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**ESTIMATION OF NEAR-WELLBORE CONDITIONS IN A VERTICAL  
WELL BASED ON PRESSURE AND TEMPERATURE DATA**

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**Abstract.** A procedure for estimating near-wellbore conditions based on measured bottom-hole pressure and temperature in a vertical well is proposed. This paper analyzes dependence of near-wellbore-area permeability and radius estimates on the initial data.

**Key words:** *vertical well, near-wellbore area, skin-factor, permeability, near-wellbore area radius, inverse problem*

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**COMPUTER-AIDED SEARCH AND ANALYSIS OF INTERVALS WITH  
HIGH CURRENT OIL RECOVERY FACTOR IN KYNOVSKIAN AND  
PASHIYSKAIN FORMATIONS OF ROMASHKINSKOE OIL FIELD**

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**Abstract.** The Romashkinskoye oil field is among the top ten largest world oil fields. In terms of oil reserves, the most important are the Upper Devonian Kynovskian and Pashiyskain terrigenous formations ( $D_0$  and  $D_1$ ). Most of the development targets (areas) of the Kynovskian and Pashiyskain formations have entered the stage of maturity characterized by high water cut of the wellstream, low production rates, high values of oil recovery factor, deteriorated structure of reserves. In the area under study, more than 23 000 wells have been drilled penetrating more than 82 000 productive intervals. The objective is to analyze the extent of reserves depletion in all of these intervals. Manual processing of a bulk of information as huge as that does not seem likely in any reasonable term. The task was solved with the help of a proprietary geologic and reservoir simulator LAZURIT workstation.

Algorithms and computer programs for the subsystem Analysis of Residual Oil Reserves were designed; also a new task—Analysis of Areas with High Oil Recovery Factor—was added in the subsystem. This helped to identify all intervals with high current oil recovery in the Romashkinskoye field.

The geologic cross-section of three members was analyzed: the Kynovskian formation, the upper and lower members of the Pashiyskain formation.

All in all, 82 881 intervals were analyzed, including 16 440 intervals with high current oil recovery factor. Majority of intervals with high current oil recovery factor fall within the upper member of the Pashiyskain formation, the least number is in the Kynovskian formation.

In the cross-section of  $D_0 + D_1$  formations, 13 683 wells (58.12 % of total well inventory) have no intervals with high current oil recovery factor; 5 959 wells (25.31 %) have one interval, 2362 wells (10.03 %) have two intervals, 986 wells (4.19 %) have three intervals, 389 wells (1.65 %) have four intervals, and 119 wells (0.51 %) have five intervals with high current oil recovery factor.

OOIP and ROIP were estimated for all intervals with high current oil recovery factor, as well as production forecast. In terms of mobile residual oil-in-place, all intervals were divided into three groups:

- completely depleted (less than 1500 tons ROIP);
- heavily depleted (between 1500 and 7500 tons ROIP);
- relatively weakly depleted (not less than 7500 tons ROIP).

In the Kynovskian and Pashiyskain formations, 212 intervals fall within the latter group with OOIP and ROIP 40,709,000 and 2,591,000 tons, respectively. Average permeability of relatively weakly depleted intervals is 1.073 micron<sup>2</sup>, average pay thickness is 4.5 m, total area is 6294 hectares, average sweep efficiency is 0.933.

ROIP density maps were constructed reflecting annual production and injection volumes and highlighting intervals with high current oil recovery factor. Based on the information obtained, recommendations on redevelopment of intervals with high current oil recovery factor were issued.

***Key words:*** oil recovery factor; interval with high oil recovery factor; OOIP; mobile reserves; production forecast; geological map; mapping procedure

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**MODEL STUDY OF NON-STATIONARY WATER FLOODING FOR  
DEVELOPMENT OF HIGH-PRODUCTION NONUNIFORM  
PERMEABLE LOW-VISCOSITY OIL RESERVOIRS**

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**Abstract.** The paper presents results of reservoir-simulation-based evaluation of non-stationary water flooding of low-viscosity nonuniform permeable oil reservoirs. Quantitative indicators of oil production rate increase and watercut decrease vs. initial values are presented.

**Key words:** *non-stationary water flooding; permeability; heterogeneity; reservoir simulation; reservoir; efficiency; oil flow rate; watercut.*

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**EVALUATION OF VARIOUS FACTORS AFFECTING DEMULSIFIER  
PERFORMANCE**

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**Abstract.** The paper presents the results of studies looking at the link between emulsion properties and demulsifier performance. One of research objectives included evaluating the effects of ionic strength of brine solution in the emulsion on the efficiency of emulsion breaking. It has been demonstrated that demulsifiers better perform in emulsions containing salts. At the same time, the ionic strength and demulsifying activity of surfactants do not exhibit a proportional relationship for different salt composition of water. To evaluate the correlation between interfacial tension and demulsifying activity of surfactants, the interfacial tension was determined as a function of concentration for different surfactants at their adsorption from water (distilled and mineralized) and oil phase with demulsification performance in emulsions consisting of distilled and mineralized water. Reduction of oil/water interfacial tension to low values does not result in high demulsification performance when using surfactants which are not demulsifiers. The interactions at phase interfaces are manifested through zeta-potential (electrokinetic potential) which should be considered as one of the principle characteristics of aggregative stability of emulsions. The behavior of zeta-potential indicates the efficiency of various additives in changing the stability of the emulsion and enables to wholly control the flocculation process. Thus, high zeta-potential implies low probability of flocculation whereas reduction of its value suggests higher probability for the particles to approach each other and clump together into a floc. Surfactants

reduce zeta-potential with certain concentrations of salt ions and surfactants in fresh water providing proportionate changes of zeta-potential.

***Key words:*** *demulsifier, performance, interfacial tension, zeta-potential, water composition.*

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**IMPLEMENTATION OF INTENSIFYING DEVICES IN OIL  
DEHYDRATION AND DESALTING PROCESSES AT OIL  
TREATMENT FACILITIES OF OAO TATNEFT**

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**Abstract.** Oil fields in the Republic of Tatarstan are, for the most part, at late stages of development which entails high water cuts, deteriorated properties of residual oil produced and implementation of various enhanced oil recovery (EOR) schemes and chemical treatments of bottomhole zone. This causes the formation of highly stable oil-water emulsions and, consequently, impairs produced oil treatment efficiency.

Combined efforts of TatNIPIneft Institute and ZAO Research and Development Complex ModulNefteGazKomplekt aimed at improvement of oil dehydration and desalting processes resulted in the invention of intensifying devices comprising a static mixer and coalescer. These are tubular elements of specified diameter provided with a coalescer section. Dispersion of water in oil emulsion is carried out by means of mixer containing bulk elements. The mixer is positioned downstream of the dehydration stage after freshwater feed point. Oil and freshwater are agitated together while flowing through the mixer. Then the mixture is directed to the coalescer where water droplets collide and aggregate. This enables reduction of emulsion settling time and enhances efficiency of oil dehydration and desalting. Intensifying devices improve desalting performance and stabilize the operation of oil treatment facilities, as a whole. Moreover, they reduce freshwater consumption and the volume of drainage water; thus, cutting down oil treatment operating costs (OPEX). As a

result, the procedures designed to improve oil dehydration and desalting processes increase the overall performance of oil treatment facilities. Application of intensifying devices yielded encouraging results at several sour crude oil and extra-viscous oil treatment facilities of Tatneft.

***Key words:*** *oil dehydration and desalting; mixer; coalescer; OPEX reduction.*



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**THE EFFECT OF INTERNAL PRESSURE ON DISTRIBUTION  
PATTERN OF STRESSES AND STRAINS AT THE WALLS OF  
SLUDGE PROCESSING REACTOR**

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**Abstract.** Processing of oil sludge traditionally accumulating in waste pits and presenting serious ecological hazards has always been an urgent issue especially as oil sludge is a valuable secondary raw material with a wide range of useful products extractable from it.

Pyrolysis is the most promising process in terms of recovery rates of useful products and minimization of harmful environmental impact. The pyrolysis of raw material is known to proceed without access of oxygen. Therefore, thermal treatment of oil sludge is carried out at excess pressures to prevent oxygen from entering the reactor.

The paper presents a model that fully reflects the original design of the pyrolysis module of a modular oil sludge thermal treatment unit. The results of strain-stress analysis of the pyrolysis module and its bottom depending on action of the pressure uniformly distributed in the reactor are provided. Moreover the conclusions are made on the internal pressure effects on stress and strain distribution patterns at the walls of oil sludge processing reactor.

**Key words:** *oil sludge; heat treatment; unit; mixer; bottom; stress-strain state.*

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# IMPROVING HYDRAULIC FRACTURING PERFORMANCE IN THE YUZHNO-PRIOBSKOYE FIELD THROUGH JUDICIOUS SELECTION OF STIMULATION TARGETS

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**Abstract.** Advantages and disadvantages of hydraulic fracturing treatments conducted in various fields of Gazpromneft-Khantos are considered. Solutions are proposed to achieve optimal post-frac production performance. Quantitative criteria of hydraulic fracturing optimization are obtained for the wells in the Yuzhno-Priobskoye field.

**Key words:** *hydraulic fracturing, oil recovery factor, reservoir properties, geological and field parameters, hard-to-recovery reserves, clay content, porosity, permeability, well logging*

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## IMPROVEMENT OF FRACTURED OIL WELL PERFORMANCE IN YUZHNO-PRIOBSKOYE FIELD, OOO GAZPROMNEFT-KHANTOS

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**Abstract.** This paper discusses improvement of hydraulic fracturing technology through reducing proppant flowback. It has been shown that reduced well deliverability after frac jobs due to reservoir pressure decline can be stabilized or restored through reservoir pressure maintenance systems. However, decreased well productivity due to proppant flowback can hardly be recovered.

Use of resin systems or resin-coated proppant has been proposed in a number of wells to prevent proppant flowback for efficient fractured well operation.

**Key words:** *hydraulic fracturing, oil recovery factor, solids content, reservoir properties, field-geologic parameters, hard-to-recover reserves, proppant*

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**POST-FRAC PROPPANT FLOWBACK EFFECTS ON THE RUN TIME  
AND PRODUCTIVITY OF WELLS IN THE YUZHNO-PRIOBSKOYE  
FIELD**

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**Abstract.** Low permeabilities obtained from core studies and low flow rates observed during well testing necessitated to hydraulically fracture all newly dilled wells of the Yuzhno-Priobskoye field. Hydraulic fracturing treatments to increase permeability often entail proppant flowback. This has an adverse effect on well productivity resulting in poor production performance (daily oil and water production rates, cumulative oil production, run time) and unfavorable pump operating conditions leading to excessive wear of mechanical parts due to abrasive action of proppant particles.

The paper provides the results of well performance analysis for 2014 and statistics of pumping unit failures ranked according to causes of such failures. Report documentation on the removal of downhole pumping equipment that failed in less than 365 days is examined in detail. The proportion of wells experiencing proppant flowback is determined. A group of wells complicated by flowback of solids, particularly, proppant is considered. According to one well performance analysis, the decline in production rate proved to be more severe in case of proppant flowback detrimental to the condition of downhole pumping equipment and pumping unit operating conditions with the resultant reduction of run time to failure and increase of additional workover expenses. Suspended solids concentration profiles are presented which demonstrate that the wells with

proppant flowback problems have much higher solids content in the production stream compared to other wells.

***Key words:*** *proppant; productivity; hydraulic fracturing (HF); permeability; electric submersible pump (ESP).*

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**HISTORY AND PROSPECTS OF EXTRA-VISCOUS  
AND HEAVY OIL PRODUCTION IN TATARSTAN**

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**Abstract.** This paper gives an overview of historical and future production of extra-viscous and heavy oils in the Republic of Tatarstan. Heavy oil production in Tatarstan is characterized by three main stages. A new strategy of sustainable use of heavy oil resources is considered in this paper.

**Key words:** *extra-viscous oil; heavy oil in Tatarstan; historical production; oil production strategy and prospects.*