data, laboratory testing

of core samples, and the application of new technologies, such as managed pressure drilling (MPD) technology, nanotechnology, and polymer-based muds. By evaluating the main causes of fluid lost circulation and studying successful case studies, the project will aim to develop practical solutions to enhance drilling capabilities, reduce costs and improve operational safety in the Absheron region.

### Objective

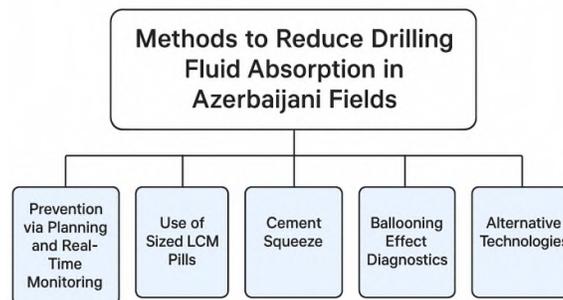
The objectives of this diploma project are to study in Absheron fields reasons and impacts of drilling fluid absorption and reviewing its current prevention and control methods. Evaluation of new drilling fluid systems and technologies, analysis of geological aspects of fluid loss, and giving practical recommendations for reducing non-productive time and ensuring wellbore stability. The overall aim of the research is going to be primarily to improve drilling performance in an area where geology is difficult in safe and effective/cost-effective way.

### Methods

In the Absheron oilfield, one of the major geological challenges, is the lost circulation while drilling through very permeable and fractured rock. Reactive and preventative actions should be used in combination to properly respond to lost circulation. This report outlines the procedures involved in a particular incident at the Absheron field, occurring on March 23, 2022, where significant fluid absorption while drilling the 8½" reservoir section.

In Absheron fields, lost circulation of drilling fluids is a recurring and costly challenge, primarily through fractured high permeability areas. Engineers combine lost circulation material (LCM) treatments, staged flow tests, live monitoring, and squeeze cementing when situations need it. Each of these actions is taken in accordance with the formation response and the severity of the loss. Diagnostics, using a low-rate circulation test, are often the first step in the sequence, providing an assessment of losses. Specifically developed LCM tablets are used to fill the fractures to try and restore partial or total circulation, if circulation is observed to be lost. Squeeze cementing is used as a final action to isolate the loss zone, when the methods implemented above fail. Surface pressure, trends in flow rate, and downhole data direct the methods used and the sequence of actions taken to ensure proper implementation.

**Techniques for Reducing Absheron Field Drilling Fluid Absorption.** Significant geological difficulties exist in the Absheron oilfield, especially when it comes to fluid losses that occur during drilling through extremely permeable and fractured rocks. Reactive and preventative tactics must be used in tandem to successfully address these losses.



**Figure 1.** Breakdown of different remedial methods during drilling fluid absorption

### First Approach: The Stress Cage Method.

The Stress Cage is a proactive method of treating fluid loss and is particularly useful in formations prone to cracking, illustrated in deep water with an Absheron field case study. Stress Cage is created

by pumping a specially designed pill with a variety of bridging materials, which are typically larger particles like marble and graphite as well as fibrous materials, to form a "stress cage" that supports the wall of the wellbore without allowing cracks to develop and expand.

Operational Principles:

The pill is pumped prior to anticipated loss zones, and the additional material adds hoop stress to the borehole surrounding the pill, redistributes stress to the edge of the fracture, and crosses fractures. So even though the well may be subjected to higher pressures, the formation will not suffer loss since it applies an artificial increase to the fracture gradient.

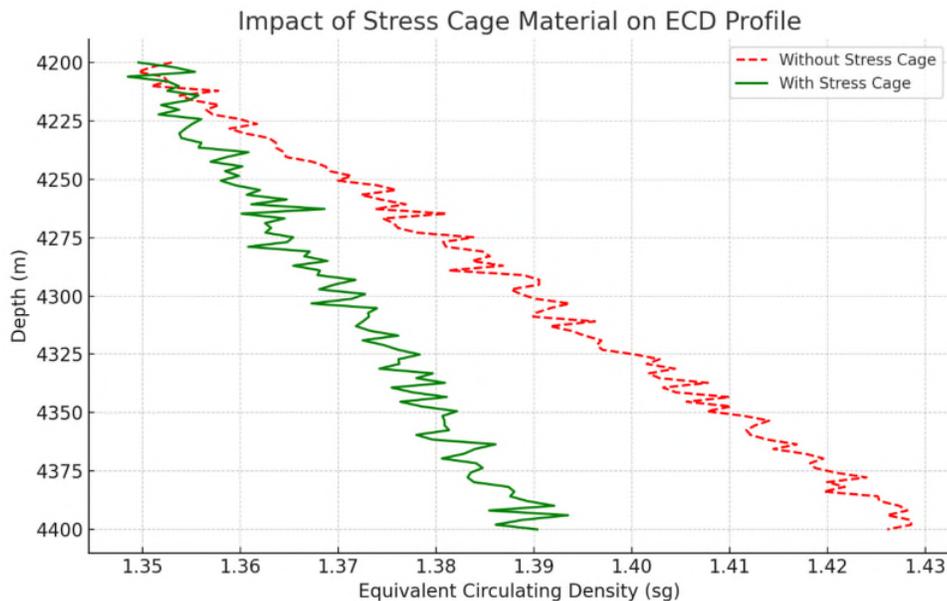
Field Observations:

The drilling data indicates that fluid loss began at 4302.7 m, where a well pressure increase occurred and total return loss recorded. There is a possibility this formation could have sustained a larger ECD before breakdown if a stress cage pill was set proactively before reaching 4302.7 m.

The graph below shows:

ECD rises sharply in the absence of a stress cage and can exceed the fracture gradient.

A stress cage held the ECD profile flat, providing pressure support and limited circulation losses.



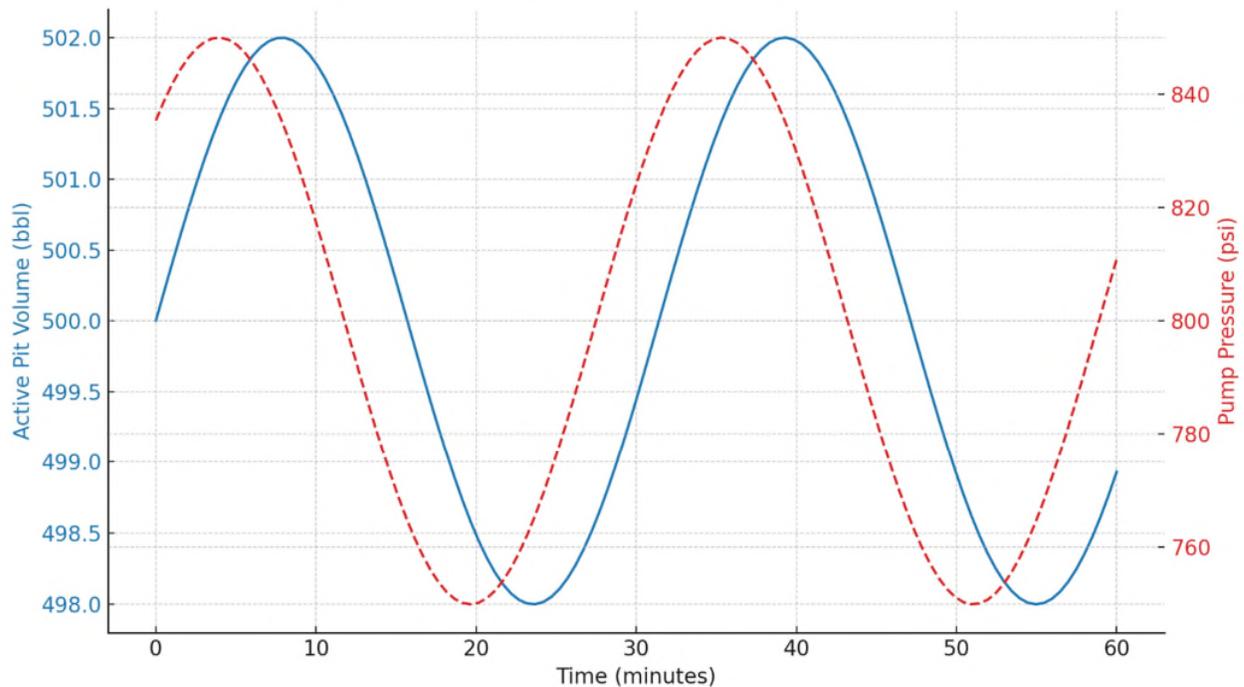
**Figure 2.** Impact of spotted Stress Cage material on ECD plotted on horizontal axis versus depth on vertical axis

The Stress Cage Method has many advantageous attributes that do not typically reflect the benefits of a means of mitigating or severely reducing lost circulation. It enhances fracture coexistence and therefore increases operational time. It limits or eliminates reactive procedures, such as cementing, or LCM use. It can lower the total dollars and or time related to non-productive time (NPT). When planned and applied in advance and utilized in high permeability rocks with natural fractures, such as in the Absheron basin, the Stress Cage Method works best.

#### **Analysis of Diagnostics for the Ballooning Effect.**

Wellbore breathing, which is also called ballooning, is a phenomenon that makes it seem the well is losing and gaining mud volume in cycles that are often similar to a false alert for formations losses. The wellbore expands slightly and "absorbs" fluid with an increase in pressure and contracts and "releases" the fluid when pressure decreases. Apparently, this is caused by the elastic deformation of the formations walls when the pressure changes.

Ballooning Effect: Active Pit Volume vs. Pump Pressure Over Time



**Figure 3.** Demonstration of ballooning effect on time graph through pump pressure in psi versus active pit volume in barrels

We used two basic data sets to demonstrate the usual ballooning signature in the preceding graph: Over time, the Active Pit Volume (blue line) experiences small cycles of gains and losses. The pump pressure (red dashed line) shows correlated pressure cycles.

#### **Important findings:**

The active pit volume declines as pump pressure increases which means the formation is temporarily absorbing drilling fluid due to expansion. Conversely, when the pressure drops, mud returns from the well bore into surface pits as shown by the increase in pit volume. These symmetrical oscillations influence reversing the net fluid losses over time confirms ballooning not actual loss circulation.

#### **Diagnostic Importance**

The crew conducted diagnostic tests and noticed an increase in the trip tank volume during the field incident on March 9, 2024. This behavior, which is known as classic ballooning, was utilized to distinguish it from real formation loss. Following a brief period when the fluid volume returns with a quiet well following shut-in. Implications for operations Avoid unnecessary cementing or LCM: This may result in a squeeze job or a unsuccessful and premature LCM treatment due to the mistaking of ballooning for loss. Observe Pressure vs. Volume Trends: Operators can validate the cyclical characteristics of ballooning through real-time diagnostics with mud logger systems and an Electronic Drilling Recorder (EDR). Use of Flowback Signatures: One important means to identify ballooning is to validate return volumes following pump shutdown.

#### **Bulla-Deniz Field Case Study**

The Bulla-Deniz field off the Caspian Sea presents complex geological conditions with high pressure areas and porous formations. To manage the loss of drilling fluid advanced cement squeeze methods were used:

- The EZSV Packers and the mechanical setting equipment allowed an accurate placement of cement slurry in the indicated zones.
- Simulation Programs: Before activities started simulations were run to anticipate the performance

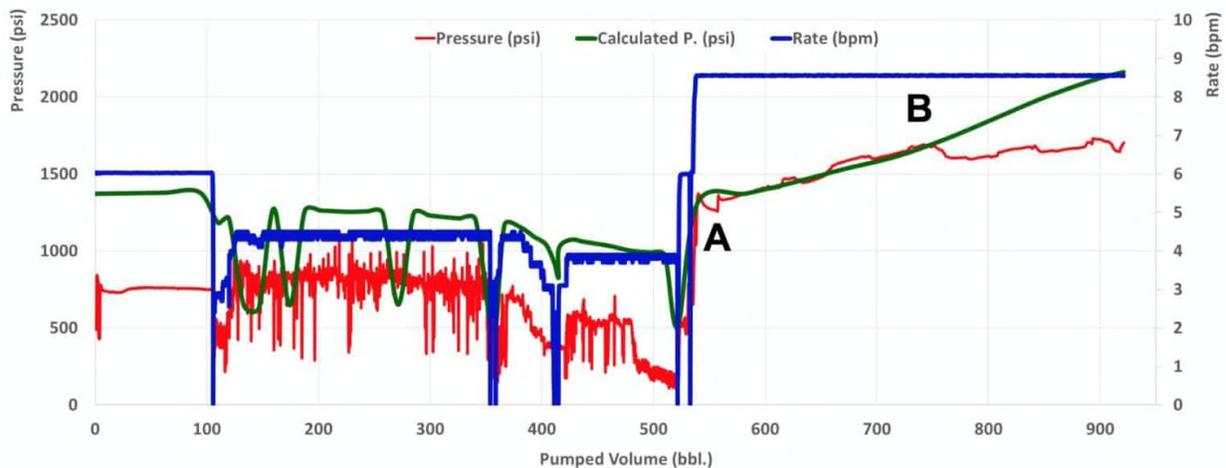
of the cement, before operations started to ensure successful sealing.

The Bulla wells are complex wells in the Caspian region, before drilling into the reservoir section that utilizes high MW, the drilling liner was run to the cased off VII horizon and high pressure, that has major concerns including differential sticking and loss of circulation, which in the past had caused stuck pipe and losses. In order to be prepared for the risks, under reaming/liner cementing at MW less than PP were imaged and implemented to provide good cementing along the open hole and good shoe, in order to drill into the reservoir section as part of the project.

### Cement Squeeze

Cement squeezing operations became a critical corrective measure to resolve issues by preventing fluid loss through porous formations and the sealing of porous formations. Cement squeezing (or squeeze cementing) is the operation where cement slurry is injected into a defined zone in a wellbore to seal permeable formations or to halt the leak. Packers are used to isolate the zone to be cemented, and pressure is applied to the cement slurry to push the cement into the formation. The cement will prevent fluid migration once it hardens. In response to industry requirements, and to improve the efficiencies of cement squeezing applications, several materials have been added to cement slurries:

- Nano-Silica Gel: It enhances the sealing capabilities of cement, especially in channels and micro-annuli.
- Hydrated Zeolite Aluminosilicate: It helps stabilize the well, reduce the ingress of sand, and improves the durability of the cement.
- Plasticizers (e.g., Bentomix 1275): It increases the flexibility of the cement so they can accommodate higher dynamic loading during use.



**Figure 1.** Real world cementing job evaluation through pump pressure and rate in comparison with calculated output

From point A, defined by the first point where the cement slurry, the heaviest cementing fluid, turns around the shoe and starts an ascent in the annulus; the potential increase in pressure is essentially related to pumping rate and volume of annular space. This section of the pressure comparison process is primarily intended to calibrate the model. Just before point A is reached, when all cementing fluid has not yet reached the shoe, the pumping pressure may be greater or less than calculated by a constant. This could perhaps be an under- or over-estimation of surface friction pressure. Here is an example of the curve:

The measured and calculated pressure curves depart at the same pumping volume (point A) as there is a top and bottom plug in use, both being a mechanical barrier at the top of the lead cement slurry beneath and the spacer or mud above to avoid intermixing inside casing. This ensures that there were not any two forties mixed within the casing. The displacement in the annular space from point A to point B slope remains constant for both measured and calculated pressure curve growth, only rising. The pressure measured at B was relatively constant, suggesting a volume loss. Whereas the actual



pressure remains flat, indicating total loss, and therefore, the volume of loss can be easily calculated from the amount of shown pumped volume. If, on the other hand, the actual pressure increases but is at a lesser slope than the calculated pressure curves the volume of loss can also be inferred from the actual and calculated curves slope.

### Conclusions

The issue of mud loss in the Absheron oilfield is multi-faceted and requires multiple strategies to account for the challenging complexities of the geological environment, especially fractured and highly permeable rock. Three major solutions – stress cages, ballooning diagnostics and squeeze cementing – have proven to be vital tools resulting in a reduction in mud loss as a result of the operational geology analysis and operational actions. The Stress Cage is a predictive solution, with an advantage of circumstantial stress management, having the capability to support the repair of the wellbore and increase the fracture gradient using designed particles. If Stress Cage is implemented beforehand in times of risk, future reactive responses could be lessened, and mud loss would be realized as a significant saving.

Based on field data, if the stress cage material had added pre-drilling of the critical shoetrack depth, circulation could have been established, and appropriate and costly correlative measures would have been avoided. Finally, squeezing cementing will become the option of choice when the losses exceed the containment ability of LCM pills and other bridging material. Based on the field case, we have re-established wellbore integrity and isolated the loss channel via sequential cement injection into the loss zone. Squeeze cementing, if suitably planned and executed, is still an effective last resort—despite the level of resources required.

### Literature

1. Fan, G., Li, M., Chen, X., Palyanitsina, A., Timoshin, A. A Numerical Study on the Application of Stress Cage Technology. *Energies*, Vol. 15, No. 15, 2022, pp. 5439.
2. Akhundov, F.A. Increasing the Efficiency of Drilling Wells under the Condition of Absorption of Drilling Mud in Oil-Gas Fields of Azerbaijan. *Azerbaijan Oil Industry Journal*, Vol. 89, No. 11, 2012, pp. 9–13.
3. Suleymanov, E.M., Ibrahimov, R.S., Bakhshaliyev, Sh.O. U-tube Effect in Well Cementing on the Absheron Peninsula. *Azerbaijan Oil Industry Journal*, Vol. 101, No. 11, 2024, pp. 9–13.
4. Kamalov, K., Mirzayev, R., Kilic, A. Creeping Claystone Formation in Absheron Field, Azerbaijan: Description, Issues and Mitigations for Future Wells. *SPE Caspian Technical Conference and Exhibition, Paper SPE-217564-MS*, 2023.
5. Izadi, M., Chaparian, E., Trudel, E., Frigaard, I. Squeeze Cementing of Micro-Annuli: A Visco Plastic Invasion Flow.
6. Olayiwola, O., Nguyen, V., Andres, R., Liu, N. The Application of Nano-Silica Gel in Sealing Well Micro-Annuli and Cement Channeling.
7. Mehdiyev, K.K., Ahmad, F.F., Hajikerimova, L.G., Kazimov, Sh.P. Composition for Toughness Increase of Deposit Rocks. *Azerbaijan Oil Industry Journal*, Vol. 96, No. 2, 2019, pp. 45–52.
8. Veliyev, E.F., Aliyev, A.A. Comparative Analysis of the Geopolymer and Portland Cement Application as Plugging Material under Conditions of Incomplete Displacement of Drilling Mud from the Annulus. *Proceedings of SOCAR*, Issue 1, 2022.
9. Islamov, R., et al. Fluid-Loss Control Technology: From Laboratory to Well Field. *Processes*, Vol. 12, No. 1, 2024, pp. 114.
10. Wikipedia Contributors. Squeeze Job. *Wikipedia*, Last updated 2022.

## ABŞERON SAHƏLƏRİNDƏ QAZMA MƏHLULUNUN UDULMASININ SƏBƏBLƏRİNƏ QARŞI TƏDBİRLƏR

**Eldar Suleymanov<sup>1</sup>, Anar Azimov<sup>2</sup>**

<sup>1,2</sup>Azərbaycan Dövlət Neft və Sənaye Universiteti

<sup>1,2</sup>“Neft-qaz mühəndisliyi” kafedrası

<sup>1</sup>Professor, t.e.d.; <sup>2</sup>magistr tələbəsi

E-mail: <sup>1</sup>eldar.suleymanov.1950@gmail.com,

<sup>2</sup>anarezimov56@gmail.com

## XÜLASƏ

Məqalə Abşeron yataqlarında qazma zamanı tez-tez rast gəlinən qazma mayesinin udulması problemini araşdırır. Geoloji baxımdan bu sahə yüksək məsaməlilik və çatlıqla xarakterizə olunur ki, bu da qazma mayesinin udulmasına və bununla bağlı texniki və iqtisadi çətinliklərin yaranmasına səbəb olur. Tədqiqatda 2024-cü ilin mart ayında real sahə əməliyyatlarına əsaslanan hadisə təhlil edilmişdir. Problemə qarşı tətbiq edilən üsullar sırasına axın dərəcəsinin mərhələli şəkildə artırılması, böyük ölçülü LCM (itkiyə qarşı material) həllərinin vurulması, stress qəfəsi texnologiyasının tətbiqi və son mərhələdə sement sıxma əməliyyatı daxildir. Həmçinin, quyuya qazma dayandırıldıqdan sonra baş verən "balonlaşma" effekti də təhlil olunmuş, bu prosesin dinamik təzyiqlə dəyişmələri və əməliyyat qərarlarına təsiri qiymətləndirilmişdir. Sahə məlumatları və qrafik analizlər əsasında müəyyən olunmuşdur ki, itkilərin effektiv qarşısının alınması üçün real vaxtda monitoring, uyğun LCM dizaynı və zəruri hallarda sement sıxma tədbirləri ardıcılıqla və koordinasiyalı şəkildə həyata keçirilməlidir. Bu iş, Azərbaycanın digər oxşar geoloji şəraitə malik yataqlarında da istifadə oluna biləcək effektiv yanaşma metodikasını təqdim edir.

**Açar sözlər:** qazma mayesinin udulması, quyu tikintisi, qazma performansı (və ya qazma göstəriciləri), polimerlə gücləndirilmiş mayelər, idarə olunan təzyiqlə qazma, real vaxt rejimində monitoring (və ya izləmə).

## ПРОБЛЕМА ПОГЛОЩЕНИЯ БУРОВОГО РАСТВОРА НА МЕСТОРОЖДЕНИЯХ АПШЕРОНА

**Эльдар Сулейманов<sup>1</sup>, Анар Азимов**

Азербайджанский государственный университет нефти и промышленности

<sup>1,2</sup>Кафедра «Нефтегазового машиностроения»

<sup>1</sup>Профессор, д.т.н.; <sup>2</sup>студент-магистр

E-mail: <sup>1</sup>eldar.suleymanov.1950@gmail.com,

<sup>2</sup>anarezimov56@gmail.com

## РЕЗЮМЕ

В разведке углеводородов проблема поглощения бурового раствора является повторяющейся и дорогостоящей, особенно в геологически сложных районах, таких как Апшеронские месторождения Азербайджана. В данной дипломной работе рассматриваются процессы, сопутствующие факторы и методы смягчения последствий, связанных с большими потерями бурового раствора при строительстве скважин на различных участках. Исследование включает геологический анализ, полевые данные, лабораторные испытания и современные технические подходы с целью выявления ключевых зон поглощения и оценки эффективности существующих буровых систем. Пористые и трещиноватые породы выделяются как основные причины неконтролируемого вторжения жидкости. Изучается применимость и эффективность передовых решений, таких как бурение с управляемым давлением (MPD), материалы для устранения потерь раствора (LCM), полимерные растворы, наноматериалы и системы мониторинга в реальном времени в условиях Апшеронского региона. Наряду с сопоставлением традиционных и современных методов, исследование предлагает практические рекомендации по снижению потерь раствора, сокращению времени непроизводительной работы (NPT) и повышению



устойчивости стенок скважины. В конечном итоге полученные результаты способствуют более безопасному ведению работ в сложных геологических условиях региона, повышению эффективности бурения и оптимизации затрат.

**Ключевые слова:** поглощение бурового раствора, строительство скважин, эффективность бурения, полимерные растворы, управляемое давление (MPD), мониторинг в реальном времени.

Publishing history: 30.06.2025

Article received: 22.05.2025

Article accepted: 10.06.2025