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**FUNDAMENTAL PROBLEMS OF THE DEVELOPMENT OF RUSSIAN  
OIL SECTOR AND TRANSITION FROM RESOURCE-BASED TO  
RESOURCE AND INNOVATION DEVELOPMENT**

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**Abstract.** The paper proves the importance of innovative approach at all stages of oil and gas fields characterization and development (laboratory rock and fluid analysis up to nanoscale, petrophysical studies, well logging, geological and reservoir simulation modelling, selection of new (including nanoscale) technologies based on the results of laboratory studies and numerical simulations, field tests, innovation design engineering).

A fundamentally new approach to geological modelling is proposed with account of original, in-place, outbalance and recoverable reserves. Criteria of sustainable and efficient field development are substantiated.

**Key words:** *unconventional oil and gas, shale rocks, extra-viscous oil, innovative development planning, geological and field development model, reserved classification, sustainability and optimal field development.*

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**APPROACHES TO EVALUATION OF HYDROCARBON POTENTIAL  
OF TIGHT RESERVOIRS USING THE EXAMPLE OF DOMANIC  
DEPOSITS OF TIMAN-PECHORA PETROLEUM PROVINCE**

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**Abstract.** The paper reviews approaches and methods for estimation of reserves and resources of hydrocarbon accumulations confined to tight (“shale”) rocks.

Remaining hydrocarbon potential of tight petroleum source rocks depends on depositional history and burial environment of high-carbon deposits. This means that reliable reserves estimation requires studies of the matrix rock as well as the conditions of petroleum generation and preservation.

In North American shale projects, for evaluation of commercial value of shale oil and gas accumulations well production testing data are used which are extended or interpolated with respect to inter-well space using high-resolution seismic.

This approach is highly efficient but very expensive, which makes it impractical for Russia in contemporary conditions.

A new approach is proposed for estimation of reserves and resources of the Domanic sediments in the Timan-Pechora petroleum province. This approach consists in modification of volumetric method for reserves estimation using volumetric parameters determined for individual vertical (horizontal) wells with subsequent data verification using geochemical mass balance methods and integrated geochemical method with data control provided by geological analogue extension method for estimation of reserves; and integrated

geomechanical method with data verification using geological analogue extension method for estimation of resources.

It was found that due to extensive facial and geomechanical variations, extension of volumetric parameters determined in an individual well to more than 2-3 drainage diameters is unreasonable.

Based on integrated geochemical method with consideration of pore and fracture volume, residual petroleum reserves of the domanikoid petroleum source rock were estimated at 4.4 billion tons of oil and 4 trillion cubic meters of gas.

Further study methods are proposed for estimation of petroleum reserves of tight domanikoid reservoirs.

***Key words:*** *tight oil, the Domanic, reserves estimation, evaluation of resources, Timan-Pechora province*

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**INTEGRATED APPROACH TO OIL FIELD DEVELOPMENT AND  
FACILITIES CONSTRUCTION PLANNING**

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**Abstract.** Review of subsurface formation, wells and surface facilities as a whole, which is the main objective of integrated design approach, enables integration of oil field development processes and surface facilities construction to ensure field-wide operations management opportunity and maximum achievable production performances.

**Key words:** *integrated design, field development planning, field facilities construction planning.*

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## ASSESSMENT OF THE SOLVENT PREINJECTION IMPACT ON SAGD WELL START UP PARAMETERS

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**Abstract.** The article presents the results of a study of the solvent efficiency for start up of the steam assisted gravity drainage (SAGD) wells. There are results of an assessment of heavy oil/solvent mixture viscosity at their various concentrations based on the convection and diffusion processes of the mass transfer for the conditions that are typical for Ashalchinskoye heavy oil field development. The experimental data on a viscosity versus temperature dependence have been used. In addition, the developed methodology and the calculations are used for the comparative efficiency evaluation of various concentrations and different solvents for viscosity reduction of oil while start up of SAGD wells. The method has been tested when 2 different solvents were compared. Have been determined that the most significant decrease in specific viscosity for an estimated solvent occurs at low concentrations in the 0.05-0.1%. It is shown that taking into account diffusion time and a characteristic distance of the passage of diffusion processes technologically efficient concentration discussed in the article of solvents can take 0.01 to 0.02 pore volume swept by injected solvent. It is achievable in field conditions by injection of a solvent in one or two production casing volume of the horizontal well.

**Key words:** *heavy oil, solvents, diffusion, steam assisted gravity drainage, well start up*

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**THERMO-HYDRODYNAMIC RESEARCHES OF HORIZONTAL  
WELLS BASED ON MULTIDETECTIVE TECHNOLOGIES**

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**Abstract.** In this paper, a mathematical model of the thermohydrodynamic processes occurring in the oil reservoir and in the trunk of a horizontal well is constructed. On the basis of the theory of ill-posed problems, a numerical method is proposed for solving the inverse coefficient problem for determining the reservoir properties of an oil reservoir operated by a horizontal well. As the initial information, curves are taken of the temperature changes taken simultaneously by several deep instruments installed at different parts of the horizontal part of the wellbore.

According to the proposed method, the heterogeneity of the formation along the horizontal part of the wellbore is evaluated. This method was used to interpret temperature curves recorded in horizontal well No. 18326 RT.

**Key words:** *Horizontal well, pressure, temperature, permeability, multi-sensor technology, inverse problem*

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## **FLUID FLOW PATTERN TOWARDS HORIZONTAL WELLS**

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**Abstract.** Nowadays, horizontal completions (including horizontal wells, horizontal fractured wells and multilateral wells) are being extensively drilled throughout the world for the development of low-profit fields. Construction of these wells enables reduction of flow resistance, thus resulting in well productivity increase and costs reduction.

For selection of optimal well design with regard to reservoir characteristics, effective well operation and determination of reservoir flow properties, calculation methods for steady and unsteady liquid flow are required.

Few related papers have been published so far.

However, analytical methods for steady flow are suitable only for homogeneous beds with simple geometry and equal-length laterals.

Available approaches to pressure build up analysis allow to account for various lateral trajectories but FEA or semi-analytical methods are too labor-intensive for practical application.

Therefore, simple methods of productivity index determination and pressure transient test interpretation are proposed for horizontal completions.

These methods are based on the superposition of flow resistance for two plane problems. Trajectory of the laterals is simulated as a number of closely spaced vertical wells or nodes.

The suggested method allows determining the field of application and regularities for horizontal wells.

Dimensionless fluid-movement profile calculated from steady flow and superposition method for pressure build ups in the nodes are used for determination of pressure build up.

For description of build up in a node we recommend a diffusion equation in Laplace space and Stepest numerical algorithm. The problem is solved for porous and dual porosity reservoirs.

Numerical calculations show that cross-flows occur after the horizontal or multilateral well shutdown. Pressure derivative maximum suggests low effective length of the borehole or positive skin-effect. Knowledge of effective intervals length is critical to pressure curve interpretation.

***Key words:*** *horizontal well, multilateral well, productive index, trajectories of laterals, unsteady flow, determination of optimum length.*



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## RESULTS OF SOME STUDIES OF HYDRAULIC FRACTURING

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**Abstract.** Studies on geomechanical properties of carbonate rocks have been conducted with the aim to use them in hydraulic fracture design. Such parameters as rock hardness, spurt loss and filter cake resistance, hydraulic diffusivity, reaction rate, and activation energy have been determined. Hydraulic fracture conductivity loss has been analyzed at various net pressures. Unified acid fracturing design procedure has been worked out.

**Key words:** *hydraulic fracturing, rock hardness, fracturing fluid leak-off, proppant embedment, fracture conductivity, hydraulic diffusivity, reaction rate, activation energy, unified design, geomechanical properties*

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## SELECTIVE WELL INTERVENTIONS TO TARGET INDIVIDUAL INTERVALS OF HORIZONTAL WELLS

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**Abstract.** In TatNIPIneft Institute, research is underway on the development of the technology and hardware to provide control of oil and water flows in horizontal wells. These will enable fluid production from different intervals along the horizontal section and shutting-off high water-cut intervals without production interruptions; cyclic production from individual intervals; continuous monitoring of downhole pressures in each production interval.

**Key words:** *horizontal well; managed fluid production; flow control devices.*

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**VIBRATION PROBLEMS DURING OPERATION OF PUMPING  
(COMPRESSOR) EQUIPMENT AND AVAILABLE SOLUTIONS**

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**Abstract.** The paper reviews available vibration dampers for pumping and compressor equipment, identifies and analyses their advantages and disadvantages. In view of research findings, an idea of vibration protection system design with quasi-zero stiffness has been proposed based on elastic element, which moves between two guides of certain shape. Spring is considered as an elastic element.

**Key words:** *vibration damper, pumping unit, elastic element, design, frame, reliability, quasi-zero stiffness.*

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## ENERGY COOPERATION BETWEEN CHINA AND RUSSIA

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**Abstract.** Over the past 20 years, China's economic growth is associated with the expansion of the industrial sector with the resultant increase in energy demand. In 2003, the Peoples Republic of China ranked second in terms of energy consumption behind the United States and ahead of Japan [1].

Domestic fuel supplies are no longer sufficient to satisfy the rising demand of the industrial sector; hence, in 1993, China began to import crude petroleum. Major energy sources are coal and scarce domestic hydrocarbon resources, which cannot meet the local demand.

In 2014, China imported about 310 million tons of oil. By 2030, crude oil imports will rise by 80% [2].

China is now the second-largest importer of crude oil in the world after the United States. China's oil import dependence has reached 59% in 2013 while US import dependence does not exceed 46.3%.

Therefore, the development of energy relations with China will contribute significantly to the economic growth of China and oil exporting countries. Contemporary geopolitical environment will lead to substantial fluctuations in the number of oil exporting countries.

**Key words:** *cooperation, economy, energy strategy, oil and gas industry. Energy cooperation between China and Russia. Conclusion of contracts. China's energy strategy. Construction of Skovorodino-Daqing oil pipeline.*