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**RECENT DEVELOPMENT OF INFLOW CONTROL TECHNOLOGY
FOR HORIZONTAL WELLBORES**

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Abstract. Method and device for controlled inflow from horizontal wellbores can effectively be used for separate production of productive intervals with varying reservoir properties, as well as for commingled production. The system comprises inflow control valves (ICV), made as electric valves with temperature and pressure gauges, packers to isolate borehole space, and junction pipes. ICVs and gauges are connected with the analysis hardware (surface computers). The system comprises also an insert pump installed upstream ICVs to lift well production to surface. The technology provides for injection of treatment fluids through valves.

Key words: *horizontal wellbore; controlled inflow; ICV.*

ON MECHANISM OF GAS SHOWING DURING WOC

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Abstract. The article discusses possible ways of gas showings and mechanism responsible for channelling. One of the common reasons behind this mechanism is decrease of hydrostatic pressure during cement setting. Because of cement slurry gelation, bottomhole pressure decreases to the level of the hydrostatic pressure of the column of water contained in the pores of thickening and setting slurry, not infrequently, below reservoir pressure.

The gas showings problem could possibly be solved through application of gas blocking agents, which are able to form a gastight seal during cement setting period.

To investigate the mechanism of gas showings during the waiting on cement (WOC) period, an experimental setup was designed. Experiments were performed with cement slurries treated with different agents. Decrease of hydrostatic slurry pressure during WOC was studied; also, gas showings at initial in-situ pressure below hydrostatic slurry pressure were simulated.

The results obtained made it possible to establish the relationship between the kinetics of gelation and decrease of hydrostatic slurry pressure, on the one hand, and the likelihood of gas showings, on the other hand. This evidence can be used to work out an effective methodology for assessment of gas blocking agents.

The best performance was demonstrated by polymeric electrolyte VPK-402. It was able to prevent gas channelling, did not affect strength characteristics of the cement sheath, neither did it affect cement setting time. EXR and CFL-117 agents showed moderate results. The relationship between the change in gel

strength of cement slurry after 10 seconds and 10 minutes and the effectiveness of prevention of gas showings during WOC has not been confirmed.

Key words: *gas showings; waiting on cement (WOC); hydrostatic pressure; reservoir pressure; slurry gelation; gas blocking agents.*

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USE OF PETROCHEMICAL WASTES TO PRODUCE DRILLING CHEMICALS

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Abstract. Chemically, drilling agents are complex organic compounds based on polymer matrix which can be modified to provide specified properties of drilling chemicals. Multivalent metal (iron, chromium, manganese) cations often serve as modifiers for lignosulfonate-matrix-based chemicals. These metal cations form soluble complex compounds exchangeable in drilling muds and setting on clay matrix. However, these exchanges rely on redox potential of lignosulfonate matrix, which varies greatly depending on raw material (wood) quality and ways of its delignification, i.e. acidic and neutral sulfite pulping, alkaline pulping, etc. This paper discusses applicability of sulfur-containing petrochemical wastes (sulfite-alkaline effluents and elemental sulfur) to improve reducing capacity of lignosulfonate, with phenylpropane unit as its structural component.

Electrochemical and spectrophotometric methods showed that use of sulfur compounds with various rates of oxidation provides production of new high quality drilling chemicals comparable to their domestic equivalent – ferrochrome lignosulfonate. Moreover, these new drilling chemicals have some competitive advantages. For example, toxic anionic chrome compounds were reduced from 4 to 1.3 wt. fr. Degree of anionic chrome III reduction to generate chrome cation reaches 89%, which promotes complex compounds reactions. In addition, sulfur-chrome-lignosulfonate drilling agents provide reduction of production costs due to elimination of ferric sulfate from the process flow and reduced amount of expensive sodium dichromate, as well as they feature stability over time with no fermentation typical of lignosulfonate agents.

Key words: *lignosulfonate; complexing ability; sulfur-containing wastes; optical density; bathochromic shift.*

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**NANOTECHNOLOGY FOR DRILLING APPLICATIONS: SELF-
ASSEMBLING MICELLAR SYSTEMS STABILIZE HIGH-SALINITY
BIOPOLYMER MUD**

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Abstract. The paper considers state-of-the-art technologies for stabilization of drilling muds. These are based on drilling mud treatment with oleophilic nanofluids capable of self-assembling into supramolecular structures. As demonstrated in the paper, micellar dispersions of ionophores may be used for this purpose. Mechanisms responsible for their stabilizing effects are revealed, test results are presented. The opportunity to obtain high-quality drilling mud system based on formation water, polysaccharide fluid-loss additive and adaptive lubricant is presented as having no disadvantages inherent to biopolymer solutions.

Key words: *biopolymer; biodegradation; bactericide; ionophore; supermolecule; molecular self-assembly; micellar dispersion*

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**RESERVOIR CHARACTERIZATION OF UV-1 PRODUCTIVE
FORMATION WITH DYNAMIC ANALYSIS OF SEISMIC WAVE
FIELD**

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Abstract. The Povkhovskoye field is the first field in Kogalym Region where operations have been performed to identify zones with near-vertical discontinuities which are deep-seated in the basement and cut across up-section to the Lower Cretaceous. Dynamic analysis of the seismic wave field identified from 3D seismic survey was carried out with derivation of 16 different attributes. Zones of intense fracturing and decompaction were identified related to various types of faults that are attributed to uplifted basement fault blocks as well as not associated with such basement highs. The stratified wedge-shaped architecture of UV-1 reservoir was observed. The findings lead to new understanding of the Upper Jurassic formations and their productivity, and give grounds to review the approach to planning reservoir development and management, as well as selecting targeted production enhancement operations and exploration activities.

Key words: *zones of near-vertical discontinuities; seismic survey; UV-1 reservoir; faults*

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**HORIZONTAL DRILLING IMPROVES RESIDUAL RESERVES
RECOVERY FROM TERRIGENOUS DEVONIAN FORMATIONS**

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Abstract. The bulk of PJSC TATNEFT's crude oil output comes from large mature fields with 80% reserve depletion and 90% water cut. TATNEFT's oil production divisions have been operating oil fields in Tatarstan for several decades; however, a large amount of reserves still remain undiscovered. This prevents a long-term growth of oil sector due to limited active reserves.

Over the past decade, TATNEFT was able to maintain sustainable oil production due to incremental ultimate recovery from employing new technologies.

The authors tried to find the best development strategy for mature fields with the purpose of attaining the highest possible oil recovery factor and maximum production of residual reserves. This can be attained by drilling horizontal wells in a primary terrigenous productive formation of the Devonian age containing 62.1% of $A+B+C_1+C_2$ in-place reserves.

Key words: *oil field; reservoir; oil production rate; oil accumulation; horizontal well; hydraulic fracturing.*

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**DEVELOPMENT OF OIL RESERVOIRS
WITH NON-NEWTONIAN FLUIDS**

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Abstract. Special attention should be given to structural and mechanical properties of oils in oilfield development projects. Reservoirs containing oils that can be characterized as non-Newtonian fluids require an alternative formula to calculate oil recovery factor.

Key words: *structural and mechanical properties; oil recovery factor; non-Newtonian fluid; well spacing*

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**EFFICIENCY OF HEAVY OIL PRODUCTION BY IN-SITU
COMBUSTION BASED ON SIMULATION RESULTS**

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Abstract. CMG's STARS simulator was used to forecast heavy oil production from reservoirs with various characteristics by in-situ combustion which is initiated by air injection into the reservoir. The discussed reservoir characteristics include the reservoir depth, the initial reservoir pressure, the initial reservoir temperature, the initial in-situ oil viscosity. Simulation results show that reservoir characteristics affect the average temperature time history, as well as oil production data. Based on the simulation results, criteria for applying electric heaters during in-situ combustion initiation were identified in terms of various reservoir characteristics and oil viscosities.

Key words: *heavy oil reservoir; reservoir characteristics; STARS reservoir simulator; horizontal well; vertical well; in-situ combustion; initiation of in-situ combustion; air injection; oxidizing agent.*

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WATER SHUT-OFF WITH SODIUM POLYSILICATE SYSTEMS

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Abstract. This paper discusses application of interpolymer systems based on polydiallyldimethylammonium chloride (PDADMAC) and sodium polysilicate as water control agents in enhanced oil recovery projects. Coagulum resistance to various organic solvents has been investigated to evaluate strength and stability of water-diverting screens.

Penetration tests were conducted on sand-pack models to address the problem of water-control system coagulation in the bottom-hole area.

Key words: *Enhanced Oil Recovery (EOR); interpolymer system; water control agent; polymer; water shut-off.*

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**AN IMPROVED METHOD FOR THERMOCHEMICAL TREATMENT
OF OIL RESERVOIRS**

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Abstract. The primary recovery method for high-viscosity oil is thermal treatment of formation. In this paper, we present an improved modification of thermal-gas-chemical treatment technique. A distinctive feature of the presented technology is application of binary mixtures, namely niter plus sodium nitrate. This is a more advanced technique compared to conventional thermal-gas-chemical applications. In addition to a novel chemical composition, the technique uses the control system which enables managing reactant injection conditions as well the reaction of binary mixtures at well bottom.

Key words: *thermal-gas-chemical treatment; binary mixtures; EOR; control system, efficiency.*