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PROBLEMS OF IMPORT SUBSTITUTION OF OIL AND GAS EQUIPMENT

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This article is grounded on V.Ya. Kershenbaum's interview, with L.Yu. Belozertseva's participation, which was given to specialists of "RusEnergy". The problems relating to putting embargo on export of high-tech energy equipment to Russia and import share in the nomenclature of the equipment to be used in energy industry are touched. The nomenclature of what high-tech energy equipment contains the highest share of import?

To protect Russian fuel-energy sector of the economy in case of introduction of some additional economic sanctions by the USA and European Council Russia can lay in some strategic stock of constituent parts of high-tech equipment, manufactured abroad. The problem was discussed at the presidential commission on fuel-energy complex development. Strategic reserve of what constituent parts can be required in case of sanctions' introduction? What alternatives are there at the international market?

Key words: expert; high-tech energy equipment; components; strategic reserve; the share of imports; the problem; import substitution.

UPDATING OF HELICAL CUTTING STRUCTURES OF LEADING ROLLING-CUTTER TEETH ROW OF DRILLING EQUIPMENT

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The results of work aimed at improving the design of cutting structures of leading rolling-cutter teeth rows of drilling equipment to minimize the effect of rack formation are presented. The main causes of "rack formation" effect during drilling of oil and gas wells are determined. Some principal scheme of helical cutting structures of a rolling-cutter drill bit, which allows avoiding possibility of rack formation during its operation through usage of multi-directional geared cutting structures of leading teeth rows at all three rolling-cutter drill bits, asymmetrical teeth with cutters of varying degree and direction of asymmetry, various steps of teeth cutting-structures of leading rolling-cutter teeth

rows at each of three rolling-cutter drill bits, kinematic characteristics of leading rolling-cutter teeth rows is submitted. Usage of the proposed constructive scheme of cutting structures of a rolling-cutter drill bit will allow improving efficiency of rock destruction due to better aligning of bottom-hole surface and minimizing possibility of rack formation development during drilling. All this will eventually increase drilling mechanical penetration rate per one drill bit with simultaneous reduction of drilling operations cost.

Key words: rolling-cutter drill bit; rack formation; leading rolling-cutter teeth row; ratio; helical cutting structures of a rolling-cutter drill bit; teeth cutting structures; mechanical speed; destruction efficiency.

ANALYSIS OF RESULTS OF EXPERIMENTAL OPERATION OF POSITIVE DISPLACEMENT PUMPS USED FOR WATER INJECTION INTO A FORMATION

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The analysis of usage of volumetric piston-type pumping units, manufactured abroad, at facilities of a formation pressure maintenance is presented in the article. The causes of accidents and the ways of their prevention are discussed. The energy, vibration and pulsation characteristics of pumps are studied, recommendations on reduction of pressure pulsations and piping vibration are submitted. The results of trial operation served the basis for making conclusions and giving recommendations on raising operational efficiency of positive displacement pumps.

Key words: formation pressure maintenance; positive displacement pump; energy efficiency; pressure pulses; vibration; head pressure; consumption; filter.

STUDYING OF INFLUENCE OF CHEMICAL REAGENTS, USED TO AVOID ASPHALT-RESIN-PARAFFIN SEDIMENTS ACCUMULATION, ON WELLS PRODUCT PREPARATION

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Results of laboratory studies carried out to find out the effect of chemicals used in oil production system to prevent formation of asphalt-resin-paraffin sediments on preparation of wells production are presented in the article. The change of rheological properties of oil-water emulsion, its degree of stability in the presence of wax formation inhibitors of such famous brands as SNPCh 7920, SNPCh 7941, SNPCh 7912Ma, SNPCh 2005, Dewaxol 7201, FLEK-IP-106, FLEK-IP-102 is analyzed. Degree of the analyzed reagents impact on water separation dynamics during emulsion dehydration, oil dehydration depth, separated water quality is assessed. Feasibility and necessity of some experimental assessment of the effect of the chemicals used during oil preparation, providing to take into account and avoid possible complications are shown.

Key words: oil-water emulsion; preparation; inhibitor; demulsifier; effect; dehydration; oil.

STUDYING OF HIGH-VISCOUS OIL MICRO-STRUCTURE

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The research is focused on the analysis of wellhead samples of extra-heavy oil collected from Kalmayurovskoye field in Samara region and comprises the experiments, carried out to determine the main physical and chemical properties of high-viscous oil, as well as micro-photographing of the samples components. The article presents theoretical aspects, experimental data and valuable discussions to provide better understanding of the abnormal rheological and mechanical properties of such oil. The researches prove the fact that the analyzed samples are almost devoid of the components with a boiling point up to 200 °C. The fluid's high viscosity and structuring is attributed to high content of asphaltene and resin constituents.

Key words: heavy oil; density; viscosity; ash content; solids; asphaltenes; micro-photography.

POSSIBILITY OF USING UMBILICAL CORDS IN TECHNOLOGIES OF ARTIFICIAL LIFT PUMPING OPERATION OF OIL AND GAS WELLS WITHOUT THEIR KILLING DURING WORKOVER

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Development of new technologies of artificial lift pumping operation without well killing will allow solving many operational problems. The key element of such technologies is the use of umbilical cords manufactured as one segment based on steel-polymer pipe.

The most perspective for complicated conditions of deposits and marginal wells is the system for artificial lift production of oil and gas, providing the transmission of the reciprocating motion to the plunger from its drive directly into the wellbore, thereby minimizing energy losses in the intermediate links. Creation of such drive is possible on the basis of the submersible linear motor with permanent magnets.

For medium production wells umbilical technology without killing also can be used with small-size high-speed centrifugal and labyrinth-screw pumps.

The proposed technical solutions permit to reduce operating costs in case of workover, to ensure the safety of trip operations as well as improve the efficiency of artificial lift exploitation of oil and gas wells.

Key words: well killing; artificial lifting; umbilical cord; submersible plunger pump with linear electric motor; small-size high-speed centrifugal and labyrinth-screw pumps.

SOME ASPECTS OF THE PROBLEM OF ANNULAR PRESSURE OCCURRENCE IN AN OIL AND GAS WELL

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While drilling wells in oil and gas fields followed by wells' further operation there appear cases of some annular manifestations leading to annular pressure occurrence, increase of which is of some potential danger that can cause destruction of casing strings, well in the whole and is dangerous from technogenic and ecological point of view.

The article deals with the problem of annular manifestations (annular pressure occurrence) neutralization and practical researches, which define the main reasons for their occurrence. Some recommendations on prevention and control of this type of complications in a well are presented

Key words: annular pressure; manifestation; oil and gas fields; environmental hazards; problem; study of the causes and manifestations of annular pressure.

DEVELOPMENT OF TECHNOLOGY THAT ENVISAGES PROCESSING OF WASTE WATERS AFTER CHEMICAL-WATER TREATMENT OF BOILERS TO PRODUCE STEAM AT ASHALCHINSKY FIELD

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The results of the analysis of wastewater composition from each stage of chemical-water treatment of "Ashalchi" boiler are presented and possibility of their usage as source water for chemical-water treatment of "Severnaya" boiler is determined. The technological scheme of some installation to be used for recycling of waste water for feed water production, including wastewater purification from pollution, softening and demineralization is developed.

Key words: production of heavy-viscous oil; boiler; chemical water treatment; waste water discharge; ultra-filtration; reverse osmosis.

DEVELOPMENT OF THE SYSTEM TO CONTROL THE PROCESS OF OIL EMULSION DYNAMIC SEDIMENT

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Some new method and algorithm applied for control over dynamic sedimentation of emulsified water drops of oil emulsion of is developed on the basis of heat balance and geometrical features of horizontal cylindrical settlers. Mechanism of the proposed method of oil emulsion dynamic sediment includes redistribution of the flow that promotes cyclic flow change of oil emulsion in the settler and oscillatory motion (compression and expansion) of intermediate emulsion layers causing decomposition of armored coverings, coalescence of emulsified water drops and transfer of mechanical additives into water cushion of the settler. This results in quality increase of market oil (content of water and mineral salts in the prepared oil reduces) and risk decrease of settlers' over-flooding. In the settler where oil emulsion amount exceeds its average value as a result of cyclic redis-

tribution, intermediate emulsion layer expands, kinetic energy increases thus leading to efficiency raise of collision among drops causing decomposition of armored coverings and coalescence of drops. If oil emulsion amount is less than its average value the intermediate emulsion layer shrinks, the distance among drops, causing coalescence of drops and increase of oil preparation efficiency reduces.

Key words: dynamic sediment; oil emulsion; thermochemical processing of oil; demulsifire; intermediate emulsion layer.

IMPROVEMENT OF OPERATIONAL EFFICIENCY OF LOW-TEMPERATURE SEPARATION FACILITIES

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Principal performance criteria of gas producing companies are energy- and resource-saving. Energy-saving and ecology safety emphasis as well as deep extraction of condensate generating hydrocarbons creates conditions for economic growth at hydrocarbon production objects.

Economy of gas field treatment by low-temperature separation method depends on energy consumption required for extracting of heavy hydrocarbons, ethane, propane and butane. Decreasing of loads on low-temperature separation facilities will allow reducing energy consumption on hydrocarbons condensation and ensuring of operational efficiency of low-temperature separation facilities for the whole life-time period of a field operation.

The article presents the results of testing the scheme of gas field treatment by low-temperature separation method with preliminary hydrocarbon condensate absorption of condensate generating components. The studies, performed in the article, allowed revealing the reserves for raising efficiency of low-temperature separation facilities.

Key words: resource-saving; gas field treatment; low-temperature separation; absorption; hydrocarbon condensate.

RAISING EFFICIENCY OF OIL PRODUCTION WHILE OPTIMIZING WATER-FLOODING SYSTEM ON THE BASIS OF NEURONET AND HYDRODYNAMIC MODELING

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The use of constantly working geological-technological model and self-design products in the field of artificial intellect served the basis for developing the technology of water-flooding system optimization. This technology works without any additional costs for various geological and technological activities. The ways of flows movement vary due to deep analysis of wells operational history and the subsequent redistribution of injection volumes thus allowing putting non-covered stagnant zones of a formation into development. The effect of the technology application is stabilization or even increase of oil production from the wells' fund, being in operation, and reduction of water content. The technology of water-flooding system optimization is successfully tested at the third block of Berezovsky area. Optimized versions of wells operation, which later received a positive practical confirmation, were computed and implemented on the basis the results of neural network and hydrodynamic simulations.

Key words: constantly operational geological-technological model; neural network modeling; predictive calculations; optimization of water-flooding system; automation equipment.

**ASSESSMENT OF BETWEEN REPAIR PERIOD OF
SUBMERSIBLE ELECTRIC PUMPS ON THE BASIS OF
RELIABILITY CHARACTERISTICS**

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Units of well centrifugal electric pumps are widely used in oil industry. Optimization of between repair period of these units is an important factor for maintaining their serviceability and supporting environmental safety.

The paper presents some method to be applied for determination of periodicity of current repair works and establishment of calendar between-repairs period. Furthermore, some specification of the proposed method of inter-repair period estimation of oilfield equipment which determines the characteristic breakpoint of the failures rate curve, connected with variation of nonstationary loadings in time (through the depth of a well) with further dramatic increase of failures rate and appearance of dangerous failures of some separate elements of the equipment is presented.

Key words: well centrifugal electric pump; oil production; optimization; inter-repair period; operational capacity; ecological safety.

**OFFSHORE ARCTIC PROJECTS DEVELOPMENT AS
AN INSTRUMENT OF TECHNICAL MODERNIZATION**

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The article expresses ideas about prospects of modern economy development in the context of changes in technology, justifies priority of offshore projects development in terms of accelerating of economic growth in Russia. The paper represents the effect produced by complex implementation of offshore fields' development. Particular directions of home technologies development applied for offshore oil and gas extraction are proposed.

Key words: offshore fields, economic growth, technologies, production localization, the Arctic region.

**RESEARCH INTO EFFICIENCY OF CHRISTMAS TREE
AND PIPELINE FITTINGS VALVES IN THE CONDI-
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The article is devoted to the researching of operational factors influence on the wear mechanism of mating surfaces of lock unit details in direct-flow gate valves with sealing type "metal-metal" in condition of pressure pulsations.

By carried out on specially designed laboratory-test bench installation experiments it was established that the existing constructions of gate valves with a parallel-sided gate under medium pressure pulsations are exposed to deterioration, occurring on the contact surfaces due to the processes of fretting-corrosion. The wear intensity is influenced predominantly by factors of: materials used, design parameters of lock unit and vibrations.

With taking into consideration the identified requirements the recommendations are given for effective prevention of emergence and development of fretting-corrosive wear, also concerning the design of lock unit of high pressure direct-flow gate valves.

Key words: gate valve; gate; seat; failure-free operation; wear; fretting; corrosion; tests; pressure; pulsation.

**RESEARCH OF SAND OCCURRENCE IN DIRECTION-
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The article considers problems relating to studying of sand occurrence in directional gas-lift wells.

Study of tubing curvature effect on sand plug fluidization is experimentally carried out. It is proved that the maximum height of the sand particles in suspension state and the corresponding maximum flow rate are observed at an inclination angle of 30°.

The effectiveness of periodic injection of a working agent while applying gas-lift method of directional wells operation with a high content of mechanical impurities in the product is set up and the possibility of regulating their operational modes is shown. It is revealed that periodic flow of working agent is more effective when operating directional gas-lift wells, however, with angle increase of more than 30° the effect decreases. The maximum effect in this case, regardless of the wellbore curvature degree, is marked at one and the same rate of working agent injection. Besides, periodic gas supply when operating wells with sand occurrence not only improves the structure of the pseudo-fluidized layer, but also improves the lift performance. Almost all cases witness some decrease of working agent consumption.

Key words: operation; elevating lift; sand occurrence and slugging; curvature; pseudo-fluidization; deviation angle; gas-lift; working agent.

ASSESSMENT OF PIPES GEOMETRY INFLUENCE ON RELIABILITY AND ENVIRONMENTAL SAFETY OF OPERATION OF GAS PIPELINES REPAIRED SECTORS

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Reliable operation of main gas pipeline systems is closely linked with pipes' performance, which steadily decreases during operation.

The most common, but costly method of maintaining operation of defective sectors of main gas pipelines is replacement of defective pipes for the new ones. One of the alternatives to this method is the technique of restoration of operation of defective sectors of main gas pipelines by applying coupling technologies. These technologies are more economical and reliable enough in terms of provision of long-life trouble-free operation.

However, these techniques have a number of drawbacks. So, the inevitable geometrical imperfections during manufacturing of pipes and welded joints significantly reduce the effect of the defective sector's strengthening, as without proper couplings' clamping to the pipe while performing repair operations there occurs no strengthening of the defect, i.e. the coupling does not work.

There exist several methods to evaluate the effectiveness of steel clamp couplings, however, they do not take into account the curvature of the adjoining surfaces – the outer surface and the inner surface of the coupling. And when calculating coupling structures' efficiency it is assumed that the clearance value between the coupling and the pipe is uniform.

Taking into account the above-said, some study of pipes' geometrical parameters (wall thickness, radius of curvature, inner diameter) to assess presence and extent of already existing geometrical imperfections was carried out and some method for evaluation of effectiveness of a gas pipeline repair by using steel clamp couplings that takes into account pipes geometry imperfections was suggested.

Key words: ecological safety; steel clamp coupling; repair technology; pipeline's curvature.