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ЭЛЕКТРОННЫЙ СБОРНИК МАТЕРИАЛОВ МЕЖДУНАРОДНОЙ КОНФЕРЕНЦИИ СТУДЕНТОВ, АСПИРАНТОВ И МОЛОДЫХ УЧЕНЫХ **«ПРОСПЕКТ СВОБОДНЫЙ-2015»**, ПОСВЯЩЕННОЙ 70-ЛЕТИЮ ВЕЛИКОЙ ПОБЕДЫ

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«Oil Gas Machinery»

УДК 735.29.(32)

«UNIPOLIMER» SORBENTS FOR OIL SPILLS RECOVERY

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In the 21 century when environmental pollution of gas and oil spills has become a global problem we have to find some new methods of protecting our planet. Year by year the negative influence on the ecosystem is increasing. The problem had beenstudied in Russia and other countries, but the best decision wasn't found.

Sorbents are used for final cleanup of a spill or in very small spills. They can be synthetic materials such as plastic, organic materials such as peat moss, or inorganic materials such as clay. Sorbents come in many different forms, from loose materials to pads or even booms.

Sorbents are materials that recover oil through either absorption or adsorption. They play an important role in oil spill cleanup and are used in the following ways: to clean up the final traces of oil spills on water or land; as a backup to other containment means, such as sorbent booms; as a primary recovery means for very small spills; and as a passive means of cleanup. An example of such passive cleanup is when sorbent booms are anchored off lightly oiled shorelines to absorb any remaining oil released from the shore and prevent further contamination or reoiling of the shoreline.

The purpose of this paper is «Unipolimer» sorbents studying. These sorbents were created in oil and gas institute.We are also trying to develop some new polymer sorbents for waste water cleaning and oil spills.

The paper deals with experimental research. In order to prevent an environmental disaster, the technology, production and application were developed by our investigators. To solve the problem of recovering the thick oil spills from the water surface we used «Unipolimer» sorbents, taking into consideration the following properties which:

– are used for sobbing hydrocarbon-bearing substances on the surface of water, ground, concrete, asphalt, etc. all the year round;

– are made from ecologically clean organic materials, they are non toxic and safe for the environment;

– are non-abrasive and can be used in contact with metal, plastic and rubber parts of mechanisms;

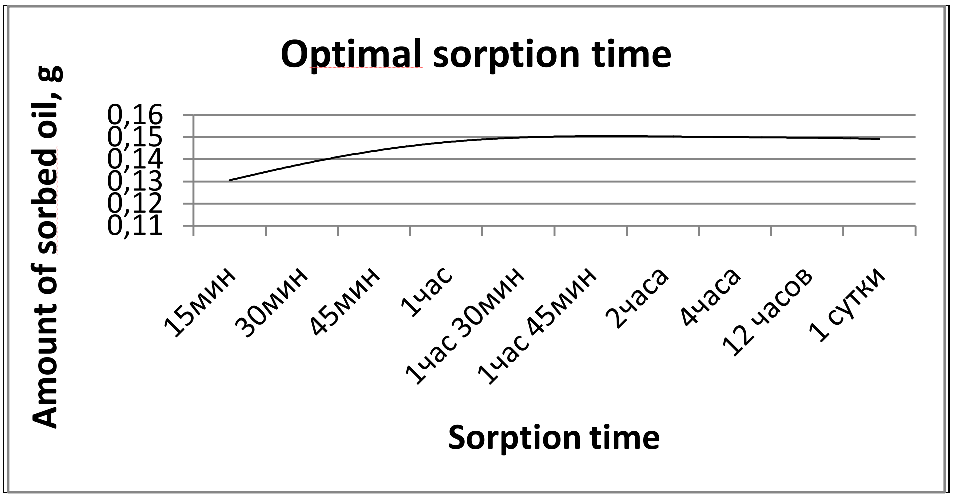
– can be applied without protection equipment for maintenance staff;

– are biodegradable and do not require gathering. In case of necessity, used sorbent can be gathered manually and also with the help of mechanical power devices;

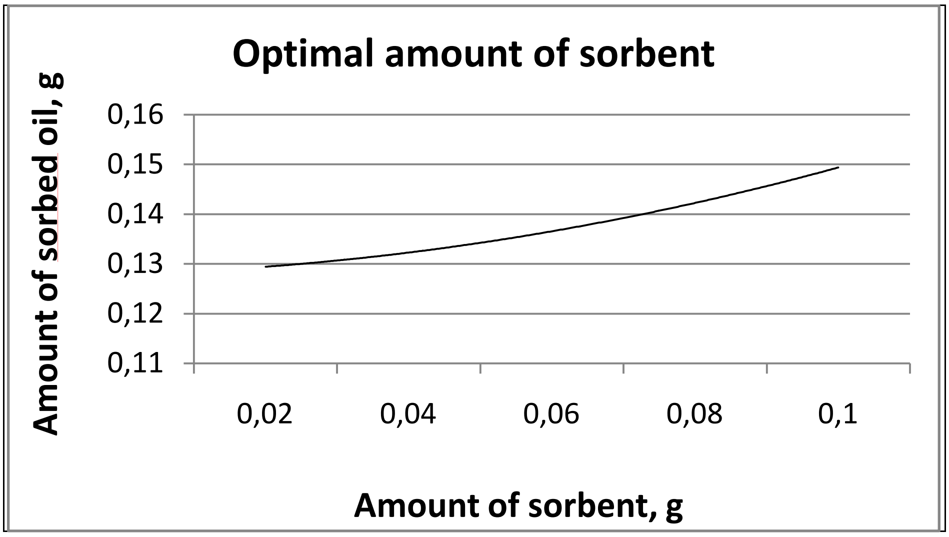
– are capable of accelerating remediation of oil-contaminated soil and being employed separately or with the biopharmaceuticals.

Wemade several experiments.During our experiments we explored the dependence of the sorption capacity of the sorbent on the amount of sorbent, sorption time, age and thickness of the oil film. To create an oil film 40 mL of river water was poured. And thenseveral drops of oil were dripped on the water surface. After that we determined the diameter and thickness of the oil film. In our laboratory tests we used Vankor oil.

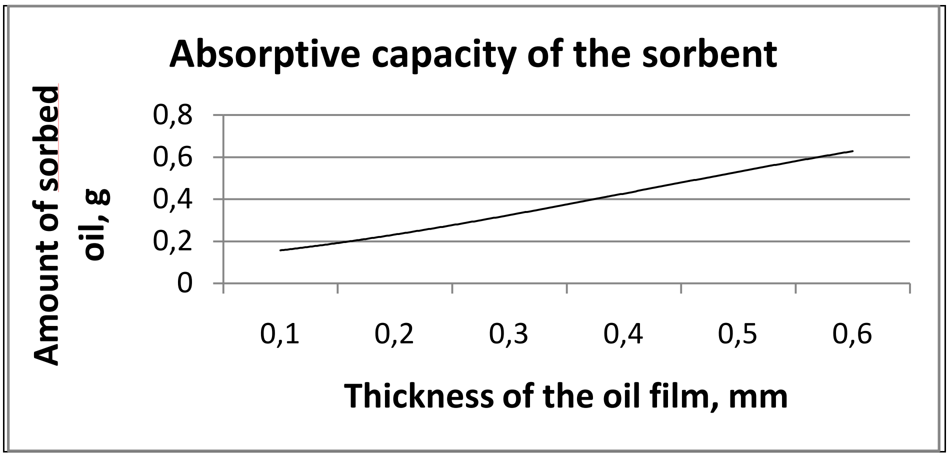
In the first graph you can see the dependence of sorption time on the amount of sorbed oil. We conducted our experiment for 1 day. Optimal sorption time was 1 hour. And we found out that after this time the amount of sorbed oil had decreased.



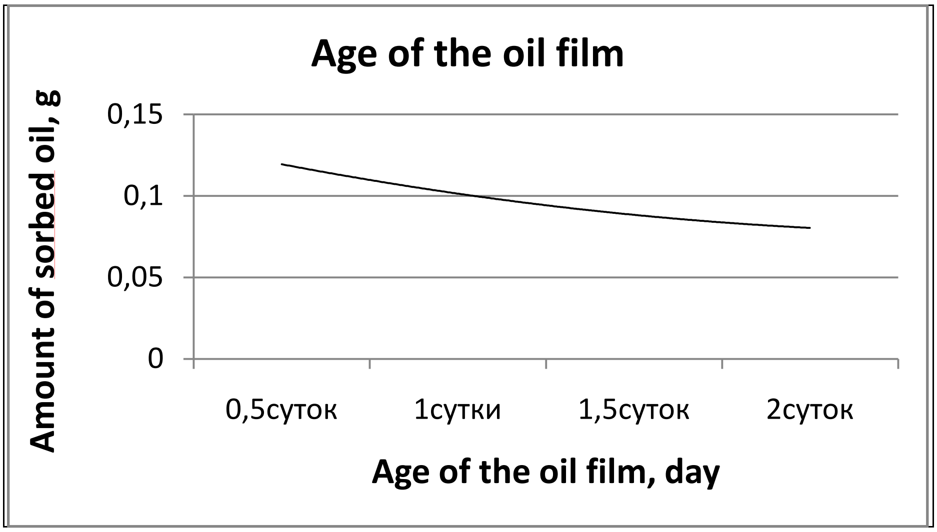
In the next graph you can see the dependence of the amount of sorbent on the amount of sorbed oil. The greater the amount of sorbent the greater the amount of sorbed oil is.



In this graph you can see the dependence of thickness of the oil film on the amount of sorbed oil. Absorptive capacity of the sorbent increases when weincreasethe oil film thickness.



In this last graph you can see the dependence of age of the oil film on the amount of sorbed oil. We have done 4 measurements: 0.5 day, 1 day, 1.5 day, 2 days.The amount of sorbed oil decreases when age of the oil film increases.



We have already received initial results of experiments and we are planning to continue our work further.The following step of our research is the comparison of different sorbents for oil slicks removal.

УДК 656.71

THE SIGNS AND SYMBOLS AT THE AIRPORT RUNWAY

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The first runway lighting appeared in 1930 at Cleveland Municipal Airport (now known as Cleveland Hopkins International Airport) in Cleveland, Ohio. A line of lights on an airfield or elsewhere to guide aircraft in taking off or coming in to land or an illuminated runway is sometimes also known as a flare path. Runway Edge Lights are used to outline the edges of runways during periods of darkness or restricted visibility conditions. These light systems are classified according to the intensity they are capable of producing:

- high Intensity Runway Lights (HIRL);
- medium Intensity Runway Lights (MIRL);
- low Intensity Runway Lights (LIRL).

The HIRL and MIRL systems have variable intensity controls, whereas the LIRLs normally have one intensity setting. Runway Edge Lights are white, except on instrument runways where yellow replaces white on the last 2,000 feet or half the runway length, whichever is less, to form a caution zone for landings. The lights marking the ends of the runway emit red light toward the runway to indicate the end of runway to a departing aircraft and emit green outward from the runway end to indicate the threshold to landing aircraft.

Many airports have lighting that help guide planes using the runways and taxiways at night or in rain or fog.

On runways, green lights indicate the beginning of the runway for landing, while red lights indicate the end of the runway. Runway edge lighting consists of white lights spaced out on both sides of the runway, indicating the edge. Some airports have more complicated lighting on the runways including lights that run down the centerline of the runway and lights that help indicate the approach (an Approach Lighting System, or ALS). Low-traffic airports may use Pilot Controlled Lighting to save electricity and staffing costs.

Along taxiways, blue lights indicate the taxiway's edge, and some airports have embedded green lights that indicate the centerline.

The edge lights must be arranged such that:

- the minimum distance between lines is 75 ft (23 m), and maximum is 200 ft (61 m);
- the maximum distance between lights within each line is 200 ft (61 m);
- the minimum length of parallel lines is 1,400 ft (427 m);
- the minimum number of lights in the line is 8.

An Approach lighting system, or ALS, is a lighting system installed on the approach end of an airport runway and consisting of a series of light bars, strobe lights, or a combination of the two that extends outward from the runway end. ALS usually serves a runway that has an instrument approach procedure (IAP) associated with it and allows the pilot to visually identify the runway environment and align the aircraft with the runway upon arriving at a prescribed point on an approach.

Typically the lights are controlled by a control tower, a Flight Service Station or another designated authority. Some airports/airfields (particularly uncontrolled ones) are equipped with Pilot Controlled Lighting, so that pilots can temporarily turn on the lights when the relevant authority is not available. This avoids the need for automatic systems or staff to turn the lights on at night or in other low visibility situations. This also avoids the cost of having the lighting system on for extended periods. Smaller airports may not have lighted runways or runway markings. Particularly at private airfields for light planes, there may be nothing more than a windsock beside a landing strip.

There are runway markings and signs on any runway. Larger runways have a distance remaining sign (black box with white numbers). This sign uses a single number to indicate the thousands of feet remaining, so 7 will indicate 7,000 ft (2,134 m) remaining. The runway threshold is marked by a line of green lights.

There are three types of runways:

- Visual Runways are used at small airstrips and are usually just a strip of grass, gravel, asphalt or concrete. Although there are usually no markings on a visual runway, they may have threshold markings, designators, and centerlines. Additionally, they do not provide an instrument-based landing procedure; pilots must be able to see the runway to use it. Also, radio communication may not be available and pilots must be self-reliant.

- Non-precision instrument runways are often used at small- to medium-size airports. These runways, depending on the surface, may be marked with threshold markings, designators, centerlines, and sometimes a 1,000 ft (305 m) mark (known as an aiming point, sometimes installed at 1,500 ft (457 m)). They provide horizontal position guidance to planes on instrument approach via Non-directional beacon (NDB), VHF unidirectional range (VOR), Global Positioning System, etc.

- Precision instrument runways, which are found at medium- and large-size airports, consist of a blast pad/stopway (optional, for airports handling jets), threshold, designator, centerline, aiming point, and 500 ft (152 m), 1,000 ft (305 m)/1,500 ft (457 m), 2,000 ft (610 m), 2,500 ft (762 m), and 3,000 ft (914 m) touchdown zone marks. Precision runways provide both horizontal and vertical guidance for instrument approaches.

Runway End Identifier Lights are installed at many airports to provide rapid and positive identification of the approach end of a particular runway. The system consists of a pair of synchronized flashing lights located laterally on each side of the runway threshold. REILs may be either unidirectional or unidirectional facing the approach area.

The Precision Approach Path Indicator (PAPI) can be seen to the right of the runway. The greater number of red lights visible means that the aircraft is below the glideslope. Each box of lights is equipped with an optical apparatus that splits light output into two segments, red and white. Depending on the angle of approach, the lights will appear either red or white to the pilot. Ideally, a pilot would aim for an even split of red and white. The FAA standard for the PAPI is the same as the ICAO's standard Visual Approach Slope Indicator.

The Visual Approach Slope Indicator (VASI) is a system of lights on the side of an airport runway threshold that provides visual descent guidance information during the approach to a runway. These lights may be visible from up to eight kilometers (five miles) during the day and up to 32 kilometers (20 miles) or more at night. Instrument Approach Procedure charts (or *approach plates*) are published for each ILS approach, providing pilots with the needed information to fly an ILS approach during instrument flight rules (IFR) operations, including the radio frequencies used by the ILS components or navaids and the minimum visibility requirements prescribed for the specific approach.

An Instrument landing system (ILS) is a ground-based instrument approach system that provides precision guidance to an aircraft approaching and landing on a runway, using a combination of radio signals and, in many cases, high-intensity lighting arrays to enable a safe landing during instrument meteorological conditions (IMC), such as low ceilings or reduced visibility due to fog, rain, or blowing snow.

UDC 622.2

DEVELOPING THE LABORATORY STAND FOR SIMULATION AND WORK SETTINGS RESEARCH OF HYDRODYNAMIC WELL GENERATOR VALVE

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Abstract. Impact on the near-well and remote reservoir areas by wave methods are becoming more common in the practice of drilling and well operations, both in Russia and abroad. The most effective and positive impact on the near-well formation zone (NWFZ) has elastic vibrations of the low frequency range. Such fluctuations in the designated frequency range provide vibro-wave method of influence on NWFZ.

Vibro-wave impact is implemented by different constructions of hydrodynamic well generators (HWG) which use hydraulic power of the pumped into the well process liquid for its work. The design of laboratory stand (Figure 1) and the procedure for researches on it has been developed for determining the flow rate regime areas of HWG and the degree of influence of various constructional parameters of HWG on their flow rate regime areas.

The construction and operating principle of the multi-purpose laboratory stand has been described in this paper. The stand allows to research the work settings of the new devices, as well as comparative tests of existing downhole equipment up to modern level with digital recording results to the personal computer. The method for determining the parameters of the hydrodynamic pulses of hydrodynamic well generators has been proposed. The investigations of identifying areas of flow rates of the hydrodynamic well generator are presented.

During the conductedstudies it's established that the amplitudes of the pressure oscillations generated by HWG tend to increase with increasing fluid pressure. The intensity ofthis increaseis determined by theflow rate ofthe working fluidpassing through theHWG. During bench tests there is a conclusion that the increase of the amplitudes of pressure oscillations can be characterized by a tangent function of the approximating line slope.

Keywords:hydrodynamic wellgenerator, parameters of the hydrodynamic pulses, modeling of the hydrodynamic wellgenerator.

Impact on the near-well and remote reservoir areas by wave methods are becoming more common in the practice of drilling and well operations, both in Russia and abroad. This is due tothe fact that thewave actionprovides for greater efficiencyat lowerpower consumption [1] andthe fact that theyare easily combinedwith the effectsof another kind. In addition, the range of possible wave impacts is very wide - from ultrasonic and high frequency oscillations to low-frequency vibrations, hydroimpacts and hydroimpulses [2].

Researches show that the most effective and positive impact on the near-well formation zone (NWFZ) has elastic vibrations of the low frequency range from 20 to 300 Hz, and therefore, causes an increased interest of researchers [3]. Such fluctuations in the designated frequency range provide vibro-wave method of influence on NWFZ. This method is characterized by an optimal implementation of the impact in such a manifestation of the effects as well as the depth of coverage of NWFZ over the frequency range and has proven effective in thousands of wells. Vibro-wave method finds application during development, increasing productivity of production wells and injectivity of injection wells that penetrated the heterogeneous, low permeability formations represented by carbonates, sandstones, clay sandstones and siltstones [4].

Vibro-wave impact is implemented by different constructions of hydrodynamic wellgenerators (HWG) which use hydraulic power of the pumped into the well process liquid for its work. Along with other constructions for carrying out vibro-wave impact on NWFZ applying HWG of spring-valve-type[5, 6, 7], characterized by simplicity of design. In order the vibro-wave impact to be efficient generator must provide the specified technological parameters: the required frequency and amplitude of the pressure oscillations. And in order the HWG work to be as effective as possible it is necessary to know its flow rate regime area at which the lowest cost of energy provides the specified technological parameters of treatment. The flow rate regime area depends on various design parameters of HWG and for each generator model determines experimentally.

The design of laboratory stand (Figure 1) and the procedure for researches on it has been developed for determining the flow rate regime areas of HWG and the degree of influence of various constructional parameters of HWG on their flow rate regime areas.

Figure 1. The laboratory stand for the research of the HWG

Developed by Siberian Federal University, together with OOO SPE "Sibron" laboratory stand (hereinafter – the stand) is designed to test and study of downhole equipment: filters, packers, couplings, swabs, ejectors, hydrodynamic wellgenerators (HWG). Main technical characteristics (selectively) are presented in Table 1.

Table 1. Main technical features of the stand

Features	Unit of measurement	Value
Inner diameter and length of wellbore simulator	mm	127,1×2500
Maximum permissible working pressure of liquid	MPa	10
Maximum fluid pressure generated by pump	MPa	4,5
Range of liquid flow	m^3/h	1,2÷9,7
Tank capacity of working fluid	m^3	1
Type the basics of working fluid	-	water
Density of working fluid	kg/m^3	1000-1800

The stand is a set of equipment which arrangement depends on the purpose of researches. The stand assembled by scheme (Figure 2) for the investigation of HWG (Figure 3) consists of the working fluid tank 1, the mud pump 2, the wellbore simulator 3 in which installed HWG 4. All equipment connected by flexible and rigid pipes and equipped with instruments to measure the parameters of the working fluid.

The suction pipe nipple of the pump 2 is connected to the tank 1 via the flexible pipeline 5 which can be cutted off by the ball valve 6 mounted on the tank. The pumpis equipped witha safety valve7 which actuates at a pressureof more than 4.5MPa. After its actuation the working fluid overshootes into the tank 1 through the flexible pipeline 8 connected to the safety valve. Pressure pipe nipple of the pump 2 is connected with the upper part of the simulator 3 through the flexible pipeline 9 through the plug 10 which is fixed in the trunk of the simulator using the handles 11. The lower part of the simulator 3 is connected to the tank 1 via the flexible pipes 12 and 13 and connecting them rigid pipeline 14. This line can be cutted off by the ball valve 15 mounted on the working fluid tank.

The wellbore simulator 3 may be both in vertical and horizontal position. Its stability is provided the upright supports 16 and horizontal supports 17. Wellboresimulatorequipped the container18, one end of whichcommunicates withinternal cavityof the simulatortrunk through the plug valve19and the other end through the plug valve20. The container is designed to be installed self-reacting downhole manometer. The bayonet connection fittings 21which are fixed in thesimulator by handles22 provide an opportunity to connect additional flexible piping when assembling another configuration of the stand. In this configuration the fittings are plugged by the plugs 23.

HWG4is installedin the trunkof the simulatorand connected to theplug10 by the pipe24 and the coupling25(lifting pipe 73 mm GOST633-80). In the upper part of the tube 24 there are longitudinal holes 26 to measure the working fluid pressure in front of HWG. Rubber seal 27is installed between HWG 4 and the trunkof the simulator which cuts off movement of the working fluid in the annulus (between the pipe 24 and the trunk of the simulator) and promotes the movement of the fluid only through the hydrodynamic well generator 4.

The laboratory stand is equipped with the following measurement tools: microprocessorpressure sensor28"Metran-100"; piezoelectricpressure sensor29;ultrasonic flowmeter"Dnepr-7" consisting of a primarysignal transducers30, the processing unit31, power supplyand display unit32. Information from the pressure sensor 28 displays on the display device disposed in the sensor, and the information from the piezoelectric pressure sensor 29 and the ultra-sonic flowmeter-counter "Dnepr-7" through the charge amplifier 33 transmits to the notebook 34, where it displays in the monitor in real-time, and records in memory.

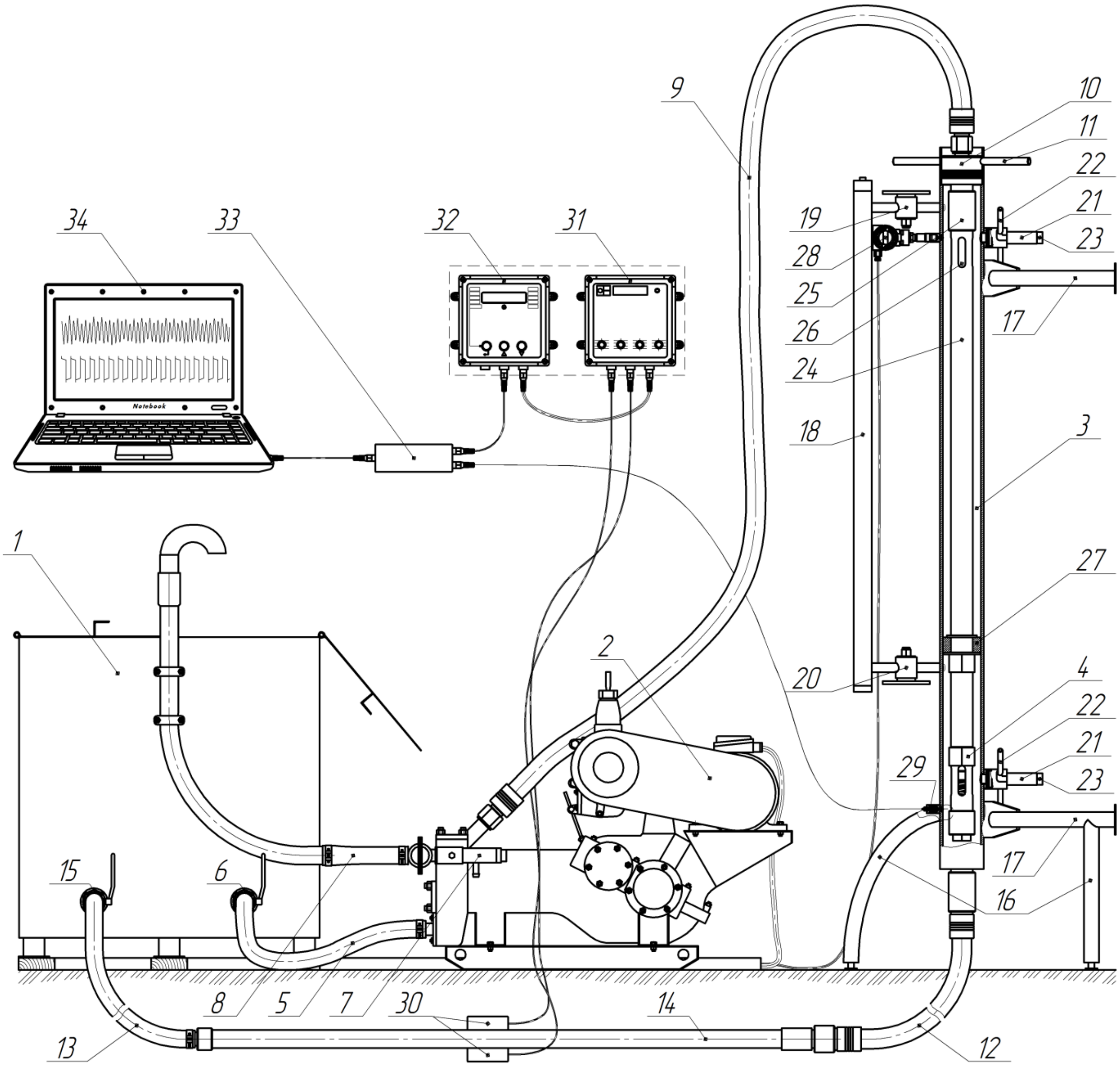

Figure 2. Scheme of the laboratory stand for the research of the HWG: 1 – working fluid tank; 2 – mud pump NB-160/6,3; 3 – wellbore simulator; 4 – HWG; 5 – suctionline; 6, 15 – ball valves; 7 – blow-off valve of the pump; 8 – blow-off line; 9 – pressure line; 10 – plug; 11 – plug handles; 12, 13 – drain line; 14 – drain line (tube); 16 – upright supports of the simulator; 17 – horizontal supports of the simulator; 18 – container; 19, 20 – plug valves; 21 – fittings; 22 – handles; 23 – plugs; 24 – lifting pipe 73 mm; 25 – coupling of the lifting pipe 73 mm; 26 – longitudinal holes; 27 – rubber seal; 28 – microprocessorpressure sensor"Metran-100"; 29 – piezoelectricpressure sensor; 30 – ultrasonic primarysignal transducers; 31 – processing unit of flowmeter; 32 – power supplyand display unit offlowmeter; 33 – charge amplifier; 34 – notebook

Figure 3. The hydrodynamic well generator of spring-valve-type

The laboratory stand works as follows. The working fluid is supplied to the upper part of the wellbore simulator by means of pump 2 from tank 1 through pressure line 9 then fills the inner cavity of the pipe 24 and also cavity between pipe and the trunk of the simulator through the holes 26. When it's going on the sensor 28 measures the pressure of the working fluid in front of HWG. The rubber seal 27 prevents leakage of the working fluid through the annulus and thus, the entire flow of the fluid from the pump tends to HWG 4. Upon reaching the designed pressure the spring with a piston moves down in the HWG and occurs the pressure relief. An abrupt pressure drop occurs in the simulator cavity located above the seal 27 and abrupt pressure rise occurs in the cavity located below the seal 27. Thus, in the liquid passing through the HWG 4 arises pressure pulsations with a definite amplitude and frequency, which are recorded by sensitive piezoelectric pressure sensor 29 while fluid pressure before HWGis recorded by less sensitive pressure sensor 28. Upon exiting the generator fluid goes to the lower part of the simulator and further through the drain line composed of high-pressure hoses 12, 13 and tubing 14 back into the tank 1. With the passage of the working fluid through the pipe 14 its volume flow measured by the ultrasonic Doppler method using primarysignal transducers 30.

Such characteristicsof fluid flowasthe pressure dropsafter theHWG andflow ratedisplayin real timein a special programon the PC screenwith simultaneous recordingin thecomputer's memory. Switching the transmission of the pump 2 allows changing the values of the working fluid, and the throttling of the valve 15 allows setting up the requiredpressurein the system. Due to the fact that the inner diameter of the wellbore simulator corresponds to the real diameters of the wells, and creates pressures and flow rates of the working fluid are close to real conditions, it allows for testing samples of new generators in full size and test of existing production prototypes. Thus,the multi-purposelaboratory complex is createdand allows to investigatethe operating parameters ofthe new devices and conduct comparative testsof existingdownhole equipmentat the modern levelwiththe digital recordingof the resultson thePCthan theincreasedspeed and qualityof the researches.

On the basis of the stand the technique of determining the parameters of the hydrodynamic pulses schematic view is developed and shown in Figure 4. The essence of the technique consistsindetermining the parametersof the hydrodynamicpulsesof the working fluidpassing throughthe HWG, namely the determination of the amplitudeand frequencyoscillationsin the manner describedpreviously. In the study of HWGthere are changing parameters: the mass of the piston, the spring stiffness, pressure and flow rate of the working fluid forward of HWG and determining a link between the variable parameters and hydrodynamic parameters of the pulses generated by the GHA.

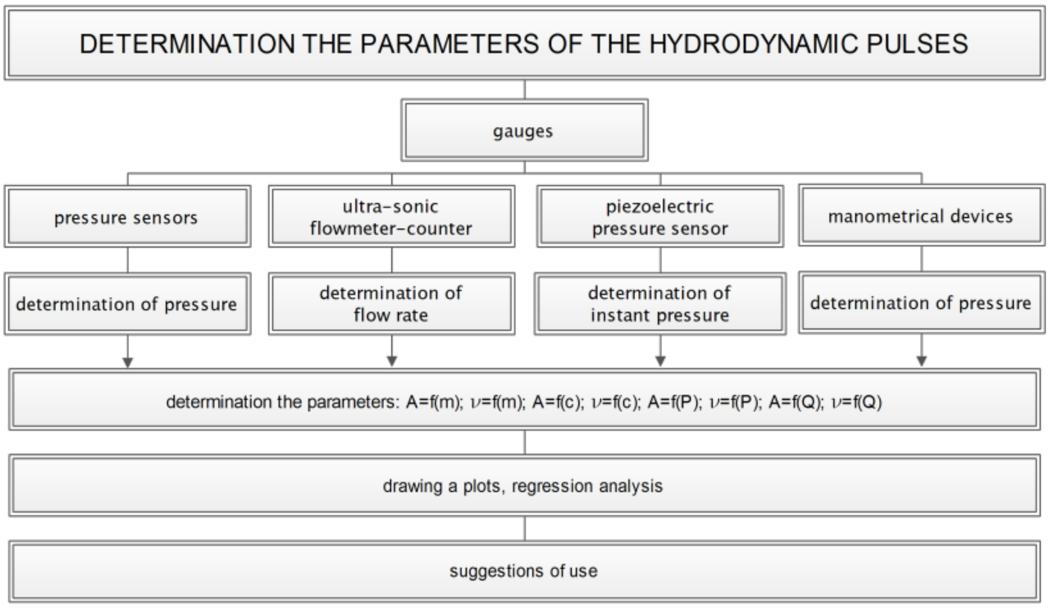

Figure 4. Scheme of methods for determining the parameters of hydrodynamic pulses

In particular, the studies have been performed to determine the flow rate regime areas of hydrodynamic well generator (Figure 3). The aim ofthe study is toidentifythe most energy-rational characteristics offluid flow–its pressureandflow rate. Example of recording hydrodynamic pulses (pressure oscillations) at a flow rate Q = 5 m^3/h and varying pressure is shown in Figure 5.

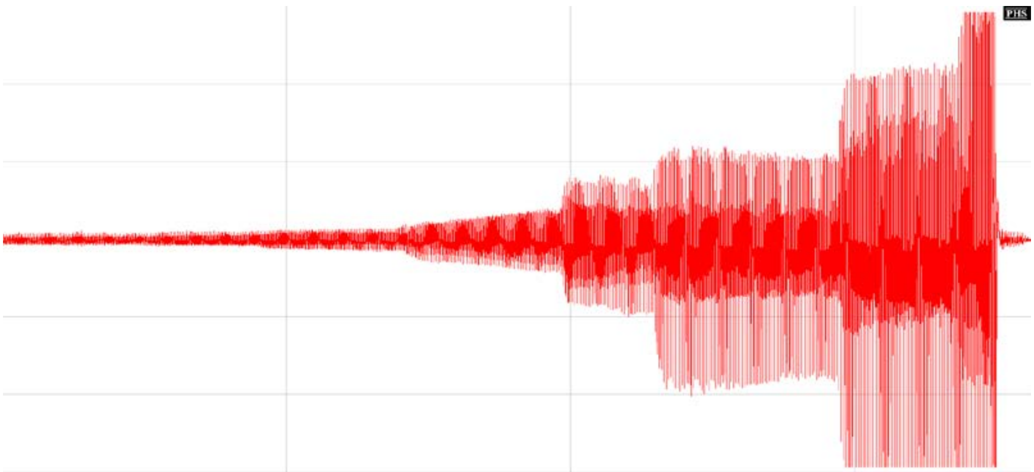

Figure 5. Changing the amplitude of the hydrodynamic pulses at constant pump output flow(Q = 5 m^3/h) and increasing pressure at the inlet of the HWG

(P = 0,1÷1,3 MPa)

In the experiment, for given values of the pump the pressure of the working fluid forward of HWG has been changed and using a highly sensitive piezoelectric pressure sensor the amplitudes of the pressure oscillations generated by HWG have been measured. Results from the studies are shown in the graph (Figure 6). Experimental research data are approximated by linear functions by least squares.

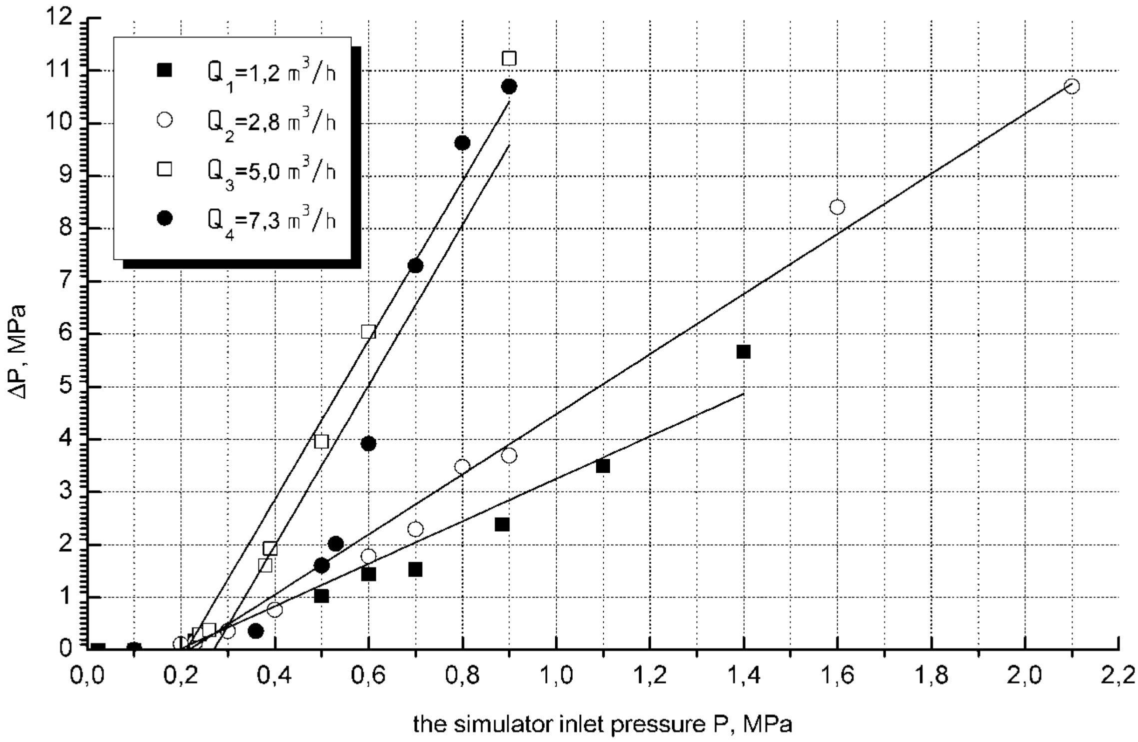

Figure 6. The dependence of the oscillation amplitudes of pressure created HWG from the pressure of the working fluid

Conclusions. During the conductedstudies it's established that the amplitudes of the pressure oscillations generated by HWG tend to increase with increasing fluid pressure. The intensity ofthis increaseis determined by theflow rate ofthe working fluidpassing through theHWG. During bench tests there is a conclusion that the increase of the amplitudes of pressure oscillations can be characterized by a tangent function of the approximating line slope. Thus, it has been noted that the efficiency of the generator can be quite reliably determined by means of the inclination angle of the approximating line. For the prototype of HWG made by authors it should be supposed that the flow rate regime areas of Q = 5÷ 8 m^3/h, since these flow rates the inclination angel of this line is maximum.

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UDK 622.24.063

NEW INSTRUMENTSFORMEASURINGOF DRILL MUD CHARACTERISTICS

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TheRussian oil companies are buying the foreigninstruments to measurethedrill mud rheological parameters after perestroika. Russian manufacturers of these devices lost money and had to reduce the modernization of the instrument.If You want to measure the static shear stress, yield point and plastic viscosity of drilling mud You must use one foreign apparatus or two Russian apparatusnow. This apparatus are SNS-2 or SNS-2M orSNS-3 and rotational viscometerVSN-3 (Fig. 1).

Figure 1. Apparatus for measuringstatic shear stress, yield pointand plastic viscosity of the drilling fluid:a - SNS-2; b-SNS-2M; c-SNS-3; d-VSN-3; e-Brookfieldrotational viscometerseriesDV2T;f -rotational viscometerseriesOFITE; g - rotational viscometerseriesZIM; h–rotational viscometerseries CHANDLER; i - rotational viscometerseriesFANN.

If the anti-Russian sanctions will be increase, Russian companies will be increase the modernization of apparatus. The first stage of this work is to find the requirements for this apparatus.

This apparatus must havethe simple design, the possibility of repair in the field. The apparatus should be capable to measure of three parameters of quality drilling fluids, visualization of the results on a computer screen and automatic entry in the laptop. Weight of the device must be at the level of the foreign units.

Every apparatus has the same control unit (Fig. 1). This control unit consists of two cylinders with fluid between them. That is why the renew apparatus must have the same control unit.

The mass of the VSN-3is a few times higher than the mass of SNS-2, SNS-2M and SNS-3. That is why better to take SNS-2, SNS-2M or SNS-3 as a base for modernization. The new apparatus must measure static shear stress, yield point and plastic viscosity of drilling mud.

The measurement of the yield point and plastic viscosity is based on the rheological model. All models have at least two parameters in one equation. That is, the measurement task is reduced to solving a single equation with two unknowns. For example, the most common Shvedov-Binghammodel has the form [1]:

$$\tau = \tau_0 + \mu_p \frac{dU}{dy}; \qquad (1)$$

where τ_0 - ultimate shear stress; μ_p - plasticviscosity; $\frac{dU}{dy}$ - the derivative of the velocity in the direction perpendicular to the direction of fluid motion.

The apparatus must find a shear stress- τ_0 andplastic viscosity - μ_p .

For determining the two unknowns you need two equations, not one. For this measurement are carried out at a relative speed of rotation of the cylinders 300 and 600 revolutions per minute. After the measurements obtained coefficient of the system of equations [2]:

$$\begin{cases} \tau_{300} = \tau_0 + \mu_p \left.\frac{dU}{dy}\right|_{300} \\ \tau_{600} = \tau_0 + \mu_p \left.\frac{dU}{dy}\right|_{600} \end{cases}; \qquad (2)$$

where τ_{300} и $\frac{dU}{dy}_{300}$, τ_{600} и $\frac{dU}{dy}_{600}$ - shear stresses on the outer surface of the inner cylinder and the derivative of the velocity in the radial direction while rotating the inner cylinder at a speed of 300 and 600 rpm, respectively.

Shear stresses are associated with the corners of the twisting yarn ratios [3]:

$$\tau_{300} = \frac{\phi_{300} \cdot d^4 \cdot G}{64 \cdot R^2 \cdot h \cdot L}; \qquad (3)$$

$$\tau_{600} = \frac{\phi_{300} \cdot d^4 \cdot G}{64 \cdot R^2 \cdot h \cdot L}; \qquad (4)$$

where φ_{300} and φ_{600} - angles twisting steel filaments with a diameter *d* when the rotation speeds of the external cylinder 300 and 600 rpm, respectively; *G* is the shear modulus (G=79,3·10^9 Pa);*R* is the radius of the outer surface of the inner cylinder, mm;*h* - the height of the inner cylinder, mm;*L* is the length of the thread which is suspended inner cylinder, mm;

The presented method is applicable to a linear relationship between the tangential stress on the outer surface of the inner cylinder and the derivatives of velocity in the radial direction. To identify other parameters of rheological models, such as a power of nature (fig. 2) modern devices have more than two speeds, allowing for more data.

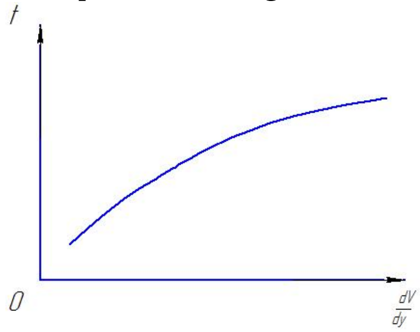

Figure 2. The dependence of the limiting shear stress

For a more precise definition of the coefficients of the rheological models accept that the next-generation device must have at least 8 speeds.

УДК 735.29

DRILLING BITS AND THE RATE OF PENETRATION (ROP)

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A drilling bit is the cutting or boring tool which is made up on the end of the drill string. The bit drills through the rock by scraping, chipping, gouging or grinding the rock at the bottom of the hole. Drilling fluid is circulated through passageways in the bit to remove the drilled cuttings. The drilling engineer must be aware of the drillbits design variations in order to be able to select the most appropriate bit for the formation to be drilled. The engineer must also be aware of the impact of the operating parameters on the performance of the bit. The performance of a bit is a function of several operating parameters, such as: weight on bit (WOB); rotations per minute (RPM); mud properties; and hydraulic efficiency.

There are basically three types of drilling bit. These are Drag Bits, Roller Cone Bits and Diamond Bits.

Drag bits were the first bits used in rotary drilling, but are no longer in common use. A drag bit consists of hard steel blades shaped like a fish-tail.

Roller cone bits (or rock bits) are still the most common type of bit used worldwide. The cones provide cutting action by either steel teeth or tungsten carbide inserts. Rock bits are classified as milled tooth bits or insert bits depending on the cutting surface on the cones.

Diamond bits are divided into Natural Diamond bits and Polycrystalline Diamond Compact (or PDC) bits. The cutting action of a diamond bit is achieved by scraping away the rock. Despite its high wear resistance diamond is sensitive to shock and vibration. The major disadvantage of diamond bits is their cost (sometimes 10 times more expensive than a similar sized rock bit).

The major components of PDC bit design are Cutting Material, Bit Body Material, Cutter Rake, Bit Profile, Cutter Density, Cutter Exposure, and Fluid Circulation.

- Cutting Material

Problem: PDC bit cutters were sometimes chipped during drilling due to internal stresses.

The improvement: Thermally Stable Polycrystalline - TSP - Diamond bits were introduced. These bits are more stable at higher temperatures because the cobalt binder has been removed and this removes internal stresses.

- Fluid Circulation

Removing the cuttings efficiently and cooling the bit face may be satisfied by increasing the fluid flowrate and/or the design of the water courses that run across the face of the bit.

Problem: increased fluid flow may cause excessive erosion of the face and premature bit failure.

Solving: more than three jets are generally used on a PDC bit.

New Bits Speed Drilling In Unconventional Plays:

- Rotating Cutter

Problem: With a traditional cutter, most of the cutting edge is fixed into the bit blade, which means that only a small part comes into contact with the formation. In fact, more than 60 percent of the cutter's peripheral edge goes unused during the run. It does not seem optimal to have 360 degrees of diamond, but use only a portion of it.

Improvement: To use more, Smith Bits developed a mechanism that allows the cutter to rotate 360 degrees and suffer the most wear leads to dramatic improvements in durability.

Rolling cutters have higher durability not only because they use more of the diamond edge, but also because they protect the diamond from heat.

- Conical Element

Problem: the cutter at the center of the bit cut less efficiently than the ones at the outer edge. PDC bits drill by a scraping action, and it is difficult to scrape away the middle of a formation, in part because the bit's center rotates at a slower speed than the outer edge.

Improvement: Smith Bits research showed that crushing the central part of the formation is the best way to destroy it. To achieve that goal, they developed the Stinger conical diamond element, a thick and durable feature that can be placed in the center of the bit to fracture the central part of the hole, and then crush it. The Stinger element helps to centralize the bit and improves stability. It produces larger cuttings that make formation evaluation easier. In many applications Stinger element-equipped bits have delivered much greater ROP improvements.

Bit performance:

The performance of a bit may be judged on the following criteria:

- how much footage it drilled (ft)
- how fast it drilled (ROP)
- how much it cost to run (the capital cost of the bit plus the operating costs of running it in hole) per foot of hole drilled.

Since the aim of bit selection is to achieve the lowest cost per foot of hole drilled the best method of assessing the bits' performance is the last of the above. This method is applied by calculating the cost per foot ratio, using the following equation:

$$C = \frac{C_b + (R_t + T_t)C_r}{F},$$

where: C = overall cost per foot ($/foot),

C_b = cost of bit ($),

R_t = rotating time with bit on bottom (hrs),

T_t = round trip time (hrs),

C_r = cost of operating rig ($/hrs).

This equation can be used for post drilling analysis to compare one bit run with another in a similar well, and for real-time analysis to decide when to pull the bit. The bit should be pulled theoretically when the cost per foot is at its minimum.

УДК 624.139

SIMULATOR FOR EXPERIMENTAL RESEARCH OF THERMALLY INSULATED CONDUCTOR MODEL

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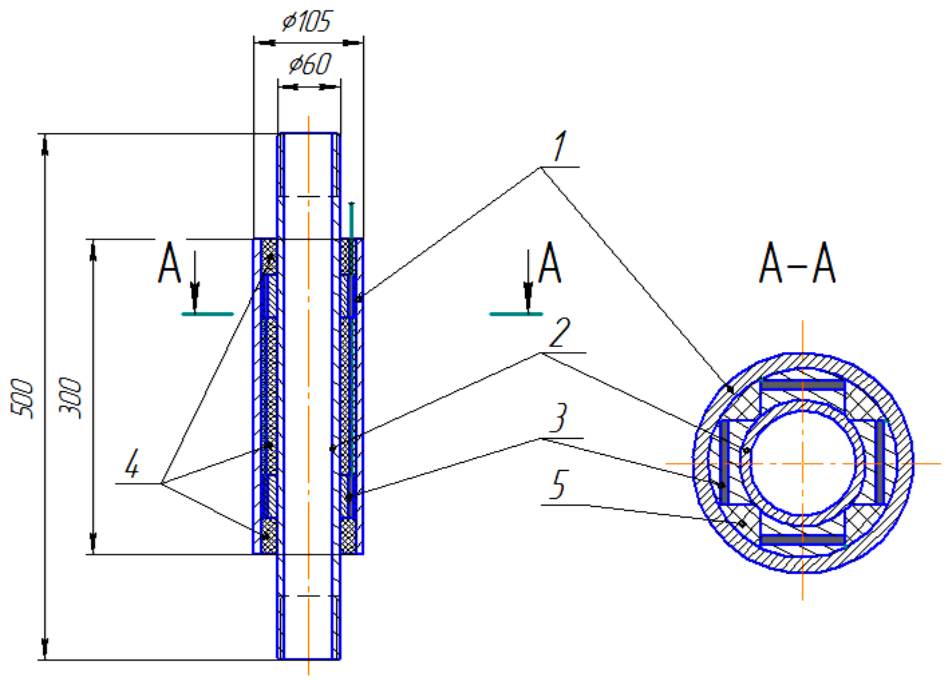
The permafrost, which is the main base of hydrocarbons, occupies more than half of the Northern territories of the Russian Federation [1]. For the last 15-20 years the area of regions with a favourable climate for the existence of permafrost has been reduced by a third [2]. Melting the permafrost and increasing the depth of seasonal thawing significantly complicate the development and operation of wells in permafrost areas.

Researchers [1,3,4 and others] who involved in the problems of drilling and operating wells in permafrost areas have noted the need for using drilling fluids that are cooled to the ice melting temperature, as well as thermal equipment, materials and coatings. They consider the possibility of freezing the wellhead.

In the current situation it is very topical to develop equipment for freezing the wellhead, where the operation does not depend on temperature conditions.

Solving the problem, the structure of thermally insulated conductor with thermoelectric cooler modules (TEC) [5] has been demonstrated. For experimental studies for the development of this structure a simulator is designed (Figure 1).

Figure 1 - The structure of thermally insulated conductor model



The simulator contains outer (1) and internal (2) pipes, inside of which there is a device of TEC (3), rings (4) and segments (5) of the heat insulating material (foam plastic), which fills the annular space between the outer and internal pipes. The device of the TECs (3) includes cases (6) made of the heat conducting material (aluminum) and the parallel connected Pelteir's TECs (7). The TEC is fixed to the case by the thermal grease (8) (Figure 2).

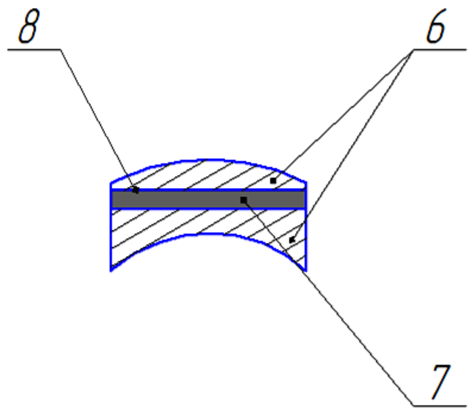


Figure 2. The device of Pelteir's thermoelectric cooler modules (TEC)

The device is fitted tightly to the outer and internal surfaces of pipes. The simulator has thermometers (9, 10, 11) to register the temperature of the outer pipe and the flow of the fluid that passes through the inner pipe (2), as well as the power supply unit (12). The installation scheme of thermometers is shown in Figure 3.

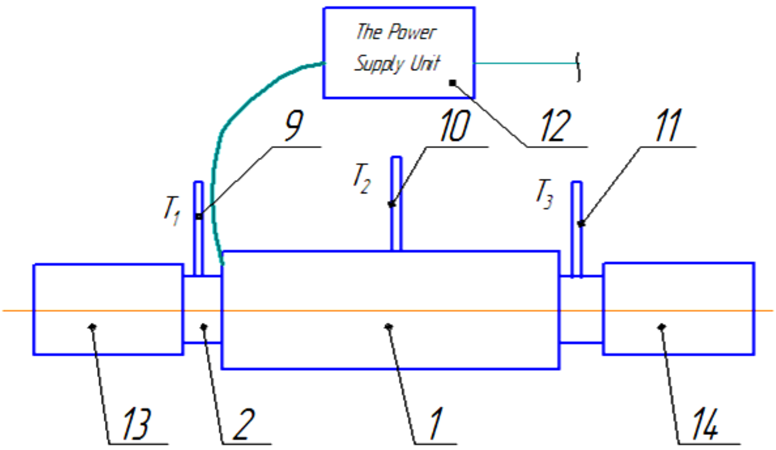


Figure 3. Schematic installation of thermometers

The simulator for research of thermally insulated conductor model is fixed by mandrel subs (13, 14) on the pipe of the laboratory simulator of the wellbore [6].

The simulator for experimental research of the thermally insulated conductor model works as follows. The working fluid pumping from the tank on a pipe runs to the inner pipe (2) with a bore of 50 mm. Electrical current is directed from the power supply unit (15) to the device of the TEC (3). The device (3) will cool the outer tube (2) and transfer the heat generated by Peltier's modules to the inner pipe (1).

As for the overall dimensions the simulator is 0.5 m wide the diameter of pipes is 0,105 m, the weight of the laboratory simulator is 15 kg.

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УДК 656.7.082:544.236.3

METHOD TO IMPROVE SAFETY IN EMERGENCY SITUATIONS ON RUNWAYS

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In order to prevent and eliminate the accidents that occur during emergency situations with a deviation from the norm (Fig. 1), it is vital to quickly eliminate the risk of fire and to ensure human safety and environmental safety area in the process of emergency operating.

Currently the most reliable method implemented is covering runway surface with the using of fire foam layer to reduce the degree of aircraft structural damage during landing and to reduce the likelihood of fuel system units failure.

Figure 1. A passanger jet made an emergency landing on a protective layer of foam

In recent years, a number of airlines and airports have contacted Airport Technology concerning the procedures for the application of aircraft rescue and fire fighting foam onto runways for various types of aircraft experiencing unsafe landing gear indications.A foam path is the aviation safety practice of spreading fire suppression foam layer on the airport runway prior to an emergency landing (Fig. 2).

Figure 2. Spreading of fire suppression foam layer on the airport runway

Originally, it was thought this would prevent fires, but the practice is now discouraged.The U.S. Federal Aviation Administration (FAA) recommended foam paths for emergency landings beginning in 1966, but withdrew that recommendation in 1987, although it did not bar its use. In 2002, a circular recommended against using pre-foaming except in certain circumstances. In particular, the FAA was concerned that pre-foaming would deplete firefighting foam supplies in the event they were needed to respond to a fire.

Also, foam on the runway may decrease the effectiveness of the landing airplane's brakes, possibly leading to it overshooting the runway.Foam is still used in aviation firefighting, usually in conjunction with Purple-K dry chemical.

Due to this disadvantage we propose to use polymer foam, which is produced on the technical base of sorbent Unipolimer-M. This layer is intended to amortizate dynamic shock and absorb energy for emergency response at landing aircraft. What is more, we developed a method for its use.

There are several fundamental benefits of using this material: flammable, energy-absorbing construction of aircraft, high oil capacity, eco-friendly and easy to manufacture.

Foam generating unitPGU-Mspreads polymer self fusing foam on the runway. Installation includes tanks with emulsion, hardener, pumps, dispensers of piping systems and temperature control units to optimize the components measuring instruments with valves and equipment.

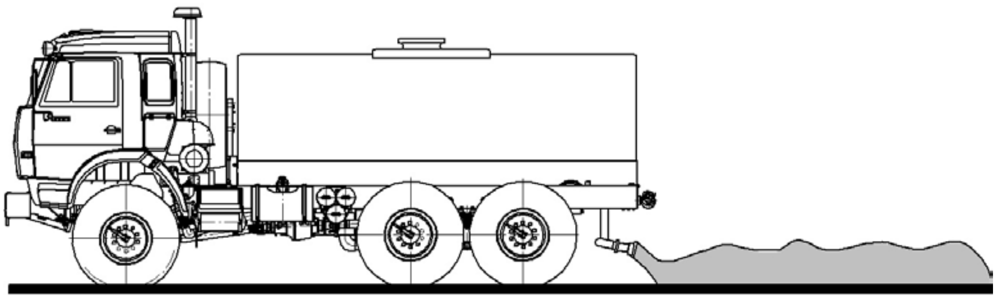

Figure 3. Foam generating unit PGU-M spreads polimer fireproof material

Polymer coating method and device for its realization illustrated by the scheme (Fig. 4):

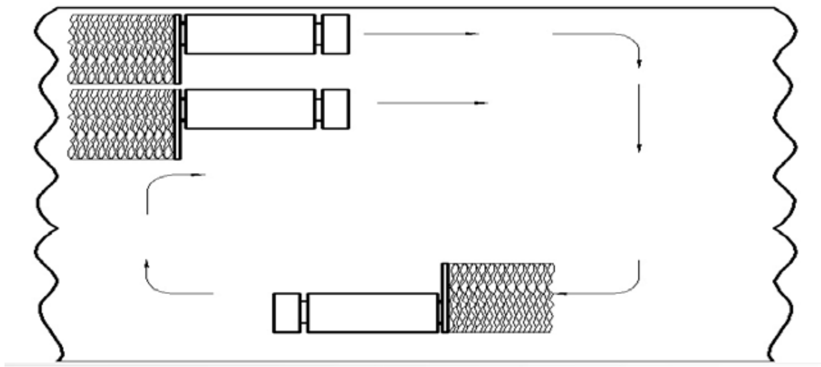

Figure 4. Traffic scheme of foam generating unit used for applying a polymeric foam on runways section during an emergency situation

Amortization of transient dynamic forcesis illustrated by thespecific example(Fig. 5), which however, is not only possible, but it can clearly demonstrate the possibility of achieving essential characteristics of the technical result.

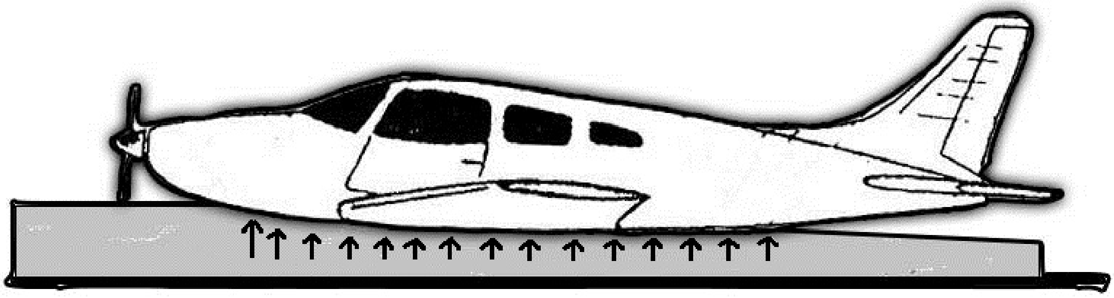

Figure 5. Scheme of aircraft emergency landing on a polymer mat

This technology is the subject of know-how and is currently being patented.

Thus, the developed technology will allow to prevent emergency aircraft landings,risk of fire, environment pollution and to ensure safety of aircraft construction, crew and passengers.

УДК625.7

IMPROVING THE EFFICIENCY IN SNOW ROADS CONSTRUCTION

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Snow roads are constructed to provide transportation network to remote settlements, delivercargo and equipment in severe northern weather conditions. In permafrost areas, snow roads are used during the arctic winter season to provide an improved traffic surface and protect the underlying vegetation and permafrost. Sufficient snow cover and frost depth in the active layer are required to support construction activities.

According to Construction Codes 137-89 [1] constructing snow roads requires that snow road density profile should be over 0,65 g/cc. Density and hardness are the most important snow road characteristics. Density depends on efficiently packing snow crystals, i.e. it depends on the degree to which a volume unit of snow is free from void space. The hardness depends on the tendency of the neighboring crystals to bond each other by ice bridges (sintering). Both density and hardness are metamorphic, i.e. they change with the time and surrounding environmental conditions. Methods for snow road construction need to alter the state of natural metamorphism to accelerate the rate at which density and hardness increase. Those operations will ensure maintenance quality by maximizing snow grain contacts for optimal sintering and minimizing labor and equipment operation hours [2]. Most experiences for constructing snow roads led to the achievement of such values of density and hardness, for this it is necessary to moisten snow preliminarily[3].

There are several snow roads construction techniques. Methods differ from each other and depend on climatic conditions. AtMcMurdo Station, Antarctica roads are constructed by a layered-compaction technology, .

Layered-compaction is the most recent technique NCEL (Naval Civil Engineering Laboratory) developed to minimize the number of operators and equipment required. It involves elevating the pavement to a desired height by compacting successive 10-cm layers of snow without using snowmixers. A rotary snowplow is used to gather, process, and deposit the snow material. The recommended basic equipment and construction procedures are summarized below, they include [2,4]:

- The Caterpillar Challenger 95 is a dual-rubber-tracked agricultural tractor modified to operate in harsh Antarctic weather conditions. These tractors are designed to pull agricultural and construction equipment, trailers and sleds.

- LGP D8 tractor. The Caterpillar low ground pressure (LGP) “stretch” D8 bulldozer. The blades are modified for use in deep snow. These stretch D8 tractors were used to haul equipment, personnel and supplies.

- Snow Plane model. The Goose is a custom snow plane used to remove long wavelength “bumps” on snow and ice roads. It is designed to remove snow from the “peaks” of bumps and deposit it in the “valleys” between. The Goose can also be used to scrape snow and move it laterally from one side of a road to the other.

- A Drag is used to smooth the surface of the snow roads. The drag is most commonly the last piece of construction equipment used during road construction. It is also used to redistribute snow over the road surface following a snow storm or wind event.

- A 50-ton pneumatic-tired load cart is used for deep roller compacting the snow lifts during layered-construction activities.

- A smooth-tired Canadian Foremost Delta III is used to harden the wearing surface of snow roads.

- A 50-ton capacity pneumatic-tired load cart is used to compact a road rut.

Snow road construction technology consists of the following procedures(Fig. 1):

I- Select and stake the roadbed site.

II- Compact and level the roadbed.

III- Deposit and shape snow along side of road for containment berms.

IV, V- Elevate to grade by compacting successive 10-cm layers of snow blown onto the roadbed.

VI - Level, finish, and age-harden.

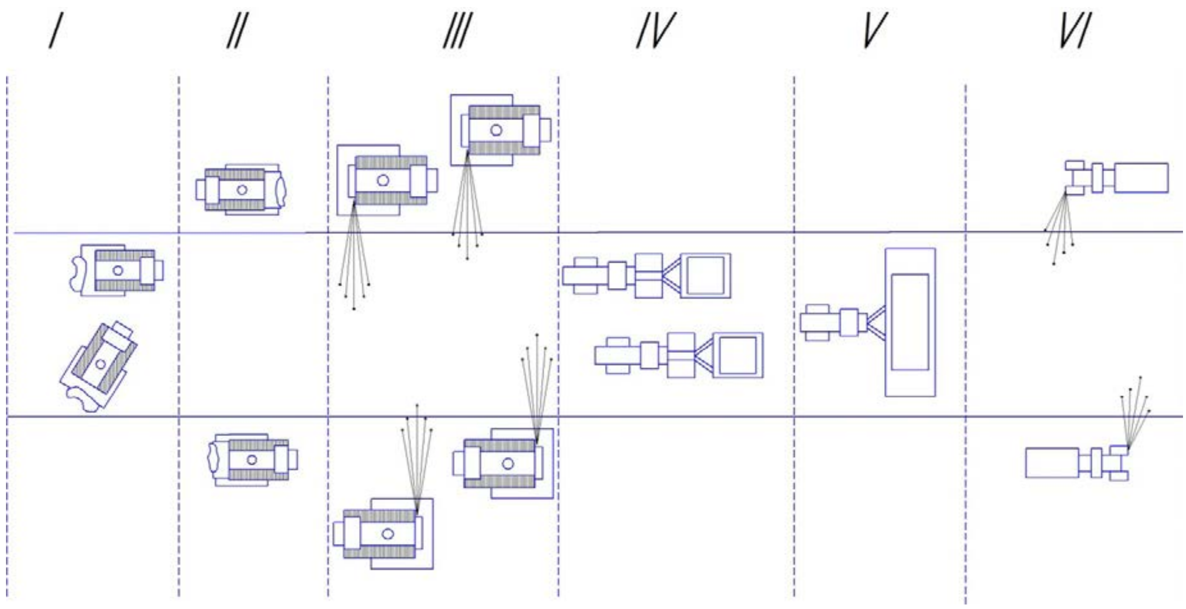

Figure 1. Functional scheme of existing snow road construction technology

It is essential to deposit, spread, and compact each 10-cm layer during a single work shift. A new road may be built in sections to realize this requirement. This construction method produces a finished pavement that is at least 9.1 mwide and elevated 61 to 76 cm above the surrounding terrain [2].

On the other hand, all these operations may be replaced by a SnowPaver. The SnowPaver combines a cutting, leveling, milling, and vibratory compaction process all in one implement. It is designed to maximize the snow grain contacts for optimal sintering and to minimize labor and equipment operation hours.

In Russia, the construction of snow roads occurs according to the similar scheme.Merdanov [3]presents the technological process of creating roads, which includes the following steps (Fig. 2):

I - clearing the ground from bushes and forests by brush cutters and bulldozers;

II – irrigatingwet areas along the road bottom using all-terrain vehicles with a low specific pressure of running systems;

III - freezing road base removing snow along side of the road using snowploughs and bulldozers;

IV – elevating successive layers of snow blown onto the roadbed. Heresnowblowers are used;

V - hydrating (using watering machines or thermo moisturizing machines and units), and profiling accumulated snow at the base of the roadbed;

VI - layered-compacting snow by trailed pneumatic rollers with preliminary ripping and mixing compacted layers with ribbed rollers;

VII - forming the road surface, drifting anti slippery notches on the road.

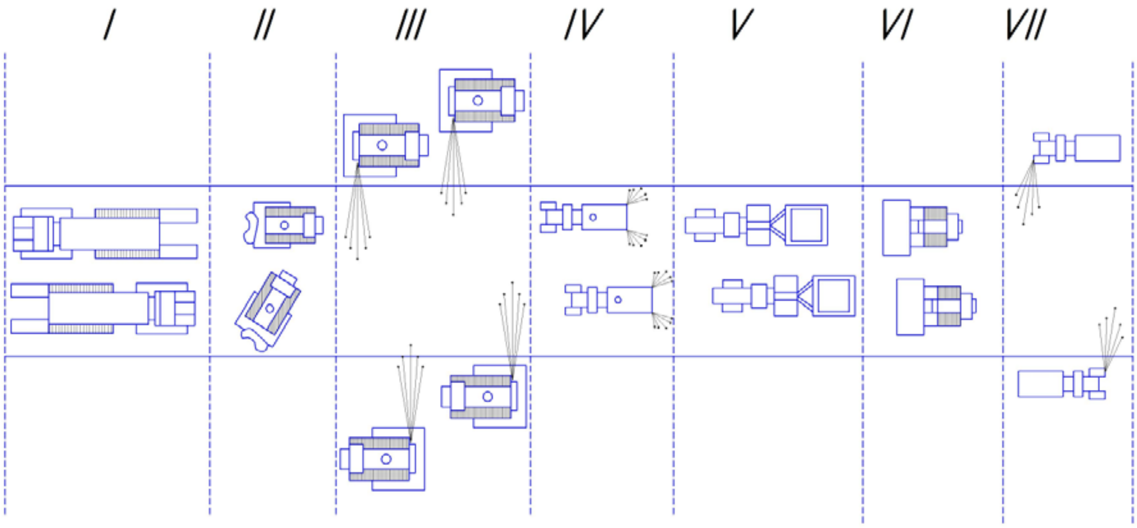

Figure 2. Functional scheme of existing snow road construction technology

When snow roads are constructed over snow fields, it is useful to use special thermal vibration snow compaction unit, operating for 1 pass with hoeing and mixing snow, heat treating the snow mass and vibration compacting. To streamline the process of the snow road construction thermal vibration snowgroomers have been developed, e.g. STM-1, STM-1A MST-0281, STM-2 (Fig. 3) , which have been tested in Antarctica during the construction of the runway, temporary snow roads for the forest industry.

Figure 3. Thermo vibration machine STM-2

This unit removes snowpack per pass, then undergoesit to heat treatment and vibration compact to obtain the density about 0,7 g/cc,the thickness from 25 to 35 cm and the width of strips 2.8 m.

Thus, the construction technology depends on climatic factors (amount of precipitation, latitude), the destination of the road and traffic.Snow during construction has been subjected to heat treatment and size reduction, i.e. the particle size is reduced and every snowflake is more efficiently melt that eventually lead to the denser road surface, so road constructed with the domestic technology will have extended service life rather than snow road constructed withthe foreign technology. In this case, thesesnow roads are less susceptible to wear and there aren`t no ruts when cars pass.

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FIRE SAFETY REGULATIONS

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Fire safety refers to precautions that are taken to prevent or reduce the likelihood of a fire that may result in death, injury, or property damage, alert those in a structure to the presence of a fire in the event one occurs, better enable those threatened by a fire to survive, or to reduce the damage caused by a fire. Fire safety measures include those that are planned during the construction of a building or implemented in structures that are already standing, and those that are taught to occupants of the building.

Threats to fire safety are referred to as fire hazards. A fire hazard may include a situation that increases the likelihood a fire may start or may impede escape in the event a fire occurs.

Fire safety is often a component of building safety. Those who inspect buildings for violations of the Fire Code and go into schools to educate children on Fire Safety topics are fire department members known as fire prevention officers. The Chief Fire Prevention Officer or Chief of Fire Prevention will normally train newcomers to the Fire Prevention Division and may also conduct inspections or make presentations.

Fire Safety regulation set up fire safety requirements for companies, enterprises and production basis. They are mandatory to follow by every company official, leaseholder as well by foreign citizens.

Regulation requires that every employee and temporary personnel are authorized to start work only after having been instructed on fire safety in accordance with the company regulation and requirements of the “Russian Federation Safety Regulation” with a respective record in the training register.

All company employees and temporary personnel should observe and maintain fire safety routines, take necessary precautions while handling electrical appliances, household, chemical goods, flammable and combustion liquids and substances. Before the start of work and after the close of business the persons responsible for fire safety in the operational buildings, office rooms and equipment as well as all company employees and temporary personnel have to thoroughly examine rooms, electrical plants, workplaces and make completely sure there is no fire hazard.

For internal water supply a company must have fire cocks equipped with hoses, fire hose barrels and connecting semi-nuts. Cocks should be placed in special closets. Fire house should be connected with cock and fire hose barrel. It is forbidden to use fire cocks and fire equipment not on purpose. On the territory there should be a fire pool. It must have an approach for stationing of fire engines and taking water any season.

Buildings, construction and open storehouses must have fire breaks in between which are prohibited to be used for storage of materials, equipment or containers, parking and construction of new buildings. Roads, passages and accesses to them and to outside fire escapes and water supply sources should be always kept free for fire engines drive, be in good condition, and free of ice and snow in winter. If road is closed signs for by-pass direction should be mounted at respective places or bridging over repaired parts should be constructed as well as accesses to water supply sources.

The territory must have serviceable outer night illumination to facilitate fast finding of fire pools, outside fire escapes, firefighting equipment locations, building and construction entrances.

It is prohibited to make fire, burn containers, waste and garbage within the territory.

Routine repair and preventive inspection of the equipment should be carried out in scheduled periods and meet fire safety requirements envisaged by design and technological documentation. Hot works on temporary sites can be carried out only according to the work permit in accordance with requirements of the Welding and Hot work Fire Safety Regulation at company facilities. Next to the equipment being of higher fire risk standard safety sings (labels) should be mounted. It is prohibited to work on malfunctioning equipment what can result in fire as well as with switched off process instrumentation and technological automatic devices providing for control over assigned temperature, pressure and other safety parameters.

To avoid the risks every employee of the company and temporary personnel must follow fire safety regulation and requirements. They must remember that it is forbidden to:

- Smoke in all rooms not equipped with fire fighting means and having no safety labels;
- Park automobiles, trailers, labs in quantities exceeding norms;
- Break automobiles location pattern;
- Reduce the distance between cars;
- Carry out fire dangerous works out of assigned places or without proper arrangement (work permit);
- Park for technical maintenance the vehicles with open fuel tanks and tanks with oil and fuel leaks;
- Fill and drain fuel from transport means;
- Keep oil in quantities exceeding the shift necessity;
- Keep vessels from flammable liquids (barrels, plastic vessels, etc);
- Fuel tanker cannot enter production building for vehicle filling:
- Leave untidy oiled rags;
- Heap the passages, doors of evacuation exits, approaches to fire cocks, equipment, electric boards with equipment, barrels or boxes;
- Use flammable substance (gasoline, kerosene, solvents, etc) in equipment degreasing and in technological processes;
- Heat equipment, pipelines with open fire;
- Charge batteries directly on transport means.

These rules will help to avoid dangerous situation. But in case fire breaks out or there are any indications of it like smoke, smell of burning, temperature increasing, fire alarm system working off every employee should inform the fire brigade of the case giving the address of the object, his name and telephone number. He make takes measures if possible to evacuate people from the building, begin fire fighting with the help of fire extinguishers, primary means and fire cocks, evacuate (withdraw) valuable materials, equipment, document from the building. If the employee is not busy in evacuation he should leave the building through the nearest escape according to Evacuation Plan. Department and group managers should check withdrawal of their employees and inform senior manager or supervisor present on the territory at the moment.

The person who is responsible for fire safety must organize people evacuation from the building through all escapes and remove people who are not engaged in evacuation measures beyond dangerous zone limits. If necessary, he must switch off electricity supply systems except emergency illumination (this is done by electrician on duty) and organize fire fighting with available fire fighting means including extinguishers and water supply the fire site from fire cocks. He is to send the security representative to meet fire brigades. On arrival, the fire fighting chief must be informed on the exact fire site location, building structures, people in rooms, operation systems, measures taken for fire fighting, prevention of its development and people evacuation.

УДК 621.895

THE CATALYTICACTION OF METALS ON OXIDIZING PROCESSES AND TEMPERATURE STABILITY LUBRICANTS

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The most urgent problem of modern mechanical engineering is rational application of the lubricants determining durability and non-failure operation of machines. Requirements to lubricants are raising, because it is necessary to provide wear resistance of materials of pairs friction in a wide range of loadings, speeds and temperatures.

High temperatures in a combination to active action of oxygen and catalytic action of metal surfaces result in destruction additives both a base basis and in intensive oxidation of oils with formation of insoluble oxidation products which drop out in a deposit. As a result of oil oxidation, its physical, chemical and operational properties change, viscosity and corrosion activity increases, anti-weld properties worsen.

The temperature has the basic influence on a resource of lubricants and causes oxidation and destruction their base basis and additives. The parameter of thermal-oxidation stability is entered for estimation of antioxidizing properties of lubricants which is regulated by specifications and standards on their manufacture on acid number and the period sludge formation.

Standard method of four-ball lubricants definition of temperature stability with the use of the machine of friction and measurement of specific size carbonization lubricants do not provide reception of the objective information.

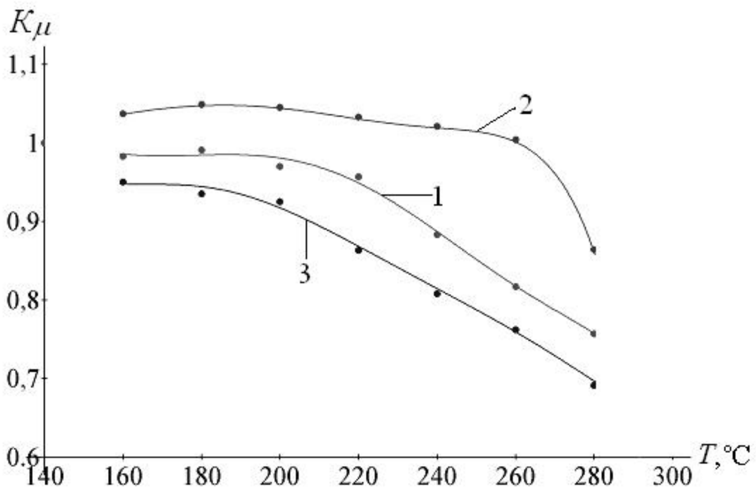
These methods do not allow researching lubricant destruction, its intensity and boundary conditions. Therefore, search and substantiation concerning new methods of lubricants, temperature stability is a top problem which solution can carry out a choice of lubricants, to supervise and predict their condition while in service.

The aim of this research projecthas, therefore, been to determine temperature stability and thermal-oxidation stability of lubricants and substantiation of criteria temperature stability and quantity indicators of influence of metals on oxidizing processes of lubricants.

For research motor oils of a various base basis have been chosen: mineral Mobil 10W-40 SJ/CH and M-10-$Г_{2к}$(GOST 8581-78); in part synthetic Zic 5000 10W-40 SH/CG-4; synthetic Pentosynth 5W-40 SH/CF.

Motor oil test for temperature stability has been carried out in a range of temperatures from 140 up to 300 °C in a glass beaker on the device for definition of temperature stability. Test of oil made of 50 gm and has been tested within 6 hours, and each subsequent stage of oil test is on 20 °C above previous one. The test temperature is supported automatically. The direct photometric measurement method is one of diagnostics methods for lubricant oils. Upon testing each sample the photometer, viscometer and electronic scales has been used as key factor for absorption of a light stream, viscosity and volatility accordingly. Oil photometric measurement has been carried out at a thickness layer of 2 mm.

Tests of motor oils on thermal-oxidation stability have been carried out in terms of commodity oil samples -M-10-$Г_{2к}$ in weight 100 g. Heating is carried out in a glass beaker, where thus oil is mixed up by a glass mixer with the frequency of 300 rev/min. The temperature is set discretely, with 10 degrees step. Each sample is tested in an interval of temperatures from 150 ºC up to 180ºC. Each test auxiliary device: a photometer, viscometer and electronic scales for definition of optical propertiescorresponding parameters, viscosity and volatilityhave been used. Tests of lubricant oils have been carried out up to the value of absorptionvalue of a light stream equal 0, 7-0, 8 units or until changes of relative viscosity changes no more than by 25 %.



Pic.1. Relative viscosity factor dependence on the test motor oil temperature

After a few experiments the following conclusion has been made. Definition methods of temperature stability and thermal-oxidationlubricants stability can allow to establish new factor for an estimation of destructionprocesses and oxidations of commodity lubricants which expand the information on their quality. Also it can allowto choose on a design stage of machines and units, to improve classification and identification oils systemusing operational properties groups.

As a result of research, regression dependences of volatility changing, factors of relative viscosity and of a light stream absorption on temperature and time of the test commodity oils canidentify lubricants on operational properties groups on such parameters as: the temperature started destruction additives, speed of process destruction, limiting temperature destruction, the temperature started destruction a basis and complex criterion of temperature stability.

The integrated criterion catalytic action of metals on oxidizing processes of a lubricant is offered. It is established, that at high temperatures there is a chemical adsorption of surface-active substances of the additives alloying base oil owing to what, processes of formation the blanket are proceed intensively. Thus, essential influence on processes of self-organizing tribology systems is rendered with superficial energy of a firm material, and also a lubricant being, at the present stage of science and technicsone of constructive elements of units and machines.

References

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УДК735.29

AUTOMATION OF HYDRAULIC CALCULATIONS IN OIL AND GAS INDUSTRY BY USING SCHLUMBERGER PIPESIM TOOL

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Typical curves of three basic reservoir types have been observedexperimentally during the life of wells. However, there are many reservoirs that have a combination of drive mechanisms, and their performance may differ considerably from the typical curves given for water drive, solution gas drive, or gas-cap expansion drive mechanism[1].

It is obvious, that, for example, in order to properly design an artificial lift installation, an understanding of the reservoir drive mechanism is important. This is bread and butter of a reservoir engineer, but it is impossible to solve such a problemdue to the amount of variables involved in final equation.

If we make several assumptions such as circular radial uniform flow with constant water saturation, neglect gravity segregation and make the solution valid for two-phase flow, then, of course, we will get the solution, but inaccuracy in measurements will grow proportionally.

This rule can be applied not to just inflow performance curves, but to everything else dealing with hydraulics in development & exploitation of oil and gas fields, including pressure loss correlation. Therefore calculations just using pen and paper become totally impractical and using computer in order to calculate such equations becomes just a necessity.

Recently a lot of pressure drop prediction methods have been developed [2]. Because of the fact that everyone creating the flow correlation tries to factor into it everything he possibly can, these correlations is such a mass of symbols and numbers so that it’s really hard to solve them,especially because you need a big amount of iterations to calculate pressure losses for the whole tube. In order to deal with such a problem there are a lot of graphs from which you can find all the data but it’s also not the ideal way of solving this problem because you need to have a graph for all the tubing sizes for all gas velocities and water oil ratios, as well as API gravity and flow rates.

The goal of my work is to use modern technologies for hydraulics problem correlation applied to reservoir engineering. In particular, to understand, which of currently most exploitable artificial lift methods should be used in order to give the highest flow rates and, as a consequence, to give the highest economical profit for a short hand period.

Particularly, in my work, two methods are compared: gas lift and ESP.

According to the study of accuracy of pressure loss prediction methods, which is made by Lawson and Brill, the best correlations arethose of Hagedorn& Brown and Beggs & Brill, but flow variables have a major effect. That’s why Hagedorn& Brown correlation is chosen in my work[1].

Typical mean values of parameters are used both for gas lift and for ESP, and the model is created using them [2].

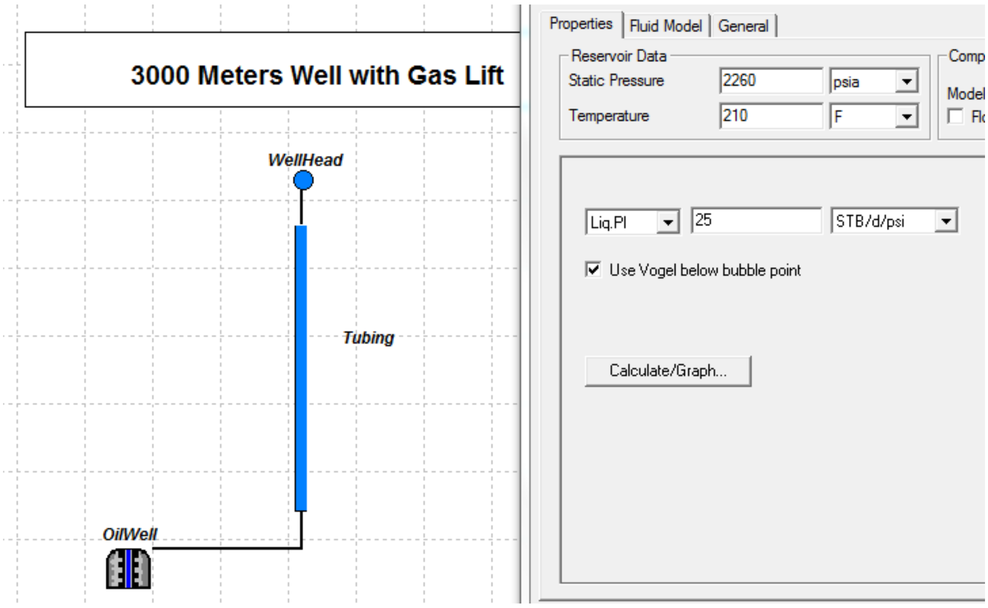

Figure 1.1. Gaslift valve is placed approximately at the 8000 feet depth, as well as ESP.

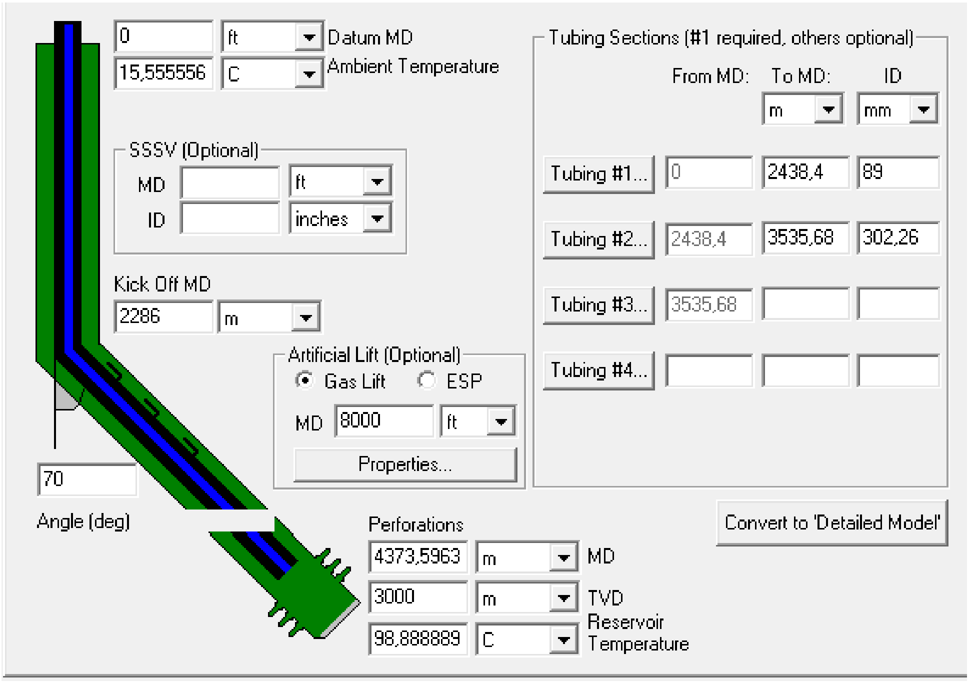

Figure 1.2. Using outlet pressure of 300 psi and varying gas injection rate, the performance curves for gas lift is depicted.

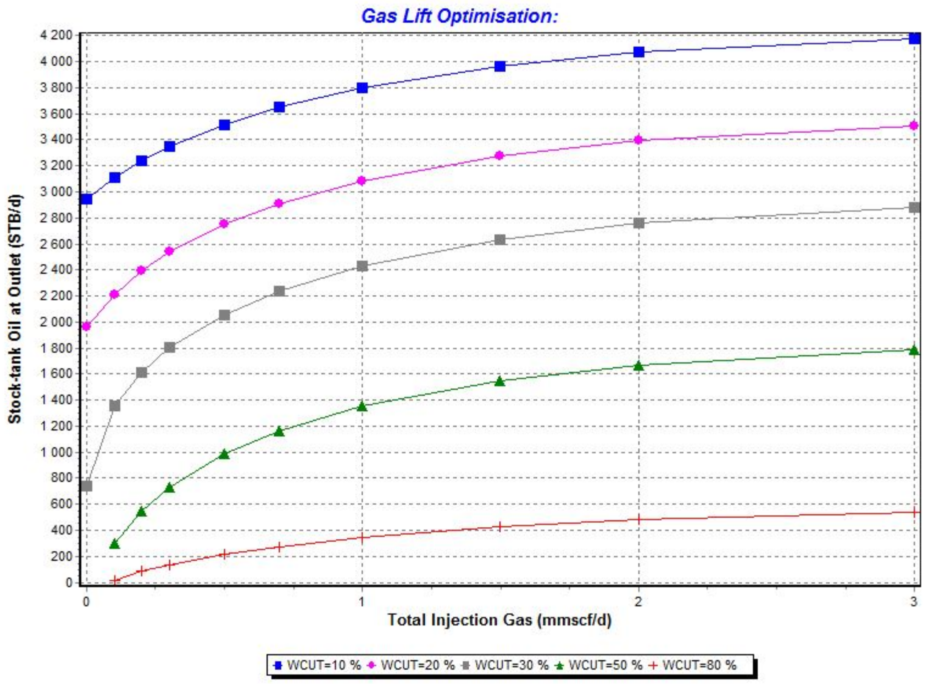

Figure 1.3. Similar graph (with stages as a variable) is established for ESP study.

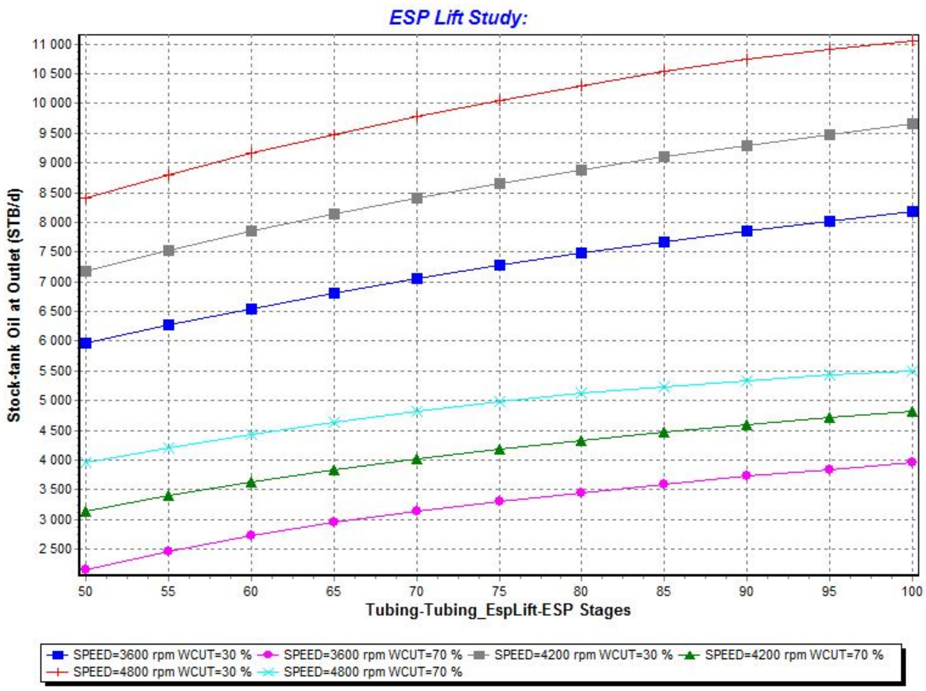

Figure 1.4. From these graphs we can clearly see that altogether gas lift gives the least barrels of total production. Therefore, using mean values of variables and implying that gas injection rate is approximately near one mmscf/d, we obtained that using gas lift valves instead of ESP will lower our production by four times.

In conclusion, in my research work I have used modern calculation technologies for calculation of the hydraulic problem in oil and gas field. The comparison between productivity of different artificial lift methods has been established and, in particular, it is shown that using ESP with mean variables gives us four times higher flow rates of oil production than using gas lift equipment for the same well in the same conditions.

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