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Contents

Effect of ethanol on saturated vapor pressure of individual hydrocarbons and development of a mathematical model for calculating saturated vapor pressure of E30 bioethanol fuel

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The results of determination of saturated vapor pressure (SVP) of blends of ethanol in 5-85 wt. % concentrations with various individual hydrocarbons are reported. Based on these results, a mathematical model has been developed to calculate the SVP of E30 bioethanol fuel. For calculating the SVP of bioethanol fuel by this model, only results of chromatographic determination of hydrocarbon composition of the fuel can be used.

Keywords: bioethanol, saturated vapor pressure, E30, mathematical model.

Synthesis and study of performance properties of a new superalkaline alkylphenol additive for motor oils

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A highly effective alkylphenol additive, V-7140, with alkali level of 400 mg KOH/g was synthesized to improve the performance properties of motor oils. It is shown that in functional and some physicochemical properties the V-7140 additive is superior to domestic commercial alkylphenol and its foreign analog ADX 410. The excellent functional properties of the additive stem from its high alkalinity and colloid stability as well as higher content of active matter.

Keywords: additive for motor oils, superalkaline alkylphenol, antisludging properties, antisooting properties, colloid stability.

Bimetallic Ni-Mo sulfide catalysts based on mesoporous aluminosilicate (Al-HMS) in shale oil hydrocracking

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Investigations of activity and selectivity of bimetallic Ni-Mo sulfide catalysts based on mesoporous aluminosilicate (Al-HMS) with Si/Al ratio of 5 in shale oil hydrocracking were conducted in a reactor with a fixed catalyst bed. The dependence of the activity and selectivity of the catalyst NiS-MoS2/Al-HMS (Si/Al = 5) on the temperature of the process was studied. It is shown that in the 330-400ºC range and under 5 MPa hydrogen pressure this catalyst facilitates conversion of heavy fraction of the shale oil to fuel fractions having high selectivity with respect to middle distillate and reduces sulfur content in liquid hydrocracking products by 78%.

Keywords: hydrocracking, hydrofining, mesoporous materials, shale oil.

Thermodynamic analysis of formation of c8 polymers in the process of isobutane alkylation by olefins

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The process and the results of thermodynamic analysis using thermobaric dependence and information model of C_8 polymers formation in the process of isobutene alkylation by olefins are presented. Based on the obtained experimental data, the probability of occurrence of reactions in the 1-3 MPa pressure range is calculated and analyzed. It is shown that no significant change in Gibbs energy occurs at pressures above 1 MPa.

Keywords: alkylation, isobutene, olefins, thermodynamic parameters, equilibrium constant, Gibbs energy.

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Modification of neutral sulfite liquors with production of lignosulfonate drilling reagents

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The composition of sodium lignosulfonates of various manufacturers is studied by IR spectroscopy and conductometric titration. The feasibility of modification of lignosulfonate of neutral sulfite cooking for getting drilling reagents with improved quality characteristics is determined by comparative analysis.

Keywords: neutral sulfite liquor, lignosulfonate, IR spectroscopy, conductometric titration, drilling fluid.

Study of feasibility of producing high-quality petroleum coke from heavy yarega oil

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The feasibility of producing high-quality acicular coke from heavy Yarega oil is studied. A scheme that involves deasphalting, hydrofining, delayed coking, demetallation, and thermal degradation or gasification is proposed for processing this oil. Also studied are the physicochemical properties and group hydrocarbon composition of the oil and the obtained heavy resid.

Keywords: heavy oil, Yarega oil, acicular coke, deasphalting, hydrofining, delayed coking, demetallation, gasification.

Increasing yield of light distillates by activation of oil stock

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It is shown that activation of oil by a rotary pulsation acoustic device that generates acoustic vibration in a wide range of acoustic frequencies, depending on the intensity of acoustic impact, can help increase the yield of gasoline fraction up to 10 wt. % of its potential content in the original oil stock. The mechanisms of change in physicochemical properties, fractional composition, and quality parameters (density, refractive index, octane and cetane number, etc.) of gasoline and diesel fractions recovered by distillation of activated oil, depending on the conditions of acoustic impact, are ascertained. The studies demonstrated the feasibility of implementation of alternative method of enhancing yield of light distillates through activation of oil stock by acoustic impact.
Keywords: activation of oil stock, rotary pulsation acoustic device, yield of light fractions.

Effect of group chemical composition of cerezines and waxes on their thermal and structural-mechanical properties

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The group chemical composition and thermal and physicomechanical properties of oil cerezines and waxes are studied. The decisive role of their normal hydrocarbon component as the strength bearer is established. A graphical relationship of melting points with molar mass is constructed for commercial samples of solid paraffin-containing oil products and separated hydrocarbons that form and do not form complex with carbamide. It is shown that the average molar mass and the melting point of oil paraffins and complex-forming hydrocarbons of cerezines and waxes correspond to very high-molecule, high-melting long-chain n-alkane of their primary fraction.
Keywords: oil cerezine, wax, paraffin, carbamide complex, structural-mechanical properties.

Procedure for Determining Rates of Generation and Growth of Microdroplets in Emulsion Formation Process

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The feasibility of application of approaches of the theory of formal analogy of processes with restructuring of the original system for the study of the dynamics of emulsion formation due to supersaturation relative to equilibrium concentrations in ternary solutions is examined. The rates of generation of conversion centers and the linear rates of growth of emulsion droplet radius are determined. The obtained data helped solve a number of theoretical problems of producing water-containing fuel emulsions.
Key words: emulsion, droplet generation rate, droplet growth rate, ternary system, supersaturation, formal analogy of processes.

Biodiesel improves lubricity of low-sulfur petro-diesels

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Biodiesel fuel is attracting interest as an alternative fuel as environmental pollution increases and fossil fuel supply diminishes. Biodiesel is not only cleaner that petro-diesel, but also has high degradability and excellent lubricity. Since biodiesel has a very low sulfur content (0.002 wt. %), it is environment-friendly. The effect of biodiesel additive in fuel system of diesel engine for reducing pollutant emission and wear characteristics is studied experimentally. The analysis was performed in two steps. First, the injection of biodiesel into the diesel engine channel was simulated. Second, tribological experiments were performed using ball-on-ring contact method. The wear scar diameters and wear surfaces of the tribopairs were then analyzed. The wear experiments showed that a small addition of biodiesel to pure petro-diesel reduces friction and wear under boundary lubrication considerably.

Keywords: biodiesel, diesel engine, additive, lubrication, wear.

Study of horizontal multi-stage fracturing method

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Horizontal well drilling technology has gained wide popularity in recent years, especially for developing low-porosity and low-permeability shale gas fields. In this paper, a 3D model is proposed for calculating process parameters based on the hypothesis of elliptic crack formation in the fracturing process. The effective pressure and stress distribution near the formed cracks can be determined by calculations by this model.

Keywords: horizontal well, fracturing, low permeability

Processing unconventional types of oil stock by gasification

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One of the problems of modern oil refining industry is associated with involvement of heavy high-viscosity oils and native asphalts in processing of unconventional oil stock. The flexibility of processing heavy oil stock, raising yield of light distillates, and improving their quality is achieved by combined use of thermal and catalytic processes. Gasification of oil residues is a promising process that allows production of synthesis gas suitable for getting synthetic oil, hydrogen, petrochemical products, electric power, or steam. The advantages of gasification are analyzed in this work. The existing technologies of heavy oil gasification and the main types of gas generators are examined.

Keywords: unconventional oil, heavy oil residue, gasification, gas generator, synthesis gas, shale.

Modeling and Simulation of Fluidized Bed and Freeboard in a FCCU Regenerator

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A model is proposed for the typical regenerator of a commercial fluid catalytic cracking unit (FCCU). It incorporates a fluid-dynamic model for a fluidized bed, taking account of three phases, namely, emulsion, wake-cloud, and bubbles, and is combined with a kinetic coke combustion model. The latter is complemented with a model for the afterburning phenomena that may occur in the freeboard. The whole model complex computes the extent to which the coke deposited on the catalyst is burnt out, the diameter and speed of ascent of bubbles, composition and temperature of the combustion gas (O2,, CO2,, CO, and H2O) at different heights of the fluidized bed and freeboard in the generator, and the temperature of the cyclones.

The regenerator model was implemented in Visual Basic to simulate the whole typical regenerator.

Keywords: FCCU, regenerator, catalytic cracking, fluidized bed, freeboard, modeling, simulation, afterburning, catalyst regeneration.

High-Temperature Slurry System for Dry Hot Rock

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Dry hot rock (DHR) is a kind of rock that has no water or steam and is embedded 2-6 km below the ground surface with temperatures ranging from 150 to 650ºC. The temperature of domestic DHR embedded 3.5-7 km below the ground ranges from 150 to 250ºC with a total energy of 6.3 ´ 1024 J, which was 1320 times the total energy consumption in China in 2010, assuming 2% of available exploration volume. Mixing of H2S, H2SO3, etc. in the steam and hot water of DHR well, may corrode the pipe materials and damage the well-stabilizing slurry easily. A high-temperature sulfur-corrosion-resisting slurry system incorporated with HTR200 (density 1.86 g/cm3, initial consistency 12 Bc, consistency time 252 min, water loss 32 ml in 30 min, bleeding rate1.20%, 1-day strength 34.4 MPa, 28-day strength 25.6 MPa) that meets all DHR well stabilization requirements has been developed.

Keywords: Dry hot rock, well stabilization, slurry.

Inflow Performance Relationship Equation for Damaged Well in Dissolved Gas Drive Reservoir

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Vogel introduced the inflow performance relationship (IPR) curve equation for solution gas drive well productivity prediction and Standing expanded Vogel's equation for damaged wells. But Standing's equation is not universally accepted, and some researchers point out that it yields incorrect results and is inconsistent with reservoir flow principles. In this paper, we show that the cause of the error in Standing's

equation is incorrect definition of flow efficiency. We propose a new productivity prediction equation for damaged well in solution gas drive reservoir, which conforms to the principles of reservoir flow and numerical simulation results.

Keywords: damaged well, Standing's equation, PIR curve, flow efficiency, productivity equation.

Effect of Surfactant on Structure of Disperse Systems of High-Viscosity Oils

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The results of studies of the effect of group and hydrocarbon composition of oils on their physicochemical properties and capacity to form cross-linked oil disperse systems (ODS) are reported. Pulsed nuclear magnetic resonance (NMR) method was used to determine the molecular mobility of the components of the dispersion medium and the disperse phase and to establish a correlation between the structural-dynamic, physicochemical, and rheological properties of the ODS. The degree of effect of surfactants on the change in mobility of the phases of the ODS and their rheological behavior is determined. It is shown that the processes of breakdown of associates of complex structural units of ODS in the presence of a surfactant occur in all oils and water-oil emulsions and their effect on the mobility of ODS increases with increase of initial degree of cross-linking of the ODS. The mechanism of the action of polyalkylbenzene resin (PABR) in the oil medium stems from the peculiarities of its structure, and addition of PABR enhances molecular mobility of the ODS components and alters their solvation, structural-mechanical, and adsorptive properties.

Keywords: heavy oil, oil disperse systems, rheological properties of oil, NMR.

Corrosion Inhibitors for Water-Glycol Based Cooling Systems

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The distinctive features of the process of corrosion of automobile cooling systems, which are comprised of a host of electrochemically diverse metals and alloys (copper, brass, solder, steel, cast iron, aluminum, etc.) operate at high temperatures and pressures and are also subjected to corrosion and cavitation. The most preferable corrosion inhibitors are determined by taking into account the mechanisms of corrosion in the cooling system for each type of metal.

Keywords: cooling fluid, cooling system, metal, corrosion inhibitor, protection.

Geothermal Transformation of Organic Matter in Supercritical Water with Magnetite and Coal Particles

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The mechanisms of conversion of high-viscosity oil in supercritical water in the presence of finely dispersed coal and magnetite are clarified. The experiments were conducted in a closed reactor under conditions that ensure transition of the aqueous phase to a supercritical fluid. The general mechanisms of change in component and group compositions are explained and the rheological properties of the original and transformed oil are studied. Degradation of the high-molecular part of the feedstock with formation of light hydrocarbons that were absent in the original oil is confirmed and significant decrease in viscosity of the transformed oil relative to the original one is proved.

Keywords: aquathermolysis, heavy oil, supercritical water, caustobiolth (combustible fossil), rheological curves.

Synergistic Blend Based on Glycol Ethers as Antiknock Additives to Motor Fuels

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The expediency and effectiveness of use of composite compositions for raising octane number of straight-run gasoline fraction are proved. It is shown that cellosolves and carbitols tested as oxygenate additives improves antiknock properties of narrow gasoline fraction selectively, depending on their fractional composition, and significantly raises octane umber of straight-run gasoline fraction. A synergistic blend of glycol ethers at determined optimal ratios can be used to get high-octane gasoline with an octane number not lower than 93, which is of interest as a high-octane component for compounding motor fuel. The low composite additive concentration (1 vol. %) in gasoline hardly exerts any influence on the change in basic performance properties of motor fuel and primarily on the fractional composition. Use of such an additive is more preferable than the existing antiknock additives for solving important economic, technological, and ecological aspects of use of motor fuels in modern automotive engines.

Keywords: gasoline fraction, knock resistance, antiknock additives, oxygenates, cellosolves, carbitols.

Pilot-Scale Tests of Polymerization Inhibitor on a Unit for Separating Heavy Fractions from Pyrogas

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The results of pilot-scale tests of Dewaxol 3002 thermal polymerization inhibitor at elevated working temperatures are reported. The reagent based on heterocyclic compounds and

aromatic amine was injected into the unit for separating heavy factions from pyrogas formed in EP-60 ethylene production process. It was found that the inhibitor is highly effective and it extends interservice life of water heaters clogged due to polymerization of heavy unsaturated components of the pyrogas.

Keywords: ethylene, pyrogas, thermal polymerization, polymerization inhibitors.

Influence of Physicochemical Properties of Highly Organized Oil Disperse Systems on Efficiency of Thermomechanical Dehydration Process

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The influence of water content in highly organized oil disperse systems (ODS) on the efficiency of evaporation of the water phase from water-hydrocarbon emulsion is studied. The dependence of the throughput of a pilot plant for thermomechanical dehydration of emulsions on the water content in the stock and mechanization of the process is studied for the first time.

Keywords: thermal dehydration of oil, oil disperse systems, oil emulsion.