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Features of the structure and regularities of location of clusters of high-viscosity oils and natural bitumens Incentral Asia

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Annotation. The article deals with the geochemical characteristics of heavy oils and natural bitumen, their classification and genetic types. Based on the analysis of geochemical characteristics of heavy oils and natural bitumens within Central Asia allocated three groups heavy oils and four types of clusters natural bitumen, which differ from each other not only on the area of distribution, but also on the material composition of bitumen. The analysis made it possible to identify the conditions of formation and the presence of regularities in geochemical parameters, as well as the location and presence of forms of deposits of natural bitumen and heavy oils in the oil and gas regions of Central Asia.

Key words: *bitumen, oil, hydrocarbon, accumulations, deposit, genesis, sediments, horizon, chemical analysis, chemical composition, well, structure, oil and gas region, depression*

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Lithological structure of the Osinskian horizon and identification of potential reservoir development zones using J. Lusia's method by the example of Srednebotuobinskoye field

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Abstract. In 2017, Rosneft started pilot operations in the Osinsky sub-horizon, and the first industrial inflows were received. Further replication was complicated by a lack of understanding of the areal development of zones with better properties.

The Osinsky subhorizon is composed of sedimentary carbonate rocks-Dolomites and limestones with different filtration and reservoir properties in area and section. The majority of reservoirs are low-permeable with an average value of less than 2 MD. Void space in most cases is represented by pores and small cavities. Fractures have a zonal distribution.

Taking into account the complex structure and lithological heterogeneity, a complex petrophysical model was created taking into account the sedimentological features of the rocks of the Osinsky subhorizon. As the main approach, the J. Lucia method was chosen, based on the typing of voids that are closely related to the structural and textural features of carbonate rocks. Taking into account the limited knowledge of special GIS methods and the limited core research, at the time of model construction, the neural network training method was used for typing purposes, and standard (model) dependencies were adapted for a specific field.

Key words: *patch-reefs, Cambrian, Osinsky sub-horizon, reef facies, J. Lucia, Siberian platform*

For citation: E.N. Maksimova, K.N. Chertina, K.D. Bobylev, E.S. Zyuzev, L.V. Torgashova, O.A. Krokhaleva Litologicheskoe stroenie osinskogo podgorizonta i vyjavlenie perspektivnyh zon razvitija kollektorov po metodike Dzh. Lusia na primere Srednebotuobinskogo mestorozhdenija [Lithological structure of the Osinskian horizon and identification of potential reservoir development zones using J. Lusia's method by the example of Srednebotuobinskoye field]. Neftyanaya Provintsiya, No. 1(25), 2021. pp. 18-40. DOI https://doi.org/10.25689/NP.2021.1.18-40 (in Russian)

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Topology in the geological heterogeneity case as a method of estimating the displacement coverage factor

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Abstract. Universal, operational and qualitative performance assessment of a selected development system, which can take into account geological heterogeneity, is one of unsolved problems in reservoir development planning.

A geological structure nature and sedimentation conditions exert influence on achievable sweep efficiency. On the one hand, existing static methods evaluate oil recovery without a digital analog of the system spatial heterogeneity. On the other hand simulation allows finding the desired parameter through long-term numerous calculations. Thus, the task of finding the sweep efficiency using a modern technique for describing spatial heterogeneity and for finding multivariable dependencies is set.

***Key words**: topological characteristics, sweep efficiency, machine learning*

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Field geophysical and production tests horizontally branched wells

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Abstract. The complexity of solving the problems of monitoring the development in multilateral horizontal wells based on the results of well logging is associated with the multiphase flow, the influence of gravitational phase redistribution along the well cross-section, different flow rates of the phases, non-monotonicity of the wellbore trajectory (the presence of ascending and descending sections in the casing), phase inhomogeneity, which occurs both along the section and along the length of the well, and with the delivery of a geophysical device into the horizontal wellbore. Under these conditions, the use of standard technologies and equipment for conducting well logging is ineffective.

The article presents the experience of conducting and interpretation of well tests on multilateral horizontal wells, and also selected a complex of well logging cases.

Key words: *oil, horizontally well, well tests*

For citation: M.V. Zuev, V.V. Milovanova, D.R. Ibragimova Promyslovo-geofizicheskie i gidrodinamicheskie issledovanija mnogozabojnyh gorizontal'nyh skvazhin [Field geophysical and production tests horizontally branched wells]. Neftyanaya Provintsiya, No.1(25), 2021. pp.55-66. DOI https://doi.org/10.25689/NP.2021.1.55-66 (in Russian)

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Parametric samplers for producing wells

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Abstract. Interest in representative sampling has recently increased due to foreign companies' activity in the Russian geophysical market. Such issues as sampling in the annular space, nitrogen compensation of the sample taken have become currently important. PJSC NPP VNIIGIS takes measures in cooperation with PJSC TATNEFT to implement a new range of samplers for sampling in the annular space. Requirements for these samplers are the following: maximum downhole tool size is 28 mm, minimum sample volume is 300 ml, maximum length is 2000 mm. Precommissioning is currently underway at some of TATNEFT's producing wells. This paper presents commercial samplers designed by PJSC NPP VNIIGIS.

Key words: *representative samplers, bubble-point pressure, dew point, single-phase sample*

For citation: A.A. Shakirov, L.F. Yusupova Parametricheskij rjad probootbornikov dlja jekspluatacionnyh skvazhin [Parametric samplers for producing wells]. Neftyanaya Provintsiya, No. 1(25), 2021. pp. 67-73. DOI https://doi.org/10.25689/NP.2021.1.67-73 (in Russian)

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Results of experimental studies on development of new surfaces in clay and siliceous shale samples

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Abstract. Clay rocks may exhibit brittle behavior, such as mudstones and siltstones, as well as high ductility, that is especially the case when water phase is considerable. Examination of the failure behavior of heterogeneous rock mass at macrolevel suggests that failure behavior and fracture opening depend substantially on the stress state of the rock mass, its structure and stimulation method. Experimental studies have revealed that stress-strain behavior of clay and siliceous shales depends greatly on water content. Ability of clay and siliceous rock samples to develop new surfaces has been studied experimentally. This ability has been found to correlate with fraction of the colloidal component.

Key words: *fracturing of shale rocks, fracture system, permeability, rock, stress-strain behavior, clay rock, colloidal component*

For citation: T.V. Arutyunov, I.N. Khakimzyanov, A.V. Lifantev Rezul'taty jeksperimental'nyh issledovanij po sozdaniju novyh poverhnostej v glinisto-kremnistyh slancevyh obrazcah [Results of experimental studies on development of new surfaces in clay and siliceous shale samples]. Neftyanaya Provintsiya, No. 1(25), 2021. pp. 74-88. DOI https://doi.org/10.25689/NP.2021.1.74-88 (in Russian)

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Investigation of the of the annular pressure buildup during main-taining well integrity

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Abstract. In the article analysis of research works focused on terms and reasons of the annular pressure buildup is presented. Three types of processes having influence on the annular pressure buildup are discussed. Increments of temperature with time in annulars are calculated using TERMOSIM^{TM} software application. Values of annular pressure buildup were defined using the semisteady-state approach of thermodynamical processes. Annular pressure buildup curves in shut-in phase were estimated with the use of annular pressure data in flowing phase. The relationship between changes of annular pressure and pressure build-up rate was estimated.

Key words: *annular pressure, annular, process of thermal expansion, spectral noise logging, annular pressure buildup curve, semisteady-state approach of thermodynamical processes, change of annular pressure, coefficient of isobaric thermal expansion, coefficient of isothermal compressibility, TERMOSIM^{TM}*

For citation: V.M. Nagimov, M.A. Lonshakov Issledovanie vosstanovlenija davlenija v mezhkolonnom prostranstve pri ocenke tehnicheskogo sostojanija skvazhin [Investigation of the of the annular pressure buildup during main-taining well integrity]. Neftyanaya Provintsiya, No. 1(25), 2021. pp. 89-100. DOI https://doi.org/10.25689/NP.2021.1.89-100 (in Russian)

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Customizing TATNEFT's horizontal drilling technology for oil production from mature Uzbekistan fields

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Abstract. An Agreement for cooperation has been reached between PJSC TATNEFT and Uzbekneftegaz Company to produce marginal mature fields in Ferghana petroleum basin using innovative and proven EOR technologies. In order to implement clauses of the Agreement for cooperation, an option of further development of remaining oil reserves in Andizhan, West Palvantash and Palvantash fields has been considered, with selection and customization of TATNEFT's innovative horizontal drilling techniques in terms of Uzbekistan field conditions.

Key words: *Ferghana petroleum basin, Jurassic, Cretaceous, Paleogene, and Neogene deposits, investment climate, Agreement for cooperation, mature field, horizontal technology, oil recovery increase, technology customization, oil reserve recovery*

For citation: I.N. Khakimzyanov, M.A. Yusupkhodzhaev, O.I. Khakimzyanova, R.I. Sheshdirov Adaptacija tehnologii PAO «Tatneft'» po gorizontal'nomu bureniju dlja vyrabotki zapasov nefti mestorozhdenij Respubliki Uzbekistan, nahodjashhihsja na pozdnej stadii razrabotki [Customizing TATNEFT's horizontal drilling technology for oil production from mature Uzbekistan fields]. Neftyanaya Provintsiya, No. 1(25), 2021. pp. 101-113. DOI https://doi.org/10.25689/NP.2021.1.101-113 (in Russian)

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On efficacy of waterflooding systems in platform-type reservoirs

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Abstract. The problem of effective development of heterogeneous reservoirs has been increasingly more acute. The lately production decline in Russia and in the Republic of Tatarstan can be explained by maturing of the main productive assets. In Tatarstan, these are, in the first place, the Devonian productive deposits of the gigantic Romashkinskoye oil field.

Bringing into production new reserves to maintain a stable production level requires huge investments, however considering that the main source of reserves' growth is hard-to-recover hydrocarbons, the ROI is rather low. In fact, production stabilization can be achieved, primarily, through the effective development of brown fields having the robust infrastructure.

In low-permeability formations, the effectiveness of water displacement is controlled, primarily, by two factors, that is, the extent of formation damage and the extent of solids' production [1, 2]. In fields with dense well spacing developed by boundary waterflooding, zones with low reservoir pressure that result from low pressure communication with the injection zones can be treated as indirect signs of formation damage.

The paper presents recommendations as to how improve efficiency of water injection in the Minnibayevskaya Accumulation of the Romashkinskoye oil field characterized by low formation pressure, which include the optimal injection ratio, requirements to the quality of the injected water. Production enhancement operations customized to conditions of reservoirs developed by NGDU Almetyevneft are offered.

Key words: *injectivity, low formation pressure, production enhancement operations, formation damage, pressure communication*

For citation: E.F. Zakharova, E.V. Levanova, V.A. Sayakhov K voprosu jeffektivnosti sistem zavodnenija na mestorozhdenijah platformennogo tipa [On efficacy of waterflooding systems in platform-type reservoirs]. Neftyanaya Provintsiya, No. 1(25), 2021. pp. 114-123. DOI https://doi.org/10.25689/NP.2021.1.114-123 (in Russian)

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Rock cavings analysis during drilling as tool for safe well construction

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Abstract. The actual physical and mechanical properties of the reservoir and its stress-strain state (SSS) may differ from the predicted values of the stability model at the pre-drilling stage.

Clay, fractured, weakly cemented or brittle rocks that are exposed to SSS or chemical effects of drilling mud change their elastic-strength properties and are prone to collapse, which leads to a whole range of undesirable consequences.

Rock caving is a valuable source of information about the SSS of the near-well space during drilling. This article discusses the conditions for the appearance and characteristics of rock cavings. Various types of rock cavings obtained during drilling at the perimeter fields of the Gazpromneft group companies are analyzed, and correlations with 1D geomechanical models of well stability are shown.

Key words: *cavings, wellbore instability, geomechanical support, geomechanical modeling, drilling efficiency, monitoring of drilled rock, stress-strain state, geological and technological research*

For citation: S.I. Gabitov, A.S. Gotsulyak, I.S. Chebyshev, T.R. Akhmetshin Analiz obval'noj porody v processe burenija kak instrument dlja bezopasnogo stroitel'stva skvazhiny [Rock cavings analysis during drilling as tool for safe well construction]. Neftyanaya Provintsiya, No. 1(25), 2021. pp. 124-140. DOI https://doi.org/10.25689/NP.2021.1.124-140 (in Russian)

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Upgrading of ultra-viscous oil in sub- and supercritical aqueous fluid

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Abstract. This paper considers heavy oil aquathermolysis experiments in supercritical water conducted on reaction mixtures containing heavy oil, carbonaceous materials, and catalytically active rock-forming minerals.

The main characteristic feature of supercritical aquathermolysis products is increased content of paraffinic/naphthenic hydrocarbons: up to 76.2 wt% and 68.2 wt% for aquathermolysis products 4 and 5, respectively, compared to the original 40.8 wt%; whereas resin and aromatic fractions reduce. Aquathermolysis product 4 exhibits reduction of the aromatic and resin content from 13.7 to 4.1 wt% and from 37.8 to 13.1 wt%, respectively. Equidirectional change in the asphaltene content is also observed in aquathermolysis products: in experiments with hard coal (experiments 1 and 3) it has increased up to 9.9 and 9.2 wt%, respectively, compared to the original 7.7 wt%.

It has been demonstrated that aquathermolysis processes involve destruction of highmolecular-weight components and formation of normal and branched alkanes that have been absent in the original oil sample.

Resultant experimental data has been used to develop a process flow diagram of supercritical fluid technology for practical applications.

Key words: *ultra-viscous oil, asphaltene, aquathermolysis, oil upgrading, supercritical aqueous fluid*

For citation: R.R. Zakieva, N.Yu. Bashkirtseva Oblagorazhivanie sverhvjazkoj nefti v sub- i sverhkriticheskom vodnom fljuide [Upgrading of ultra-viscous oil in sub- and supercritical aqueous fluid]. Neftyanaya Provintsiya, No. 1(25), 2021. pp. 141-149. DOI https://doi.org/10.25689/NP.2021.1.141-149 (in Russian)

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Application of wireless pressure regulation system at remote oil and gas transportation facilities

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Abstract. The main trend in the present-day world is maximum implementation of wireless systems and elimination of human participation in operating procedures. One of the challenging issues that many oil companies face is the necessity to monitor parameters without fixed-site power supply in the pressure points area. Application of wireless pressure gauges minimizes installation costs and optimizes maintenance costs.

Key words: *wireless technologies, gauges, oil and gas transportation*

For citation: Yu.A. Sening, Yu.V. Ananieva, E.V. Kruglov-Porunov Primenenie sistemy besprovodnogo monitoringa davlenija na udalennyh ob#ektah transporta nefti i gaza [Application of wireless pressure regulation system at remote oil and gas transportation facilities]. Neftyanaya Provintsiya, No. 1(25), 2021. pp. 150-159. DOI https://doi.org/10.25689/NP.2021.1.150-159 (in Russian)

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Treatment of produced water to be used for steam generation in PJSC TATNEFT's heavy oil fields

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Abstract. Steam injection has become a common method of extracting heavy crude oil. To mitigate environmental impact associated with disposal of large volumes of produced water in the heavy oil fields and to decrease the need in fresh water from surface sources, the Company uses the produced water for steam generation.

Currently, PJSC TATNEFT operates two water treatment units, the "Kamenka" unit with the capacity 350 m3/hour and the "Karmalka" unit with the capacity 700 m3/hour to produce demineralized water to be used as feed water for steam generation.

After extensive analysis of the available technologies, the decision was made in favor of membrane methods of water treatment and demineralization that have been realized in the above-mentioned water treatment units. The process includes the following process units and operations: sorption-filtration unit (preliminary cleaning to remove residual oil); ultrafiltration membrane unit (removal of oil); activated carbon sorption filters (further removal of dissolved oil and organic matter); reverse osmosis membranes – two stages (demineralization of water); anionic filters (removal of hydrosulfides); hydrogen peroxide dosing unit (complete removal of sulfide ions).

TatNIPIneft R&D Institute has performed extensive studies to develop an efficient technology of preliminary cleaning of produced water in the sorption-filtration unit; also, TatNIPIneft research engineers have carried out studies on hydrogen peroxide dosing into demineralized water to neutralize residual sulfide ions, and have designed an automatic hydrogen peroxide dosing unit. The performed pilot tests allowed to select the most efficient agents for chemical washing of the reverse osmosis membranes.

Successful operation of the first-in-Russia water treatment units based on the membrane methods has demonstrated that water meets the requirement to feed water for water-tube units for steam generation.

***Key words**: heavy oil, ultrafiltration, reverse osmosis, produced water, oil concentration, treatment of effluents, feed water for steam generation*

For citation: O.Yu. Antonov, L.V. Kudryashova, N.N. Gafarov, R.S. Magsumova Podgotovka poputno dobyvaemoj vody s cel'ju vyrabotki para na mestorozhdenijah SVN PAO «Tatneft'» [Treatment of produced water to be used for steam generation in PJSC TATNEFT's heavy oil fields]. Neftyanaya Provintsiya, No. 1(25), 2021. pp. 160-169. DOI https://doi.org/10.25689/NP.2021.1.160-169 (in Russian)

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УДК 622.276.5

Causes of oil-water emulsion formation. Emulsion stability factors

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Abstract. The subject of research is oil-water emulsion that forms during oil production process.

This work is aimed at studying causes of oil-water emulsion formation and stabilization factors.

Two-phase fluid behavior during oil production with application of various technologies has been studied. Sources of flow turbulence in oil-production equipment and surface facilities which cause oil emulsification have been identified. Dependence of oil-water emulsion stability on various factors has been determined.

This study is essential when selecting oil field development technology or oil dehydration method, as well as when employing various oil well stimulation techniques.

Key words: *oil-water emulsions, emulsion stability, stabilization factor, disperse medium, oil emulsification*

For citation: E.S. Samushkova Prichiny obrazovanija vodoneftjanyh jemul'sij. Faktory stabil'nosti [Causes of oil-water emulsion formation. Emulsion stability factors]. Neftyanaya Provintsiya, No. 1(25), 2021. pp. 170-181. DOI https://doi.org/10.25689/NP.2021.1.170-181 (in Russian)

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Portable solutions for pigging

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Abstract: Portable pig launchers-receivers for infield pipelines of oil and gas producing companies are offered. The paper presents a concept of specialized vehicles for transportation of portable pig launchers. Advantages and disadvantages of portable pig launchers vs. stationary pig launcher-receiver traps are discussed. Applicable scope of portable pig launchers is offered. Economic efficiency of portable pig launchers was assessed.

Key words: *pig launchers-receivers, portable solutions in oil and gas industry, improvement of pipeline reliability*

For citation: V.S. Abramov, V.A. Yudakov Primenenie mobil'nyh reshenij dlja ochistki vnutrennej polosti truboprovodov [Portable solutions for pigging]. Neftyanaya Provintsiya, No. 1(25), 2021. pp. 182-188. DOI https://doi.org/10.25689/NP.2021.1.182-188 (in Russian)

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Modeling of calculation of economic indicators for oil and gas fields using intellectual algorithms

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Abstract. The article shows that with the help of modern information technologies it is possible to represent formalized knowledge (facts), the truth or falsity of which can be proved. In particular, these methods can be used in the digital economy of subsoil use. In this case, it is supposed to analyze the processed information on the options for field development in order to solve the problem of synthesizing computational algorithms. Involvement of "systems engineers" in calculations significantly reduces the modeling process. Relevant is that the bipartite graphs, which are part of the developed automated system, allow you to visually enter and correct technical and economic information on the options for field development.

Key words: *oil and gas fields, economic assessment, economic modeling, computer modeling, automated system, investment project, economic assessment*

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