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Issue Article

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ANALYSIS OF TYPES AND METHODS OF RESERVOIR TESTING DURING DRILLING

Abstract: *the article discusses the types and methods of testing formations in the process of drilling a well in order to successfully drill a well without accidents, complications and accurately determine the characteristics of productive formations. Testing of formations during drilling makes it possible to determine the parameters of reservoir pressure and reservoir productivity in the future for accurate design of well construction during the development of a new field where prospecting and exploration work is carried out.*

This analysis of the review by types and methods of testing formations during drilling in this article is carried out to accurately select them (type, method) for testing formations in an open bore during drilling. And also in order to avoid complications, accidents, gas, oil and water shows and to fulfill the tasks set to determine the characteristics of productive layers of wells in extremely difficult mining and geological conditions at abnormally high reservoir pressures.

Key words: *inflow, testing, incision, fluid, collector, test, mode, sampling, tightness, topping up, fitting, packer, choke.*

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Introduction

Formation tests are understood as a complex of works that ensure the flow of liquid and gas from the formation, sampling of reservoir fluids and gas, identification of the gas and oil content of the formation, determination of the main hydrodynamic parameters of the formation. The test is carried out both during the drilling of the well, and after the end of drilling, descent and cementing of the production column.

Testing and testing of formations during drilling is carried out in the sequence of drilling of promising horizons (the "top-down" method) [1, 3].

Testing of formations after completion of well construction is carried out in a fixed (cased) hole in a bottom-up sequence, taking into account the results of testing in an open hole. Therefore, usually the number of objects tested in the column is less than when tested during drilling.

The advantages of testing formations during drilling are that data on the hydrodynamic characteristics of the formation are obtained more objectively, because the bottom-hole zone of the formation is not yet intensively contaminated with drilling and cement mortars and it takes less time to conduct research than to test in a cased hole.

There is a distinction between testing and testing of productive layers.

Reservoir testing is usually limited to sampling reservoir fluids.

Testing of formations, in addition to sampling of reservoir fluid, provides for hydrodynamic studies [2, 4, 5].

The objectives of reservoir testing are:

1. Assessment of the productivity of the object (reservoir).

2. Sampling of reservoir fluids for research.

3. Assessment of reservoir properties of the reservoir.

4. Assessment of the degree of contamination of the bottom-hole formation zone (BFZ).

The essence of the formation test is as follows:

1. Isolation of the formation (or its section) from the rest of the well section.

2. Creating depression on the formation and causing the inflow of reservoir fluid.

3. Registration of changes in pressure and inflow of reservoir fluid in various sampling modes.

To assess the oil and gas potential of formations during drilling, testers are used, lowered into the well on a cable, or dumped inside the drill string.

Well surveys by pipe formation testers

Well studies by pipe formation testers (PFT) should be carried out immediately after the opening of the object in accordance with the well construction project and updated GTR (geological and technological research), GIS (geoinformation system) data justifying the need to perform PFT.

The GTR data are crucial for establishing the number and intervals of PFT studies.

The representative of the drilling company specified in the work plan is responsible for the execution of the work and the general manager. Responsible for compliance with the technical and technological requirements of the PFT well research process is a representative of the geophysical enterprise - the head of the batch, the well testing master.

The Customer is obliged to provide:

- preparation of the well, drilling tools, drilling and blowout equipment, the wellhead and its binding with the manifold of the preventer installation, drilling pumps, as well as the ability to monitor the inflow activity;

- the drilling team performs all work with the test equipment at the well (unloading, assembly, descent, testing, lifting, disassembly, loading);

- conducting, together with the contractor's representatives, an operational analysis of the results obtained.

The contractor is obliged to provide:

- selection of the testing technology of the object and the layout of the nodes PFT.;

- technical means for testing the well (test tool, instrumentation, wellhead with an emergency crane for strapping the upper rough, transport for the transportation of equipment;

- technical control and management of the PFT well research with the direct participation of the test master;

- assessment of the quality and operational analysis of the results of the PFT wells study, as well as the issuance of a preliminary conclusion on the object of the study at the well;

- processing of PFT data and issuing a final conclusion on the object within the time limits set by the contract.

The research technology should be selected taking into account geological and technical conditions, goals and objectives of the test. The standard technology provides for testing the object at the bottom of the well immediately after opening it by drilling with the insulation of the object from above with a packer or with a pressure drop on the packer of more than 300 ks/cm2 - with double packers with a shank support with a shoe on the bottom of the well. The tests are carried out without releasing the top-up liquid or reservoir fluid to the surface with the maximum possible depression in a two-cycle mode. The technology of testing the object in difficult geological conditions must be applied in complicated wells:

- if it is necessary to flush the well during the descent- lifting of the PFT;

- when testing an object with an increased risk of emergency gushing (highly productive gas and gas condensate reservoirs, reservoirs with abnormally high reservoir pressure (AHRP));

- when testing formations with a high content of hydrogen sulfide and layers of reduced stability, as well as when testing wells filled with drilling fluid with increased shear stress.

Selective tests should be carried out with an excessively large interval opened by drilling, a significant distance of the test interval from the bottom of the well, with repeated descent of the PFT for additional testing of the collector in the upper part, as well as in the presence of foreign metal at the bottom [6, 7].

The technology of testing with complete initial depression is used to study formations with a polluted near zone and objects opened with increased (more than 100 kgf/cm^2) repression. The technology is also applicable for wells with a pressure in the range of studies up to 50 kgf / cm^2.

The technology of testing an object with the release of reservoir fluid to the surface is used during the re-descent of the PFT to assess the industrial significance of a gas- or oil-saturated reservoir.

In general cases, a standard test technology should be used, while a non-standard one should be used only in case of complications in the well or in order to solve additional (special) tasks.

The PFT application must contain the information necessary to select the type of PFT, its layout, the size of the packer seal and determine the main characteristics of the testing technology of the object.

To conduct research of PFT wells, the customer, together with the contractor, draws up a plan that reflects:

- deposit (field) and well number;

- technical data of the well;
- characteristics of the test object;
- preparation of the well for testing;
- arrangement of the shank and the tester;
- description of the test process;
- conclusion on the readiness of the well for testing
- technology of testing;
- type and layout of the PFT;
- diameter of the downhole fitting;
- planned pressure drop on the packer;
- the height of the column and the density of the pre-topping liquid;
- type (scheme) of strapping of the mouth (upper pipe) and anti-blowout equipment;
-the permissible (safe) duration of the PFT stay at the face (if it is less than 90 minutes, a single-cycle test is provided);
- number of test cycles;
- the maximum permissible load on the hook when walking the tool with PFT.

The diameter of the packer seal should be determined depending on the condition of the wellbore by the packing coefficient K ($K = D_{well} / D_{pack}$). K = 1.08 1.10 under normal conditions.

In order to avoid oil and gas occurrence after removal of the packer at the planning stage or before the descent of the PFT, the back pressure on the reservoir should be calculated based on the conditions of complete replacement of the solution in the test interval with reservoir fluid [8, 9].

In the process of the latter, before the descent of the PFT (hollowing and descent and lifting operations), the serviceability and operability of the descent system-lifting, anti-blowout and hydraulic strapping, lighting, inflow degassing systems, well topping, the serviceability of installed equipment and tools, the presence of a regulated volume of solution and chemicals should be checked and ensured. It is necessary to check the compliance of the threaded connections and ensure the tightness of the drilling column.

The surface equipment of the well should provide direct to reverse circulation of drilling fluid with back pressure at the mouth (throttling) through the wellhead and a special manifold.

When testing a well with the output of reservoir fluid to the surface, it is necessary:

- calculate the drill pipe string for excessive internal and external pressures that may occur during the test;
- check the drill string for tightness;
- equip the drill string with a ball valve and a head, press them to the expected pressure;
- to tie the mouth with the manifold of the proventor installation and drilling pumps with metal pipes on hinged joints;
- to provide the possibility of direct and reverse injection of the solution into the well by drilling pumps, to coordinate the scheme of tying the mouth with the anti-spontaneous service and the bodies of the Main State Service "Turkmenstandardlary";
- equip the wellhead to ensure vertical movement of the pipe column by 4-6 m together with the manifold.

It is allowed to study a well with a wellhead installed 4-5 m above the rotor. In this case, it is necessary to prepare means (a special platform, a ladder) for emergency closing of the emergency crane on the head before the start of the study.

Testing of a well by reservoir testers in an open hole and column without equipment of the wellhead with a preventer installation is prohibited.

It is forbidden to test wells with the withdrawal of reservoir fluid to the surface in the presence of hydrogen sulfide in it.

The following documentation must be prepared prior to the start of the drilling rig test:

- technical data sheets for the weight indicator, tow rope, drill pipes, blowout equipment and strapping;
- the act for the crimping of the anti-blowout equipment and the last casing string;
- plan for the elimination of possible accidents and fire;
- the act of readiness of the well and drilling equipment for the research of the PFT well;
- well exploration plan;
- the act of crimping the wellhead and drill string.

It is allowed to test the PFT well in the absence of a level at the mouth (with the absorption of drilling fluid), the presence of foreign objects at the bottom. Such tests should be carried out according to a special plan with the adoption of additional measures to ensure safety and trouble-free operation.

During the well testing, it is prohibited:

- the presence of persons at the well who are not related to the work performed;
- repair of drilling equipment;
- carrying out work using an open flame;
- turning on (stopping) the winch drive motors during the inflow and registration of pressure recovery curve (PRC);
- lifting the tool until the air or gas outlet from the pipes stops.

Well testing is prohibited in the following cases:

- malfunctions of drilling equipment and tools;
- absence of anti-blowout equipment or its malfunction;
- in the presence of inflow from the well of any intensity;
- the absence of a full-time shift or the use of students (trainees) as shift workers;
- absence of the responsible representative specified in the work plan;
- lack of documentation necessary for the work.

The test master, together with the responsible representative of the drilling company, must instruct

the watch before the start of the PFT (with its repetition for each newly starting watch).

When testing a gas-saturated or gas-condensate reservoir of high activity and the possibility of receiving an inflow with gas emissions, warning signs should be installed on roads located in the well area and posts should be set up at a distance of no closer than 250 m from the well.

It is necessary to monitor the radioactivity of the extracted fluid at wells (areas) where studies with the use of radioactive isotopes were previously carried out.

Testers lowered on a logging cable

When planning and carrying out work, as well as when interpreting the data obtained, it is necessary to take into account the features of this type of testers. These include:

1) accurate linking of the tested layers to logging diagrams;

2) high selectivity – testing is carried out on a very small section of the formation (spot testing) – and the possibility of studying closely located areas;

3) small time spent on the operation; even in deep wells, 2-4 hours are spent on one operation;

4) there is no need to specially prepare the well; testing can be carried out after intermediate logging by the same logging batch;

5) obtaining an inflow of oil and gas from a reservoir of different permeability due to high depression and a small volume of samples taken; even minor inflows of hydrocarbons can be sampled with instruments;

6) the possibility of oil and gas occurrences and open gushing is completely excluded.

The use of testers lowered on a cable contributes to increasing the reliability of interpretation of field and geophysical research data, the isolation of oil-bearing, gas-bearing and aquifers, the establishment of oil-water and gas-liquid contacts. The results of testing with devices on the cable allow us to evaluate the properties of the formation, to study its permeability.

The domestic industry has mastered the production of logging layer samplers of three types: OPK7-10; OPK4-5 and heat-resistant OPT7-10. The first two types of devices are similar in design and principle of operation and differ only in size. In the OPT7-10 device, a spool switch is used to control the operation of the hydraulic system instead of powder charges, which is actuated by an electromagnet.

The devices operate on a three-core, and when installing a special head on a single-core cable with standard ground equipment for field and geophysical work.

The design of the OPK device provides for the possibility, before creating a pressure drop, to make the channel a cumulative perforator placed in the tester. The object of testing is chosen based on the results of drilling, and this largely depends on the experience of geologists. If oil and gas occurrences are noticed during drilling (gas logging, sludge, hydrocarbon outputs with drilling fluid), then, as a rule, intermediate logging is carried out to study the exposed zone. Interpretation of the logging results can be the basis for planning the formation testing. In this case, cavernometry is required to determine the interval where the device can be installed, since if it gets into the cavern, the sealing and clamping devices may not work, and the process will be unsuccessful.

To install the device, it is necessary to select a well section without cavities.

The less time has passed after the opening of the formation by drilling before the start of testing, the more reliable the result can be expected. The success of the process also depends on the magnitude of the reservoir pressure of the tested interval. The higher the reservoir pressure, the less time it takes to fill the cylinder. Usually the balloon is kept open for 5-20 minutes.

Without considering the complex of preparatory and final works when testing the formation with a device lowered on a cable, three stages can be distinguished that are directly related to the behavior of the formation during testing [10]:

1) occurrence and propagation of hydrodynamic disturbance in the formation;

2) reduction of pressure in a certain volume of the reservoir due to the movement of liquid and gas from the reservoir into the cylinder;

3) restoration of reservoir pressure in the testing area after the flow has stopped.

It is of interest to determine the distance that the sampling process may affect, or the drainage radius. The drainage radii for various formations were determined by the work performed by the reservoir testing laboratory of the Volga-Ural Branch of VNIIGEOPHYSICS.

It is estimated that for layers of greater capacity when using cylinders with a capacity of up to 10 liters, the drainage radius is 50 cm. The drainage radius is significantly affected by the porosity of the formation. When testing the interlayers, the drainage radius is larger. Due to the heterogeneity of the layers, it can be assumed that it can be 80-100 cm.

Practice shows that the cylinders are filled with reservoir fluids and gas, drilling mud filtrate, drilling mud. The ratios of their volumes are different. Depending on the volume of the reservoir fluid, the method of its use is chosen. So, if the volume of oil is more than 0.5 liters, a full oil analysis is carried out. For samples of a smaller volume, they are limited to measuring density, viscosity and luminescent studies. The method of determining the characteristics of reservoir water and gas depends on their volume and the availability of laboratories for research [11].

When using this tester, simultaneous sampling of the soil and the liquids saturating it is possible, and the sample is not polluted by gases formed from

explosives. The presence of two cylinders (upper and lower) allows you to take both contaminated and cleaner samples of reservoir fluid. The tester is lowered into the well on a cable cable using a winch of a self-propelled drilling station.

Testers dumped inside the drill string

The testers dumped inside the drill string are used in the rotary drilling method.

The sampler dumped inside the drill string allows you to cause an influx immediately after opening the productive reservoir and take a sample of the reservoir fluid. To do this, a special packing device is installed in the bottom-hole assembly (BHA) with a bit, which does not interfere with the circulation of drilling mud through the ring annular space during drilling. After the sampler is lowered into the packer device, channels open through which the drilling fluid is supplied under pressure under the packer element and causes its expansion up to full contact with the walls of the borehole and overlap of the annular gap. Thus, the bottom-hole zone of the well is isolated from the rest of the hole.

With an increase in pressure inside the drill string, the valve in the sampler opens. Due to the fact that the sampler is filled with air at atmospheric pressure, the pressure in the sub-packer zone decreases sharply, as a result of which the reservoir fluid penetrates into the well and enters the sampler. At the same time, the pressure recovery curve in the sampler is recorded by the recording pressure gauge. After the time allotted for testing the formation, the pressure in the drill string is reduced (reset), as a result of which the valve in the sampler closes and the packer gradually returns to its original position.

Investigation of wells by pipe formation testers.

The devices lowered into the well on a string of drill pipes are called pipe formation testers. They have become most widespread when testing formations during drilling (such as CII, MIG), because they make it possible not only to take samples of reservoir fluid, but also to conduct hydrodynamic studies.

In this case, the formation can be isolated from above, from above and from below, with support on the face or on the walls of the well.

The filter-shank of the reservoir tester is designed to support the bottom when creating a compressive load, placing devices and to delay the solid phase during the inflow of reservoir fluid. The length of the shank to prevent loss of stability during compression usually does not exceed 50 m.

The safe lock is designed to disconnect the drill string and the reservoir tester in case of possible seizure of the filter-shank due to collapses of the walls of the well at high depressions.

The reservoir tester includes an inlet (main), equalization valves and a hydraulic time relay, which allow testing of the reservoir in the inflow mode.

The shut-off and rotary valve can be of single or multi-cycle action, it allows stopping the flow of reservoir fluid into the drill string and exploring the formation in the pressure recovery mode [12, 13].

The circulation valve is designed to restore fluid circulation during the lifting of the drill string and the washing out of it of the selected reservoir fluid.

The technology of reservoir testing using the layout of the MIG multi-cycle tester is as follows.

After assembling the layout, it descends into the face on a string of drill pipes. Since the inlet valve of the reservoir tester and the circulation valve are closed during descent, there is no self-filling of the column, this forces the column to be topped up with water or drilling mud from above to a depth that is calculated based on the necessary depression on the formation during the test.

The packer in the transport position has a diameter of 0.8-0.9 of the diameter of the well, which under certain conditions can cause high pressure pulses on the walls of the well (the effect of reciprocating) and hydraulic fracturing of weak formations. To reduce this phenomenon, the design of the formation tester provides that the openings of the equalization valve are open at the descent and lifting operations. This allows a portion of the liquid to flow from the sub-container space through the equalization valve.

After reaching the bottom, a compressive load is created on the layout, sufficient to open the packer. When the rubber element is pressed against the walls of the well, the tested formation (object) is isolated from the overlying section of the well.

Simultaneously with the packing, when creating a compressive load, a hydraulic time relay is activated, which opens the intake valve of the formation -tester after 3-5 minutes. The delay in opening the intake valve is necessary to prevent it from opening when the tool is lowered in the case of layout landings on ledges and cavities in the well.

When the inlet valve of the formation -tester is opened, the message of the sub-packer zone (zone of the test object) with the cavity of the drill string occurs. This leads to a sharp drop in pressure in the sub-packer zone to the pressure of the liquid column in the drill pipes, a depression is created on the formation, which is a necessary condition for the inflow of reservoir fluid.

If the pressure in the bottomhole zone has decreased and has become lower than the reservoir pressure, then the bottom - hole formation zone is cleaned and the reservoir fluid enters through the filter and the inlet valve into the drill string. The first open inflow period begins. The liquid level in the column increases, the pressure on the bottom increases, which is recorded by the depth gauges installed in the lower part of the layout.

The duration of the first open period is 3-5 minutes. After this time, the shut-off and rotary valve is closed by rotating the drill string by 10 revolutions. The flow of liquid (gas) into the drill string stops. The

first closed reservoir testing period begins. During this period, there is a rapid recovery of pressure in the sub-packer zone up to the reservoir. The duration of the first closed period is 10 – 40 minutes.

Then the drill string is rotated again for 10 revolutions, the shut-off and rotary valve opens, the second open period of the inflow of reservoir fluid into the drill string begins. The pressure of the liquid column in it is growing, the flow curve is recorded on the diagrams of the depth gauges.

The duration of the second open period is from 15 minutes to 1 hour or more. The presence of an inflow can be judged by the volume and rate of air escape from the drill string. It is usually not allowed to release reservoir fluid to the surface during the formation test, but the wellhead binding should provide for such a possibility.

At the end of the second open inflow period, the shut-off and rotary valve is closed, rotating the column for the next 10 revolutions. The second closed test period begins, during which there is a rapid increase in pressure in the sub-packer zone, the final pressure recovery curve is removed.

However, this recovery is slower, because the reservoir is drained to a greater depth and not always at the end of this period the pressure in the sub-packer zone reaches the reservoir.

The total time spent by the formation tester layout at the bottom should not exceed the permissible time of leaving the column without movement in the well, which is determined in advance.

After completion of the formation testing process, a tensile load is created on the layout. At the same time, an equalizing valve opens first, which communicates the sub-packer zone with the annulus cavity above the packer, pressure equalization occurs in these zones, i.e. the pressure of the drilling fluid column in the well with the necessary repression begins to act on the formation again, the formation is crushed.

With the further creation of the tensile load, the packer comes to the transport position, and the extraction of the drill string with the layout of the formation tester to the surface begins. If difficulties are felt when releasing the packer, then first they work with a hydraulic jar, if this does not help to release the layout, they disconnect from the seized part in a secure lock. When the drill string is lifted with the shut-off and rotary valve and circulation valve closed, the liquid in the column together with the selected reservoir fluid moves to the mouth. After the liquid level in the drill string of the surface is reached, the pressure inside the drill string increases with the help of drilling pumps or central unit (CU), and the circulation valve opens. Backwash is performed by washing out the selected fluid from the drill string with sampling. Further lifting of the drill string takes place with an open circulation valve.

Qualitative analysis of depth gauge diagrams

The layout of the test equipment lowered into the well on a string of drill pipes (CII, MIG) includes from 2 to 5 depth gauges. The greatest information is carried by the diagram of the pressure gauge installed in the filter area.

According to the results of the interpretation of the diagrams of the depth gauges, it is calculated:

- productivity coefficient:

$$k_{pr} = \frac{Q_{av.}}{P_{res.} - P_{end.p.}}$$

- blockage coefficient:

$$k_3 = k / k_{eq.},$$

- skin effect:

$$S_к = (k_p - 1)\ln\frac{R_{c.}}{R_{w.}},$$

The following designations are used in the above formulas:

P_{res} - reservoir pressure;

$P_{end\ p.}$ - pressure in the well at the end of the open period, inflow;

$Q_{av.}$ - average flow rate (inflow) of fluid in the open period;

k is the permeability of an uncontaminated reservoir (reservoir);

$k_{eq.}$ is the equivalent permeability of the reservoir within the limits of the supply circuit (polluted and uncontaminated zone);

R_c- radius of the power circuit;

R_w is the radius of the well

Testing of formations using an ejector formation tester

The technology of reservoir testing using an ejector multifunctional formation tester (EMFT) is as follows.

A layout is lowered into the well on the tubing string, including:

- funnel (expander) – installed no closer than 20 meters from the roof of the formation under study;
- packer – installed depending on the tasks to be solved at a distance of 50-100 meters from the roof of the object under study;
- ejector pump – installed on two pipes (15-20 meters) above the packer;

After packing, the fountain fittings are installed and its binding is made with a pumping unit, separator, measuring tank in accordance with the scheme.

The check valve is installed in the discharge line at high reservoir pressures.

The number and type of pumping units are determined depending on the geological characteristics of the formation and the tasks to be solved.

A filter must be installed in the injection line of the working fluid in order to avoid clogging of the nozzle of the jet pump.

After installing the packer in the tubing column, a pressure gauge is lowered on the logging cable. A sealing unit is movably installed above the pressure gauge on the cable. The pressure gauge is installed in the reservoir interval, and the sealing unit sits in the EMFT body, separating the discharge and suction channels of the jet pump. Autonomous devices can be lowered on a wire.

When pumping a working fluid (process water, oil or salt solution) through the EMFT, a vacuum is created on the nozzle section, as a result of which the liquid is sucked out of the sub-packer space, respectively, the pressure under the packer decreases. The magnitude of the depression depends on the speed of passage of the working fluid through the nozzle and is regulated by the pressure of the pumping unit. As a rule, CU –320 or 4AN – 700 units are used for work. Pressure reduction under the packer to the design value occurs in 0.5 – 3 minutes, depending on the volume of the sub-packer space.

After the downhole pressure is reduced to a value below the reservoir pressure, the reservoir fluid flows, which is mixed with the upward flow of the working fluid and comes to the surface. In the wellhead strapping, the outgoing mixture is sent to the separator, where the gas is separated, and the degassed solution enters the measuring tank.

The sealing unit does not prevent the movement of the pressure gauge in the interval of the sub-packer space. In the event that there is no need to descend the remote device, it is possible to work with a depression insert discharged into the tubing cavity. To extract the depression insert, a catcher with a jar lowered on a cable or wire is used. An autonomous pressure gauge can be attached to the bottom of the depression insert.

After stopping the operation of the ejector pump (stopping the pumping of the process fluid), the check valve on the suction line closes and the reduced pressure created by the jet pump remains in the sub-container space. After that, the pressure recovery process begins in the sub-packer space due to the energy of the formation. The pressure gauge records the pressure recovery curve.

After restoring the pumping of the process fluid through the jet pump, the pressure in the suction line decreases, the check valve opens and the inflow from the reservoir is called again. Thus, testing of the reservoir using the EMFT complex can be carried out in a monocycle mode.

During the entire test cycle of the formation using pipe formation testers CII or MIG, various loads act on the drill pipe string – stretching and compressing, crushing, bending, both static and dynamic. The calculation of the drill string and the shank is carried out for the maximum loads arising during the formation test.

The drill string is calculated for tension during unpacking with rotation, for crumpling at its maximum emptying and for excessive internal pressure if the discharge line from the drill pipe column is closed during the inflow period.

The verification calculation of the drill string consists in determining the correspondence of the actual loads and stresses with the permissible ones [14].

The most dangerous section when walking the column during unpacking is the top of the column.

In Turkmenistan, during the construction of oil and gas wells, mainly during exploration drilling, formation testing is carried out using pipe testers of the CII type or core sampling is carried out with subsequent analysis of the selected rock in special laboratories. This gives a detailed study of the characteristics of the formations, in order to successfully conduct subsequent wells when drilling in difficult mining and geological conditions at abnormally high reservoir pressure.

References:

1. Deryayev, A.R. (2022). *Construction of gas condensate wells and analysis of technological modes of their operation according to the estuarine parametrs.* “Modern directions of scientific research development”. Proceedings of XIII International scientific and practical conference. (pp.222-226). USA - Chicago: Scientific Publishing Center «Sci-conf.com.ua».
2. Deryayev, A.R. (2022). *Requirements for the designs of gas wells for their development by the method of dual completion.* “International scientific innovations in human life”. Proceedings of XIII International scientific and practical conference. (pp.115-120). United Kingdom - Manchester: Scientific Publishing Center «Sci-conf.com.ua».
3. Deryayev, A.R. (2022). *Analysis of the characteristics of reservoir properties of production formations (horizons) and their heterogeneity for dual completion exploitation*. “Problems of science, and practice, tasks and ways to solve them”. Proceedings of the XXVI International scientific and practical conference.

(pp.362-364). Publishing: Finland - Helsinki: International Science Group «isg-konf.com».

4. Deryayev, A.R. (2022). *Determination of characteristics of reservoir properties of productive layers (horizons) and their heterogeneity for the dual completion development of the field.* "Multidisciplinary academic notes. Theory, methodology and practice". Proceedings of the XXVII International scientific and practical conference. (pp.376-379). Czech Republic - Prague: Publishing: International Science Group «isg-konf.com».
5. Deryayev, A.R. (2022). *Analysis of different construction for separate operation of formations in one well.* "Multidisciplinary academic notes. Theory, methodology and practice". Proceedings of the XXVII International scientific and practical conference. (pp.380-389). Czech Republic - Prague: Publishing: International Science Group «isg-konf.com».
6. Deryayev, A.R. (2022). *Determination of properties and composition of oil, gas and condensate for dual completion development of the field*. "Modern directions of scientific research development". Proceedings of XIV International scientific and practical conference. (pp.87-94). USA - Chicago: Scientific Publishing Center «Sci-conf.com.ua».
7. Deryayev, A.R. (2022). *Causes and preventive measures to combat complications, accidents when drilling directional wells.* "Innovations and prospects of world science". Proceedings of XII International scientific and practical conference. (pp.73-77). Canada - Vancouver: Scientific Publishing Center «Sci-conf.com.ua».
8. Deryayev, A.R. (2022). *Recommendations for combating absorption when drilling directional wells*. "Modern scientific: innovations and prospects". Proceedings of XI International scientific and practical conference. (pp.61-65). Sweden - Stockholm: Scientific Publishing Center «Sci-conf.com.ua».
9. Deryayev, A.R. (2022). Recommendations for the prevention of complicacftion and accidents *when drilling directional wells.* "Modern scientific research: achievements, innovations and development prospects". Proceedings of XIV International scientific and practical conference. (pp.88-92). Germany - Berlin: Scientific Publishing Center «Sci-conf.com.ua».
10. Deryayev, A.R. (2022). The design of the directional well on the Northern Goturdepe field. *"International Science Journal of Engineering & Agriculture"* Vol.1, №3 - Poland - Gdansk: Publishing: "International Science Group", pp. 110-116.
11. Deryayev, A.R. (2022). *Requirements for the designs of gas wells for their development by the method of dual completion.* "International scientific innovations in human life". Proceedings of XIV International scientific and practical conference. (pp.85-92). United Kingdom - Manchester: Scientific Publishing Center «Sci-conf.com.ua».
12. Deryayev, A.R. (2022). Opening of productive horizons with inhibited drilling fluid "Alkar-3M" for dual completion. *International Scientific Journal "Theoretical & Applied Science"* №07(111) - USA- Philadelphia: Publishing: "Theoretical & Applied Science", pp.238-240.
13. Deryayev, A.R. (2022). Opening of productive horizons with hydrocarbon - based drilling mud for dual completion well. *International Scientific Journal "Theoretical & Applied Science*" №07 (111) - USA- Philadelphia: Publishing: "Theoretical & Applied Science", pp.241-244.
14. Deryayev, A.R. (2022). *The method of dual completion of wells on the example of the experience of the Northern Goturdepe field*. "Smodern innovations and promising ways of development of culture and science". Proceedings of the XXXI International scientific and practical conference. (pp.228-230). Publishing: USA - Boston: International Science Group «isg-konf.com».