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**TILTED OIL-WATER CONTACT IN THE BOTUOBINSKY HORIZON OF THE
SREDNEBOTUOBINSKOE OIL GAS CONDENSATE FIELD AS AN INDICATION OF
PECULIARITIES OF OIL AND GAS FORMATION AND ACCUMULATION IN
NEPSKO-BOTUOBINSKAYA ANTICLINE**

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Abstract. Sloped Oil-Water Contacts (OWC) are registered in the reservoirs at the level of Vendian-Cambrian deposits within the Nepsko-Botubinskaya Anticline (NBA) at several fields.

A review of the available understanding of sloped OWC nature has been done within Srednebotuobinskoe field. Reasons leading to sloped WOC have been reviewed analytically, the author view of the OWC slope is provided from the standpoint of oil & gas generation and accumulation in the region, at SB OGCF in particular. On the basis of an historical-genetic analysis of gas & oil generation and accumulation in the region and studies of science publications, the Vendian sediments were shown to be the only possible oil sourcing sediments the generating potential of which realized in the terrigenous set of NBA. Fundamental process of sloped WOC forming with high density oil forming has been shown. High density oil level location distributions within Central block of SB OGCF were justified theoretically. Forecast of predominant oil and gas bearing capacity in the NBA was made from the standpoints of the supposed process of gas & oil generation and accumulation in the Botubinskiy horizon, Distribution of separate fields of Nepsko-Botuobinskaya oil & gas bearing area against oil rims has been given as a confirmation. Reasonability of the following studies of high density oil level is mentioned in order to optimize the drilling support process, development monitoring and building of a verified model of the field.

Key words: *Nepsko-Botuobinskaya anticline, Botubinskiy horizon, Sloped Oil-Water Contact, a high density oil level, a historical-genetic analysis, Oil & gas bearing capacity perspectives.*

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**FEATURES OF STUDYING THE STRUCTURE OF THE VOID SPACE OF
DOMANIK FORMATIONS ON THE BASIS OF TOMOGRAPHIC STUDIES**

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Abstract. In the last decade the trend of rapid exhaustion of the developed fields with conventional hydrocarbon (HC) reserves becomes more and more evident. In this regard, the development of targets with complex geological structure requires improved approaches to the study of the features of their reservoir properties and lithological composition using modern methods of core analysis.

Application of the X-ray computer tomography as means of "digital petrophysics" is a rather new direction allowing to consider heterogeneity of reservoir properties in the volume of a whole deposit with high facial rock variability and to obtain data for the qualitative analysis of the structure of pore space, defining quantitative petrophysical characteristics of core samples.

This paper presents the experience of using computed tomography to study the structural features of the void space of the Domanik deposits of the Bavlinsky field using standard core samples, which revealed the presence of microcrack systems, cavities, an ordered distribution of dense inclusions in the sample, microlamination in the samples and a system of communicating channels. In addition, the geometric parameters of the cracks were determined, the porosity values were calculated, and the dependences of the porosity distribution over the sampling interval were obtained. Comparison of the calculated values of porosity with the places of sampling in the studied interval of the domanic sediments allowed us to carry out a correlation for samples with characteristic oil saturation.

The conducted research confirmed dependence of reservoir properties on morphology of pore space and lithologic variability of rocks. It was also established that the main share of porosity in petrosaturated samples of domanic deposits is caused by existence of ordered microcracks and the extended rock fissuring (leptoclases), as well as large hollow secretions (geodes) in single samples.

Keywords: *standard core samples, rock sections, litotype, organic matter, tomographic analysis, domanic sediments, microlamination samples*

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**TOMOGRAPHIC IMAGING OF CORE SAMPLES VALIDATES THE FEASIBILITY
OF SURFACTANTS IN EOR TECHNOLOGIES**

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Abstract. Knowledge of pore characteristics is essential for understanding of micro-scale processes that affect the performance of oil recovery technologies. In the present research effort, the study of pore space structure has been conducted with application of tomographic imaging of core samples followed by creation of a numerical model to determine rock characteristics. Studies were conducted with core samples extracted from two intervals (1444.0 – 1449.0 and 1496.0 – 1502.0) of the Vishnevo-Polyanskoye oil field. Results of core studies provided expected capillary pressure drops due to surfactants.

Key words: *tomography imaging, pore space structure, microheterogeneity, capillary pressure, surfactants.*

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**DIFFERENTIATION OF PLASTIC-COLLECTORS WITH HIGH-VOLUME OIL OF
SMALL DEPOSITS OF THE WESTERN SLOPE OF THE SOUTH TATAR
ARCHMAN ON THE BASIS OF PETRO-PHYSICAL, GEOPHYSICAL AND
HYDRODYNAMIC DIVODES**

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Abstract. The share of hard-to-recover oil reserves according to the estimates of the Ministry of Energy of the Russian Federation currently exceeds 67%, while 13% are classified as high-viscosity oil. The absolute value of such reserves according to various estimates will increase to 5-7 billion tons, which determines the relevance of the tasks aimed at improving the efficiency of the development of fields with highly viscous oil for the future for more than 50 years. For the development of such reserves, it is necessary to differentiate the use of known and new development methods based on the structuring of the petrophysical and filtration properties of productive strata and the physicochemical properties of fluids saturating them.

The analysis of the distribution of porosity, permeability of the Tournaisian and Bashkir longlines, Verey, Kashira, Tula horizons, as well as the viscosity of the oil saturating them and, related to this, such parameters of the productive layers as mobility, hydraulic conductivity and finally displacement factor, revealed three groups of productive layers with different values of the sensitivity of the change in the coefficient of displacement from the coefficient of mobility, which must be taken into account when planning and justifying geological technology eskih activities formation or development of a system modification. This is especially important for small fields of high-viscosity oil, which are characteristic of the Western slope of the South Tatar arch (LC YTS).

Key words: *viscous oil; oil displacement; correlation coefficient; oil mobility; permeability*

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**DEVELOPMENT EXPERIENCE OF LOW PERMEABLE RESERVOIRS OF
TYUMEN SUITE OF KRASNOLENINSKOYE FIELD RN-NYAGANNEFTEGAS JSC**

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Abstract. The work is devoted to summarizing the experience, gained during development of tyumen suite on Em-Egovskaya licence area of Krasnoleninskoe field.

Effective oil recovery from continental sediments depends on many key factors and needs to be proceeded by complex approach: increasing geological knowledge within improving the quality of petrophysical forecast, extended support while drilling, usage of modern well completion technologies and justification of well patterns, waterflooding management and the last but not least is to pay special attention to taxation of income.

The solutions found are recognized as successful and replicated to the Kamenniy and Talinskiy licence areas of the Krasnoleninskoe field, and can be integrated in field development process of other analogous low-permeability reservoirs.

Key words: *Tyumen suite, unconventional oil reserves, low permeability reservoir, facies-unstable reservoirs, lithofacial model, geological support while drilling, maximum horizontal stress (regional stress), a horizontal well, multistage hydraulic fracturing, rationale for the development system, matrix of well completion types, effectiveness of reservoir pressure maintenance system, tax privilege.*

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ANALYSIS OF THE FEATURES OF THE DEVELOPMENT OF RESERVES OF MIDDLE JURASSIC OBJECTS OF DEVELOPMENT IN THE TERRITORY OF KHMAO-YUGRA

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Abstract. The article is devoted to the peculiarities of the middle Jurassic oil and gas complex development, which is largely associated with the prospects of oil production in the fields of KHMAO. Over the past 20 years, oil withdrawals from the middle Jurassic sediments within the district have increased by an order of magnitude and are now estimated at tens of millions tons per year. Middle Jurassic oil deposits are characterized by high commercial qualities, but the layers themselves are characterized by low reservoir properties, intermittent geological structure, as well as a mixed (pore–fractured) conductivity. In addition, the lightness of oil turns into increased gas content, causing the accident of well equipment. Accordingly, the reserves of the middle Jurassic deposits are estimated as hard to recover, and the values of the oil recovery factor are taken in the design at a low level. In addition, a significant part of the reserves of the middle Jurassic oil and gas complex remains not involved in the development.

Development of the objects dated for average Jure is also complicated by the fact that the conduction of collectors in the middle Jurassic deposits not purely steam, and has the mixed porous–fissured character, and manifestations of a fracture component are bound to water injection. At the same time naphtha replacement by water can be ineffective because of development under pressure of flood water of bedded jointing to canals of high conduction between delivery and next production wells.

Besides geological and physical conditions the incomplete drilling capacity and also ineffective and nonrational technology solutions have an adverse effect on oil recovery the middle Jurassic of layers. As those it should be noted practice of selection of multibedded objects, collateral development with layers of other age, a rare operational grid and compensation of selections it is higher than 100 %. On the contrary, on objects without overdoping and collateral development coefficients of oil recovery are estimated on rather high level.

Key words: Tyumen Suite, middle Jurassic, oil recovery coefficient, sand content, oil saturation, permeability, jointing.

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**THE EXPRESS METHOD FOR RESIDUAL OIL RESERVES LOCALIZATION ON
THE BASIS OF PROXY MODEL**

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Abstract. The article presents and summarizes the results of the research of solving issue of mutual well influence identification and detecting areas of the uncompensated production based on the analysis of production and injection volumes. The possibility of the residual oil reserves localization on the example of the 3rd block of Berezovskaya area on Romashkino field, based on the obtained proxy models is the indirect result of the conducted research. The information about the neural network algorithms being used and identification of the parameters of differential mass balances system of equations for estimating conductance in the interwell intervals is included. The flowchart of the implemented method for calculating resistance based on the introduced notion of block potential and resistance between blocks is presented, advantages and disadvantages of each of the proposed methods are indicated. The notion of the potential of the Voronoi block partitioning of the well's bottom hole coordinates was introduced by analogy with the physical process of redistributing electrostatic potential; the ratio value of extraction/injection to the pore volume of the block is used as the potential. The sum of the absolute potentials in neighboring blocks minimizing issue is solved using the cross-entropy optimization method to identify resistances in the interwell intervals. The resulting set of resistances between blocks allows to reflect the existing structure of the fluid movement through the reservoir during the study period. The maps of the resistance between the blocks by sections of Berezovskaya area has been constructed. As a result of the maps analysis it was found that the main residual reserves are concentrated along the change boundary of the identified resistance field, and uncompensated selections partially correlate with the residual reserves by blocks.

Key words: *mutual well influence, identification algorithm, cross-entropy, proxy model, residual reserves localization.*

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FACTORS AFFECTING HYDRAULIC FRACTURING EFFICIENCY IN TERRIGENOUS RESERVOIRS OF ROMASHKINSKOYE OIL FIELD

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Abstract. The paper presents analysis of technical and economic efficiency of hydraulic fracturing in Pashiyan terrigenous reservoirs located in mature productive areas. This problem excited interest due to gradual decline of hydrofrac technical and economic efficiency. The aim was to investigate the reasons for this decline and to find solutions to the problem.

Various factors have been analyzed that affect the efficiency of hydraulic fracturing, including geological setting and field conditions in productive areas developed by NGDU Aznakaevskneft. Optimum criteria have been identified to select target reservoirs for frac jobs based on their flow properties. Hydrofrac scheme has been optimized with regard to geological setting and field conditions.

Key words: *formation stimulation, successful hydrofrac treatment, unsuccessful hydrofrac treatment, break-even point, correlation factor, remaining recoverable reserves*

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PREDICTING THE EFFECTIVENESS OF GEOLOGICAL AND ENGINEERING OPERATIONS IN HETEROGENEOUS RESERVOIRS OF LOWER CRETACEOUS COMPLEXES USING REGRESSION RELATIONSHIPS

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Abstract. This article implements the implementation of regression analysis at one of the operational facilities of the Lower Cretaceous complex. With the help of statistical analyzes implemented in the system of geological and technological measures, the effectiveness of the selected methods of influence on the formation is evaluated. This approach allows minimizing diminishing oil and gas producing enterprises when forecasting geological and technical measures (GTM), by selecting wells to obtain objects, taking into account the satisfaction of the regression model obtained during the calculations. Using statistical modeling, the duration of the effect of geological and technical measures was calculated, as well as the specific technological effect.

The object of study is in the Kogalym region, located at the northern end of the Surgut and Nizhnevartovsk vaults. Changes in the geological and geophysical parameters of the reservoir, varying degrees of oil production and the effectiveness of the application of methods of influence on the reservoir. The strata examine the object, the complexity of which consists of sandy-silty differences in detrital rocks.

For the object under study, an analysis of geological and technological measures was carried out. The sequence of stages in creating regression models: a composite matrix consisting of geological and technological indicators of operational objects, correlation input data, obtained geological and statistical dependencies after geological and technological measures, the characteristic of the insurance companies that provide the greatest efficiency of the considered geological and technical measures for this object.

Key words: *field; regression analysis; oil recovery; equation; geological and statistical dependencies; influence; geological and technical measures; hydraulic fracturing; bottomhole treatment; filtration-capacitive properties.*

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**OPTIMIZED DEVELOPMENT STRATEGY FOR TERRIGENOUS BOBRIKOVIAN
RESERVOIRS WITH DIFFERENT PERMEABILITY: A CASE-STUDY OF NOVO-
SUKSINSKOYE OIL FIELD**

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Abstract. The majority of Tatarstan oil fields are currently at the late stage of development, with large amounts of water injected and produced. High rate of reserve recovery from heterogeneous reservoirs results in non-uniform drainage leading to sharp increase of hard-to-recover reserve share. The main oil recovery method in Tatneft Company is water flooding. Enhanced oil recovery can be provided through optimized flood patterns and application of various repressuring agents, including injection of systems with various viscosities (based on polymer thickeners) depending on terrigenous reservoir permeability. The authors suggest a conformance control solution for terrigenous reservoirs with different permeability zones through the application of polymer systems with various viscosities as oil displacing agents (a case study from the Novo-Suksinskoye field).

Key words: *terrigenous reservoirs, heterogeneous deposit, displacement front, different-permeability zones, cyclic injection, polyacrylamide, uniform reservoir depletion, oil recovery factor*

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**EXPERIMENTAL ANALYSIS OF PHYSICAL AND CHEMICAL PROPERTIES OF
SALT AND FRESH WATER-BASED SURFACTANT SOLUTIONS**

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Abstract. The target for analysis is the Vishnevo-Polyanskoye field exhibiting high reservoir micro-heterogeneity, as well as varying content of high molecular weight components in produced oils. In this context, it is necessary to select the most efficient methods to enhance oil recovery.

For high-viscosity-oil fields, the best solution is to select those physical and chemical EOR methods that will provide both decrease of the interfacial tension and conformance control. Use of surfactants is an essential prerequisite for these technologies.

Results of experimental studies have been analyzed concerning physical and chemical properties of salt and fresh water-based surfactant solutions.

Key words: *surfactants, interfacial tension, high-viscosity oil, adsorption, statistical analysis*

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IMPROVED EFFICIENCY OF HYDROGEN SULFIDE STRIPPING

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Abstract. Current requirements to stock tank oil quality promote development and improvement of oil treatment technologies. One of the promising methods is enhancement of hydrogen sulfide stripping via ultrasonic treatment.

Experimental studies have been carried out to determine the efficiency of ultrasonic radiation under various conditions. The efficiency increases with temperature growth, especially for high-viscosity oils. For oil viscosity over 400 MPa·s, specific sound power increase has little or no impact on H₂S stripping, while in case of viscosity below 150 MPa·s increase of sound power from 100 to 200 kW/m³ enhances hydrogen sulfide separation twofold. Increase of ultrasonic exposure time also contributes to a more complete H₂S removal. However, increase of exposure time and specific sound power is not always economically viable. An optimum exposure time is from 4 to 17 minutes at specific sound power of 10-50 kW/m³.

The obtained results show that ultrasonic oil treatment improves transition of hydrogen sulfide from oil to the gas phase and can be used at thermal stages of separation to reduce consumption of H₂S chemical scavenger.

Key words: *hydrogen sulfide (H₂S), ultrasonic treatment, separation enhancement, H₂S stripping*

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**RISKS IN THE PRODUCTION AND REFINING OF PETROLEUM AS A RESULT
OF THE USE OF CHEMICAL REAGENTS**

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Abstract. The technological process of Petroleum production and transportation is associated with the use of chemical reagents. The use of chemical reagents entails risks of problems in the processes of production, gathering and processing, transportation and refining of petroleum associated both with their incompatibility with each other, and with undesirable reactions of reagents with heavy hydrocarbon fractions, which directly affects the quality of the final product and increase its cost price. The article describes a number of possible risks from the use of chemical reagents.

Key words: *risks, Refining, Production, Petroleum, Transportation, Processing, Chemical Reagents*

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**EVALUATION OF OIL SWEEP EFFICIENCY BASED ON THE RESULTS OF
LABORATORY EXPERIMENTS WITH FORMATION MODEL USING HEAT
EXPOSURE AND SOLVENTS**

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Abstract. Due to the worldwide decline in reserves of conventional oil, there is a growing interest in natural bitumen deposits, which represent a large resource potential in Russia and in the Republic of Tatarstan in particular. At the same time, the existing technologies for their production are quite expensive, technologically complex and do not allow for achieving high values of oil recovery.

Steam assisted gravity drainage (SAGD) using paired horizontal wells has become the basic technology for the development of deposits with pay zones exceeding 10 meters. Thinner strata located in the edge zones of bituminous oil deposits of the well undergo cyclic steam treatment alternating with cycles of heated oil production and are characterized by marginal economic efficiency.

Injection of a solvent margin is a promising technology to increase reserve recovery in edge zones of bituminous oil deposits with high heterogeneity of the oil-saturated reservoir. It will reduce the viscosity of bituminous oil, as well as additional washing out of the rock, increase the drainage area of wells, and will be aimed at developing reserves that are not exposed to steam. However, a preliminary fine-tuning of the new technology in laboratory conditions is needed, with the further scaling-up of the results for a real field. The closest to in-situ conditions is the penetration test which makes it possible to reduce the risks during the Pilot commercial Development.

The article shows the results of laboratory penetration test evaluating the recovery factor of bituminous oil at a bulk reservoir model using heat exposure and various solvent formulas developed as part of the federal target project.

Key words: sweep efficiency coefficient, core studies, core material, permeability, bituminous oil, bulk model.