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THE RAISING OF EFFICIENCE OF CIRCULATED SYSTEM IN DRILLING SET DURING DRILLING WITH WELL WASHING BY THE FOAM

There has been analyzed the existing schemes of strapping of circulated system of drilling set during drilling with well washing by the foam and argued the necessity of its efficient raising; there has been chosen the scheme of strapping of circulated system during drilling with well washing by the foam for the possibility of the most rational usage of existing foamgenerating equipment.

В статті проаналізовані існуючі схеми обв'язки циркуляційної системи бурової установки при бурінні з промиванням свердловини піною та обґрунтована необхідність підвищення їх ефективності; для можливості найбільш раціонального використання існуючого піногенеруючого устаткування передбачена схема обв'язки циркуляційної системи при бурінні з промиванням свердловини піною.

В статье проанализированы существующие схемы обвязки циркуляционной системы буровой установки при бурении с промывкой скважины пеной и обоснована необходимость повышения их эффективности; для возможности наиболее рационального использования существующего пеногенерующего оборудования предусмотрена схема обвязки циркуляционной системы при бурении с промывкой скважины пеной.

The choice of issue and its connection with vital scientific and practical tasks. The foam is highly plastic and elastic system that differs from other drilling solution. Foam systems have relatively permanent character only in the process of circulation in the well with set parameters of mode and known circumstances. After circulative stop (the stop of pump and compressor) the system becomes inconstant, elastic features can be shown and the division of phases can carry out, hence the pressure of foam in the output decreases after some period of time. That's why we have produced the foamgenerating device for creation of high-quality small-dispersed foam that treats the requirements which could concern its during washing of oil and gas wells [1–4].

The analysis of last researches and publications where solutions of set problem are represented. We have a row of researches and publications (Lyah M.M., Kusmenko M.M., Martinov V.M. [5–7]). There are depicted the solutions of set problem: it includes results of performed experiments on foamgenerating devices with different constructions, scheme analysis of equipment strapping for well drilling by the foam.

The statement of problem. The task of this research is to confirm the necessity to create such a layout of strapping of circulative system in drilling set which could provide the primary revealing of productive horizons with low pressure and small expenditure on the modernization of circulative systems of the most widespread drilling set types.

The coverage of main material. The method of oil and gas well drilling with washing by the foam has its own specific features that determine the necessity to use special and standard equipment, drilling tool and check-and-measure device. Therefore it is necessary to decide on the equipment being corresponding to all requirements and anticipate the rational scheme of equipment strapping for getting the maximum effect, using such a method.

The drilling with washing by the foam is carried on with usage of conventional drilling sets, the complement of which includes particular equipment as extra one (it means the compressor sets, twisted preventers, foamgenerating device, deaerator or industrial ladder, quencher velocity, pressure system, extra-capacity batteries). By the way shown method claims the usage (partially or fully) of such standard equipment, besides particular one: drilling pumps, degasser of the system backpressure and cleaning of solution. The efficiency of drilling depends on right choice of correlation between the amount of air and fluid. That's why such devices have to be mounted: consumption of air and fluid, recording and displaying gauges on riser and wellhead.

In the process of revealing of productive strings with usage of the foam in the bottomhole zone and well barrel we can observe the row of compound phenomenons being linked to the mode of reservoir revealing, physics and geological properties of collector and physics and chemical characteristic of the fluids that are located in the collector.

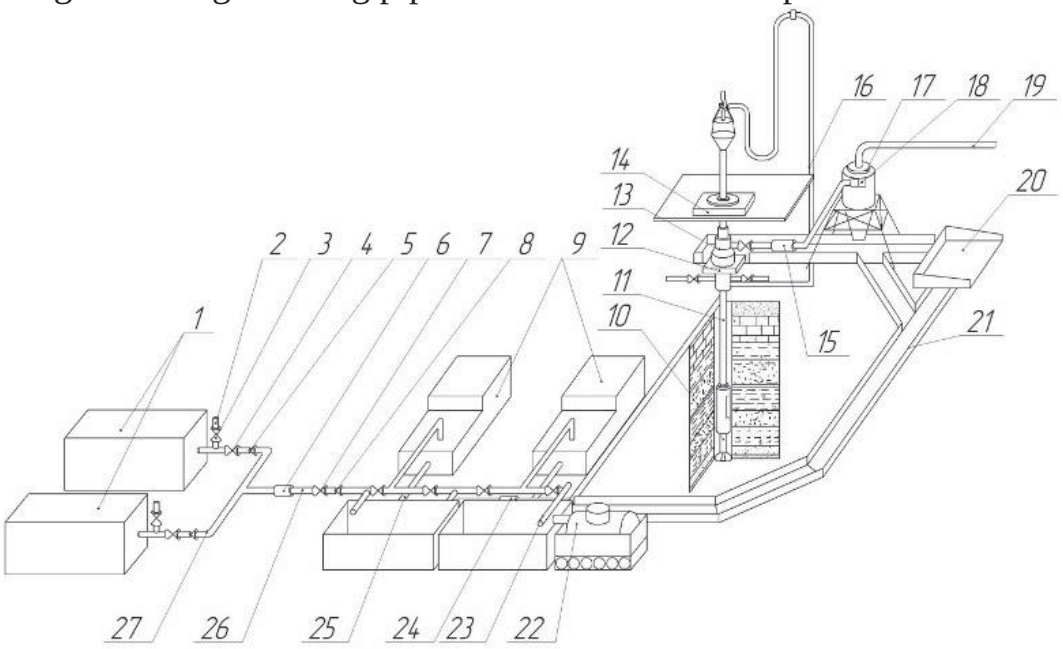
It is substantial to mention, that during foam circulation the amount of surfactants in it reduces on account of its adsorption on well walls and drilling pipes. Next decreasing is evoked by adsorption on again created well barrel and drilled rock. So it is necessary to add surfactants periodically in the solution for maintenance of required concentration of surfactants in the process of revealing the reservoir.

At the same time in the output of well we need the rapid disruption of the foam with minimal expenditure of defoamer and with minimal expenditure of material and human resources for production the foam for its re-loading in the well.

We are not planning to use chemical substance during projection of scheme of strapping for foam elimination as in such case the volume of used

surfactants for foam re-production can increase because it is important to neutralize the action of chemical elements-defoamers too. Consequently the character of the foam can alter unpredictably.

There are a big number of diverse schemes of equipment strapping being used for well drilling with washing by the foam [6]. According to offered scheme (picture 1) the fluid is provided by drilling pumps and the air from the compressor group through exhaust lines gets into mixer of air and fluid (it is foamgenerating device) that is mounted in heating line of pumps and after it the mixture goes through drilling pipes and chisel to the output of the well.



Picture 1 – The principal scheme of equipment strapping for well drilling by the foam:
1 – compressor group; 2 – starting line; 3, 4, 7, 14 – valves; 5, 8, 10, 11 – return valve; 6 – the flowmeter of air; 9 – pumps; 12 – preventer; 13 – twisted preventer ;15 – the system of pushing; 16 – waste line; 17 – deaerator; 18 – miscarriage line; 19 – line; 20 – cleaning system; 21 – the circulated system; 22 – degasser; 23 – starting line of the pump; 24 – the flowmeter of liquid; 25 – the mixer of air and fluid (foamgenerating device); 26 – the heating line; 27 – airgathering collector

Cleaning the output and cooling the chisel, the foam carries the rock through annulus to the surface where the deaerator through miscarriage line that contains the system of pushing gets into circulative system then into the solution cleaning system from the rock and then into the capacity of pumps. If we use the water as fluid phase, the foam from the carriage line gets into quencher speed and then into the capacities or barn. Using the uncirculated system we can watch that the foam moves directly to the barn.

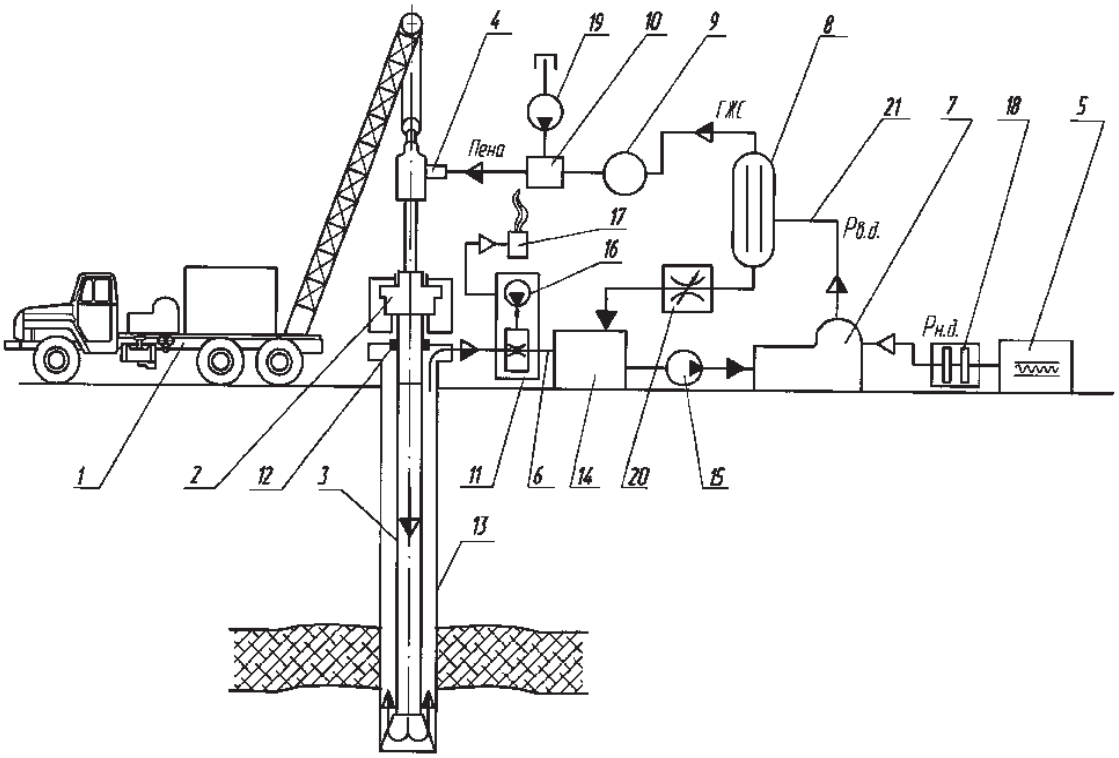
The compressor group can consist of one or several sets of high pressure either the combination of low-atmosphere and compressor sets with higher pressure or stationary compressors of high pressure that have the drive from

engines of drilling sets or stationary compressors of high pressure of industrial station. In some cases it is more lucrative to seize the natural gas not water for liquid aeration that provides with necessary pressure and expenditure.

The principal layout of location of equipment complement [7] with output washing of productive strings by the foam is represented in the picture 2. The foam preparation is complied in next way: the charging pump 15 moves the liquid from sludge separator 14 to the camera of cramping (the compressor camera) of the compressor with higher pressure 7**,** creating the water seal in the camera of cramping. The air is given under low pressure from the air compressor of low pressure 5 to the camera of cramping of the compressor with higher pressure 7 that presses the air given in the camera of cramping from the compressor 5 to essential pressure and then thrusts its together with a little amount of water seal fluid (to 5 %) through pipeline 21 to the separator of high pressure 8 during work of reciprocating action supercharger of the compressor with higher pressure 7**.**

There is reached essential correlation between gas and liquid in created gas and fluid mixture in the separator due to work of regulating throttle 20. After the separator 8 the mixture moves through node of costs and fluid density measuring 9 to the capacity of foamgenerating device 10 where the liquid emulsifier (surfactant) is given by the device 19 (dozing pump) too.

Performed analysis of used schemes of location and equipment strapping shows that it is necessary to choose such a mounting layout for well drilling with washing by the foam which does not claim any changes (or leads them to the minimum amount) of accepted scheme of location and standard equipment strapping in the field. So it is vital to create such a scheme that could provide with primary revealing of productive horizons with low pressures and little expenditure on modernization of circulated system of the most widespread types of drilling sets.



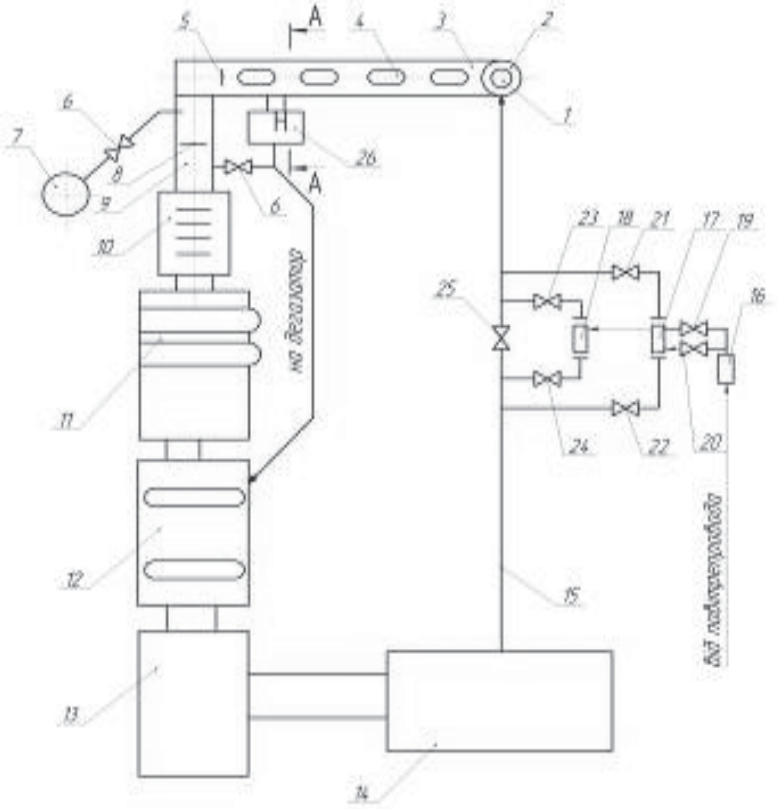
Picture 2 – The layout of location of equipment complement with output washing of productive strings by the foam:
1 – the lifting unit; 2 – the device for drilling column turning; 2 – the drilling column; 4 – the swivel; 5 – the compressor of low pressure; 6 – the circulated system; 7 – the compressor with higher pressure; 8 – the separator of high pressure; 9 – the node of costs and fluid density measuring; 10 – the foamgenerating device; 11 – the degasser of low pressure; 12 – the germetizator; 13 – the mouth of the well; 14 – the sludge separator; 15 – charging pump; 16 – demulsifiers; 17 – the device for gas burning; 18 – the gas separator membrane block; 19 – the device for emulsifier giving; 20 – the regulating throttle; 21 – the pipeline

There has been selected the most appropriate layout of strapping of circulated system [8] for the possibility of the most rational usage of foamgenerating equipment [1–4] during drilling with well washing by the foam (picture 3).

There has been mounted the germetizator of mouth of well 2 over well 1 that is aimed for germetization of space between leading pipe and detachable funnel which is set over blowout equipment with purpose to remove the foam. The circulated system of drilling set consists of starting field – closed gutter 3 with folding hatches 4 for cleaning the gutter from mud and final field – open gutter 9.

An the end of gutter 3 there has been set the control gate 5 and vacuum pump 26 that is aimed to deduct the air from the foam system and some part of washing fluid with their next transportation to the open gutter or the degasser 12 if the dissolved gas is available. In case of foam settling after vacuum pump the liquid gets into open gutter; but in case of absence of foam settling the liquid could be given to the degasser. There has to be installed turning damper 8

that provides with well filling-up from the filling-up bowl 7 through the latch 6 in the process of sinking-and-lifting operation and hopper-mudcatcher 10 that realizes the cleaning of the washing liquid and foam settling which has come to the open gutter.



Picture 3 – The layout of strapping of circulated system during drilling with well washing by the foam:
1 – the well; 2 – the mouth germetizator; 3 – the closed gutter; 4 – the hatch; 5 – the gate; 6, 19-25 – the latch; 7 – the filling-up bowl; 8 – the turning damper; 9 – the open gutter; 10 – the hopper-mudcatcher; 11 – the block of cleaning; 12 – the degasser; 13 – the receiving tank; 14 – the pump unit; 15 – the manifold; 16 – the compressor; 17, 18 – the foamgenerating device; 26 – the vacuum pump

Next step of the washing liquid is getting into the block of cleaning 11 where there has been installed the equipment for cleaning: it includes vibrating screen and hydrocyclone. After degasser 12 the liquid gets into the receiving tank 13, then that the pump unit 14 sends the washing fluid to the well through the manifold 15. The vacuum pump is resonated with upper field of the closed gutter and the reticulated hurdle for dividing of fluid and foam is located across the center of this one. The cleaning of the reticulated hurdle in case of its pollution is anticipated through the regulating throttle 5 and the swivel 4. The length of the reticulated hurdle that is advised to be set at the end of the closed gutter must be from 1,5 meters to 2 meters.

The realization of well washing by the foam is catered by two foamgenerating devices 17 and 18 that have been mounted in the field of bypass with

valves. If it is necessary to implement the circulation by the fluid, the valves 21, 22, 23, 24 become closed but the valve 25 opens. If we require the provision of solution aeration, the circulation carries on by the opening of the valves 21, 22, 23, 24 and closing of the valve 25. The compressor 16 provides with the air to the foamgenerating device. The regulation of the air flow is performed by the valves 19 and 20. Besides it, the well washing could be carried out by the washing liquid or foam. The move from the washing liquid to foam and vice versa performs rapidly and effectively.

Conclusions. We have analyzed existing schemes of strapping of circulated system in the drilling set during drilling with well washing by the foam and argued the necessity of raising of its efficiency. We have figured out the most appropriate layout of strapping of circulated system during drilling with well washing by the foam for the most rational usage of existing foamgenerating equipment.

The objective of future researches is to try out the foamgenerating equipment on the modernized scheme of circulated system strapping of drilling set in industrial way.

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ПОЛЕГШЕНІ ТАМПОНАЖНІ МАТЕРІАЛИ

Розглянуто питання розширення асортименту полегшених і легких тампонажних матеріалів. Запропоновано рецептури нових полегшених і легких тампонажних композицій для цементування свердловин в умовах геологорозвідувальних площ і нафтогазових родовищ України.

Рассмотрен вопрос расширения ассортимента облегченных и легких тампонажных материалов. Предложены рецептуры новых облегченных и легких тампонажных композиций для цементирования скважин в условиях геологоразведочных площадей и нефтегазовых месторождений Украины.

The question of expansion of assortment of the facilitated and easy cement of materials. The new facilitated and easy cement of materials are offered for cementation of wells in of geological areas and oil-and-gas deposits of Ukraine.

Проблема та її зв'язок з науковими та практичними завданнями. Питання необхідності зниження густини цементного розчину виникло у зв'язку із збільшенням глибини нафтових і газових свердловин. Основною причиною застосування розчинів пониженої густини є намагання здійснити підйом тампонажного розчину на велику висоту в один ступінь. Тому велика увага приділяється дослідженню і використанню полегшених (густина (ρ) $\geq 1400 \div \leq 1650$ кг/м^3) і легких тампонажних розчинів ($\rho \leq 1400$ кг/м^3). Зростання глибин нафтових і газових свердловин призвело до ускладнення умов кріплення, які вимагають докорінної зміни деяких властивостей тампонажного розчину – зниження густини, сповільнення часу загуснення, підвищення температурної, корозійної та ударної стійкості цементного каменю. Досягнення указаних вимог неможливе при застосуванні чистих портландцементів, проте дані вимоги легко реалізуються при