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Модернизация насадочных ректификационных колонн с применением математической модели разделения многокомпонентной смеси

Решена научно-техническая задача математического моделирования и расчета разделения углеводородных смесей в промышленных колоннах с хаотичными и регулярными насадками. Многокомпонентный перенос вычисляется с применением матрицы объемных коэффициентов массопередачи, а обратное (продольное) перемешивание потоков пара и жидкости – с помощью числа Пекле с коэффициентом обратного перемешивания. Рассмотрена задача разработки вариантов модернизации колонны стабилизации нефтегазоконденсационной смеси на нефтеперерабатывающем предприятии. Представлены расчетные профили концентраций ключевых компонентов в смеси. Определена необходимая высота слоя насадки. После модернизации колонны новой насадкой обеспечен устойчивый режим работы установки в заданном интервале нагрузок и состава смеси. Также решена задача по проектированию двух промышленных колонн в технологической схеме выделения бензола из стабильного конденсата. В результате расчетов установлены режимные и конструктивные характеристики колонн с применением хаотичных металлических насадок «Инжехим-2012». Представлены результаты расчета материального баланса и дано сравнение с данными работы установки.

Ключевые слова: математическое моделирование, насадка, многокомпонентная смесь, ректификация, нефтяные фракции.

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Upgrading of Packed Distilation Column Using a Mathematical Model for a Multicomponent Mixture Separation

The scientific and technical problem of mathematical modeling and calculation of separation of hydrocarbon mixtures in industrial columns with chaotic and regular nozzles is solved. Multicomponent transfer is calculated using a matrix of volumetric mass transfer coefficients, and the reverse (longitudinal) mixing of steam and liquid flows by Pekle numbers with back-mixing coefficients. The task of developing options for upgrading the stabilization column of the oil and gas condensate mixture at an oil refinery is considered. Calculated profiles of concentrations of key components in the mixture are presented. The required height of the nozzle layer has been determined. After upgrading the column with a new nozzle, a stable mode of operation of the unit is provided in the specified range of loads and the composition of the mixture. We also solved the problem of designing two industrial columns in the technological scheme for the separation of benzene from stable condensate (gasoline fraction). As a result of calculations based on a mathematical model, the operating and structural characteristics of columns with the use of chaotic metal nozzles "Injekhim-2012"were established.

Key words: *mathematical modeling, nozzle, multicomponent mixture, rectification.*

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Улучшение трибологических свойств полимочевинных смазок
за счет применения функциональных присадок

Рассмотрено влияние противоизносных присадок на основе диалкилдитиофосфорной кислоты и молибден-содержащих модификаторов трения (А-22, А-23, А-24, ДФ-11, ПАФ-4, ТЭФ-3, АДТФ, ВНИИ НП-354) на трибологические характеристики полимочевинных пластичных смазок, приготовленных на нефтяных и синтетических маслах. Изучена зависимость трибологических свойств полимочевинных пластичных смазок от природы, концентрации присадки (1–3% мас.) и дисперсионной среды. Оценка противоизносных и противозадирных свойств осуществлялась тремя известными стандартизированными методиками: четырехшариковой машины трения ЧМТ-1, трибометра Бруггера, и четырехшариковой машины трения КТ-2.

Ключевые слова: пластичные смазки, полимочевинные смазки, добавки к смазкам, диалкилдитиофосфат цинка, диалкилдитиофосфат молибдена, диалкилфенилдитиофосфат цинка, трибология.

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Improvement of Polyurea Greases Tribotechnical Properties
Based on Different Dispersion Media with Different Additives

This work describes antifriction additives based on dialkyldithiophosphoric acid and molybdenum-containing friction modifiers and its influence on lubricating greases prepared with petroleum and synthetic oils tribological properties. The dependence of tribological properties of polyurea greases tribological properties on the nature, concentration of the additive (1–3 wt%) and the dispersion medium has been studied. Evaluation of antiwear and extreme pressure properties was carried out by three well-known standardized methods – FBW (four ball wear test system) and KT-2 and also using the Brugger tribometer.

Key words: *polyurea grease, solid additives, additives, zinc dialkyldithiophosphate, molybdenum dialkyldithiophosphate,*
zinc dialkylphenyldithiophosphate, tribology.

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Оценка эффективности действия функциональных присадок
в зимних дизельных топливах различного группового углеводородного состава

В работе исследован структурно-групповой состав трех базовых зимних дизельных топлив и рассмотрено его влияние на низкотемпературные и смазывающие свойства топлив. Показано, что высокое содержание насыщенных углеводородов, прежде всего, среднемолекулярных н-алканов, и аренов с большей долей замещения приводит к ухудшению низкотемпературных свойств. Снижение доли среднемолекулярных алканов и даже небольшое повышение содержания би- и полициклических ароматических углеводородов ухудшает смазывающие свойства топлива. Отмечено влияние компонентного состава дизельных топлив на эффективность действия противоизносной и депрессорно-диспергирующих присадкок. Исследование совместимости присадок разного функционального действия выявило, что противоизносная присадка на основе жирных кислот талового масла не влияет на работу депрессорно-диспергирующей присадки, в то время как совместное применение этих присадок несколько ухудшает смазывающие свойства, но не выводит данный показатель за рамки установленных нормативов.

Ключевые слова: базовое дизельное топливо, углеводородный состав топлива, депрессорно-диспергирующие присадки, предельная температура фильтруемости, температура застывания, противоизносная присадка, диаметр пятна износа, взаимовлияние присадок.

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Estimation of Efficiency of Functional Additives
in Winter Diesel Fuels of Different Hydrocarbon-Type Content

The paper reviews the structural and group composition of three basic winter diesel fuels and its influence on the low-temperature and lubricating properties of fuels. It is shown that a high content of saturated hydrocarbons, primarily medium-molecular n-alkanes, and arenes with a higher proportion of substitution leads to a deterioration of low-temperature properties. A decrease in the proportion of medium-molecular alkanes and even a slight increase in the content of bi - and polycyclic aromatic hydrocarbons impairs the lubricating properties of the fuel.
The influence of the component composition of diesel fuels on the effectiveness of anti-wear and depressor-dispersing additives was noted. The study of compatibility of additives of different functional actions revealed that the anti-wear additive based on fatty acids of tallow oil does not affect the activity of the depressant-dispersing additive, while the combined use of these additives slightly worsens the lubricating properties, but does not lead this indicator beyond the established standards.

Key words: *base diesel fuel, hydrocarbon composition of fuel, depressor-dispersing additives, cold filter plugging point, pour point temperature, wear scar diameter, mutual interference of additives.*

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Методологический комплекс исследования устойчивости
функционирования трубопроводных транспортных систем

В статье представлены исследования устойчивости функционирования трубопроводных систем обеспечения войск горючим. Дано определение условия устойчивости функционирования, рассмотрены условия его проявления на различных уровнях. Дана последовательность формирования научных основ устойчивости функционирования трубопроводных систем на методологическом уровне. Аргументирована сущность методологии исследования устойчивости функционирования различных трубопроводных систем нефтепродуктообеспечения.

Ключевые слова: трубопроводная система, методология исследования, устойчивость функционирования, характеристики качества системы, надежность, живучесть, критерии оценки.

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Methodological Complex of the Pipeline Transport System Stability Research

The circumstances causing increased interest in the study of pipeline systems operation stability for providing troops (forces) with fuel are given. The definition of the conditions for the operation stability is given, the conditions for its manifestation at various levels are considered. The sequence of the formation of the scientific foundations of the operation stability of pipeline systems at a methodological level is given. The essence of the methodology for studying the operation stability of various pipeline systems of petroleum products supply is argued.

Key words: *pipeline system, research methodology, operation stability, system quality characteristics, reliability, survivability, evaluation criteria.*

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Прогнозирование испаряемости моторных топлив в условиях длительного хранения

Изложены элементы методики прогнозирования испаряемости моторных топлив применительно к условиям длительного хранения, которая основана на физическом и статистическом моделировании процесса испарения топлива подобного реальному в средствах хранения. Новая методика позволяет оперативно с незначительными затратами ресурсов получать прогнозные оценки, необходимые для принятия обоснованных решений на закладку топлив на длительное хранение. Приведены примеры прогнозирования уровня испаряемости моторных топлив, подтверждающие преимущества предлагаемой методики.

Ключевые слова: моторные топлива, автомобильный бензин, испаряемость, процесс испарения, моделирование, прогнозирование, хранение топлива.

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Motor Fuels Evaporability Forecasting under Conditions of Storage

Elements of method of motor fuels evaporability forecasting under conditions of longterm storage is proposed. Method is based on physical and statistical modelling of fuels evaporation process that is similar to the process in storage tanks. New method allows for improved predictive estimates that is needed for decisions on fuels longterm storage to be taken quickly and with negligible expenditures of resources. Some examples of motor fuels evaporability forecasting that confirm the of the method are provided.
Key words: *motor fuels, automobile gasoline, evaporability, evaporation process, modeling, forecasting, fuel storage.*

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Новые методы атомно-абсорбционного определения содержания металлов
в авиационном и автомобильном бензинах

Разработаны методы прямого пламенного атомно-абсорбционного определения содержания свинца как компонента штатных антидетонаторов в авиационном и лития как компонента альтернативных антидетонаторов в автомобильном бензинах в диапазоне концентраций 120–1700 (свинец) и 2,5/0,25–100 (литий) мг/дм^3. Соответствие условий атомизации растворов проб и градуировочных растворов, а также устранение влияния матрицы анализируемых проб на результаты определений достигается адекватным разбавлением проб и вовлечением в состав растворов сравнения и градуировочных растворов аликвот растворов-имитаторов состава бензинов, приготовляемых из индивидуальных углеводородов высокой чистоты. Методы характеризуются высокой прецизионностью, простотой в исполнении и могут быть рекомендованы для осуществления контроля качества и идентификации бензинов.
Ключевые слова: бензин авиационный, бензин автомобильный, антидетонационные присадки, тетраэтилсвинец, карбоксилаты лития, атомно-абсорбционная спектрометрия, матричные влияния.

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New Atomic Absorption Methods for Metals Determination
in Aviation and Automotive Gasoline

New methods for direct atomic absorption determination of lead and lithium as antiknock additives components in aviation and automotive gasoline in the concentration ranges 100–1700 (Pb) and 2.5/0.25–100 (Li) mg/L have been developed. To overcome the difference in analytical signals for samples and standard solutions due to concentration values and matrix effects the proper sample dilution and the addition of the blank as pure reagent hydrocarbons mixture in the solutions have been offered. The methods have high precision, are simple and may be recommended for gasoline quality control and identification procedures.
Key words: *aviation gasoline, automotive gasoline, antiknock additives, tetraethyl lead, lithium carboxylates, atomic absorption spectrometry, matrix effects.*

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Применение электрометрического метода для определения содержания свободной воды в топливах для реактивных двигателей

Приведен анализ недостатков средств контроля чистоты топлив для реактивных двигателей. Представлены теоретические и экспериментальные исследования зависимости нагруженной добротности цилиндрического объемного резонатора от объема помещенной в него воды, на основании которых предложен метод определения концентрации свободной воды в топливах для реактивных двигателей прямым электрометрическим методом с использованием СВЧ-резонатора.

Ключевые слова: свободная вода в топливе для реактивных двигателей,
СВЧ-резонатор, нагруженная добротность.

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Application of the Electrometric Method for Determining the Free Water Content in Jet Fuels

The article provides an analysis of the deficiencies of fuel purity control tools for jet engines currently in use. It presents theoretical and experimental studies of the dependence of the loaded quality of a cylindrical cavity resonator on the volume of water placed in it, on the basis of which a method of determining the concentration of free water in jet fuels by the direct electrometric method using a microwave resonator is proposed.

Key words: *free water of jet fuel, microwave resonator, loaded quality.*

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Об эволюции нормативных требований к реологическим характеристикам дорожных вяжущих в России

В статье дан краткий анализ истории нормирования основополагающих критериев оценки качества дорожных битумных материалов в России за последние десятилетия. Основное внимание уделяется реологическим характеристикам битумов, определяющих долговечность асфальтобетонных покрытий, в которых вяжущее «работает» в плёночном состоянии и сложных климатических условиях. Это позволяет аргументированно определить направления дальнейших исследований по повышению качества дорожных вяжущих. Подчеркнута актуальность и целесообразность разработок по созданию премиальных марок полимербитумных вяжущих и внедрению технологий стабильного производства на НПЗ рядовых вяжущих

из сырья различного генезиса. Отмечена перспективная целесообразность в организации производства вяжущих по системе Superpave.

Ключевые слова: реологические свойств, асфальтобетонная смесь, полимерно-битумные вяжущие, эластичность, программа Superpave, компаундированные битумы, технология смешения окисленного и прямогонного компонентов.

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On the Evolution of Regulatory Requirements for the Rheological Characteristics Of Road Binders in Russian Federation

This review article provides a brief analysis of the history of the regulation of the fundamental criteria for assessing the quality of road bitumen materials in the Russian Federation over the past decades. With an emphasis on their rheological characteristics, which determine the durability of asphalt concrete pavements, in which the binder "works" in a film state. This allows researchers to reasonably determine the directions for further research to improve the quality of road binders. Special attention is paid to the relevance and expediency of developments for the creation of premium grades of polymer bitumen binders and the introduction of technologies for stable production at refineries of ordinary binders from raw materials of various genesis. The immediate need for organizing the production of binders according to the SuperPave system was also noted.

Key words: *rheological properties, asphalt concrete mixture, polymer-bitumen binders, elasticity, Superpave program, compounded bitumen, technology of mixing oxidized and straight-run components.*

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Нефтегазохимия в России:
состояние, проблемы, перспективы развития

В статье рассмотрен уровень развития в России нефтегазохимической промышленности, сравнение его с показателями развитых стран. Приведены ассортимент и объемы производства нефтегазохимической продукции, производимой различными нефтяными, газовыми и нефтегазохимическими компаниями России. Проведен анализ проблем развития нефтегазохимии в России. Обсуждаются перспективы развития нефтегазохимии в России.

Ключевые слова: нефтегазохимия, высокая добавленная стоимость, пиролиз, полимеры, пластик, каучук.

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Oil and Gas Chemistry in Russia:
State, Problems, Development Prospects

The article considers the level of development of the petrochemical industry in Russia, the range of products, and the volume of its production. Petrochemical product range manufactured by various oil, gas and petrochemical companies in Russia is described. The analysis of problems in the Russian petrochemical industry, a comparison of its range and production volumes with indicators of developed countries is carried out. The prospects for the development of petrochemical chemistry in Russia were discussed.
Key words: *petrochemical industry, high added value, pyrolysis, polymers, plastics, rubbers.*

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The Effectiveness of the Copolymer of Polymethylmethacrylate and Styrene as a Plugging Agent in Water-Based Drilling Fluids

In the development of shale gas, it is important to ensure the stability of the borehole wall. The good plugging ability of the drilling fluid is the basis for the stability of the borehole wall, and the plugging agent is the basic guarantee for the good plugging ability of the drilling fluid. The traditional drilling fluid plugging agent has a large volume, and it is difficult to effectively plug shale micro-pores and micro-cracks. In this work, the PMMA-St copolymer was synthesized by emulsion polymerization with methyl methacrylate and styrene. The PMMA-St copolymer was characterized by FT-IR, TGA, and phase analysis optical scanning. The results show that the particle size of PMMA-St nanoparticles ranged from 34-58 nm and the average diameter is about 40.6nm.The decomposition temperature of PMMA-St nanoparticles is 374.8°C, which indicates that they have good heat resistance. The PMMA-St nanoparticles have little effect on the rheological properties of water-based drilling fluids. The plugging performance of PMMA-St nanoparticles was evaluated by simulating the mud cake. The permeability of mud cake is 2.24×10^{-5} m^2, which is close to the permeability of shale formation. When 0.5wt % of PMMA-St nanoparticles were added to the solution, the blocking rate was 70.27%.With the increase of PMMA-St nanoparticle concentration, the blocking rate of mud cake increases. When the dose of PMMA-St nanoparticles is 1%, the blocking effect is excellent. The simulation results of the core and the mud cake simulation experiment are consistent, which shows that the PMMA-St has an excellent sealing effect. Therefore, the PMMA-St nanoparticles can be used as an excellent nanoparticle plugging agent to deal with shale borehole instability.

Keywords: nano plugging agent, PMMA-St copolymer, mud cake, plugging performance.

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The Blocking Properties of Styrene-Styrene Sulfonic Acid Sodium Copolymer as a Nanodispersing Agent in Water Based Drilling Fluids

Nano plugging materials are used in the drilling fluid system to seal nanopores and cracks in the shale formation, which is a focus for developing shale gas. In this work, the St-NaSS copolymer as nano plugging particles were synthesized by emulsion polymerization with styrene and styrene sulfonic sodium. The St-NaSS copolymer was has been characterized by FT-IR, TGA and phase analysis light scanning. The results show that the grain size of St-NaSS nanoparticles is between 37-50 nm, and the average diameter is about 43.2 nm. The decomposition temperature of St-NaSS nanoparticles is 410.7°C, indicate it has a good temperature resistance. St-NaSS nanoparticles have little effect on the rheological properties of the water-based drilling fluid. The plugging performance of St-NaSS nanoparticles was evaluated by mud cake simulated. The permeability of mud cake is 3.32×10^{-5} μm^2, which is close to the permeability of shale formation. When 0.5wt% of St-NaSS nanoparticles was added in the solution, the plugging rate was 88.93%. The plugging rate of mud cake increase with the increasing of the concentration of St-NaSS nanoparticles. When the dosage of St-NaSS nanoparticles is 1.0%, the plugging effect obtains excellent results. Therefore, St-NaSS nanoparticles can be applied as a kind of excellent nano plugging agent to deal with the shale borehole instability.

Keywords: nano plugging agent, styrene-styrene sulfonic sodium copolymer, mud cake, plugging performance.

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A Design Model of Target-Hitting Trajectory Drilled into the Reservoir with Elliptical Truncated Cone Surface

The location and orientation of target-hitting point on the reservoir surface significantly affects the well productivity and wellbore stability. Thus, before actual drilling, the optimal location and direction of the well trajectory entering the reservoir should be determined by reservoir numerical simulation method. However, the target-hitting surface between the reservoir and wellbore is generally assumed to be a plane on which the coordinates and direction vector of the actual landing point, as well as the off-target distance are calculated. Compared with the curved target-hitting surface model, the planar target-hitting surface model cannot take the actual reservoir shape into account, which affects the location and direction of the well trajectory entering the reservoir. The inaccurate landing due to the inaccuracy of target-hitting surface model will increase the operational and economic challenges in drilling. This paper proposes a mathematical formulation for target-hitting trajectory design in the case of nonplanar target-hitting surface. First, the elliptical truncated cone surface is assumed to be the target-hitting surface due to its complex and diverse shape. Second, the geometric model of wellbore trajectory and elliptical truncated cone surface is carried out by vector algebra method. Thirdly, the target-hitting trajectory design model is established and the model is solved by genetic algorithm. Finally, the case studies is performed, and the off-target distance designed by horizontal circular

target-hitting surface model, horizontal elliptical target-hitting surface model and our model are compared. The case stud indicate that the results designed by the model established in this paper is more accurate than other models in case the target-hitting point locate on the reservoir with elliptical truncated cone surface. The model in this paper provides a theoretical guidance for the target-hitting trajectory design for nonplanar surface reservoir.
Keywords: target-hitting trajectory design, directional drilling, vector algebra, genetic algorithm, nonplanar surface reservoir.

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Optimization of Criterion for Rock Crack Propagation under Acidizing Treatment

Since most of the conventional oil and gas resources have been intensively investigated, uncon-ventional oil and gas resources such as deep marine carbonate reservoirs and heavy oil have become the primary focus in the exploration and development of oil and gas. The oil and gas reservoirs with complex fracture geometries account for nearly 45% of the global oil and gas reserves, and the pro-duction of such complex fractured oil and gas accounts for nearly 60% of the total natural gas pro-duction. Consequently, fractured oil and gas reservoirs have received considerable research attention in recent years. Further, fractures are crucial to determine the permeability and productivity of petroliferous reservoirs. This paper investigates the current status of rock research under the action of acid etching. At the same time we summarize the existing rock fracture propagation criterion theory and crack propaga-tion criterion, and selects the most common crack propagation criterion for simulation parameter set-ting. Subsequently, the Brazilian split test and the rock acidification sensitivity experiment are com-bined, and the comparative experiment method is used to obtain the hydrochloric acid concentration and acidification treatment time that can meet the DIC optical experiment. Through DIC technolo-gy, the expansion of rock cracks from the beginning of the loading of the experimental species to the completion of the splitting is recorded, the strain and displacement of each point on the rock surface during the Brazilian splitting test are obtained. Finally, through the ABAQUS software, different fracture propagation criteria are used to simulate the fracture process of the rock samples of the Bra-zilian fracturing experiment, and the results are output, and the expansion model that best fits the carbonate fracture before and after acid etching is selected. In this study, the in-situ stress field of the fault zone in the Shunbei area is exceedingly complex. Based on the Shunbei area, the model is set up. Furthermore, the features of plane geomechanics are studied and the fracture propagation laws of acid salt reaction are analyzed which provide the basis for optimizing acid fracturing tech-nology and construction parameters in Shunbei area.
Keywords: Brazilian test, Fracture propagation criterion, Mohr-Coulomb criterion, Drucker-Prager criterion, numerical simulation, acid etching.

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Research on Production Pattern Optimization of Intermittent Wells

The article is devoted to tight sandstone gas reservoir with poor physical properties. One of such gas reservoir is Sulige gas field. The number of low productivity and low efficiency wells increases every year, intermittent production provides the way to maintain production of those wells. However, there are great differences in the classification of intermittent wells and the production pattern, which is not conducive to the standardized management of gas wells. Therefore, according to the geological characteristics of intermittent wells, as well as the production performance, the intermittent wells were classified into three types: natural decline type (ND), poor reservoir physical property type (PRPP) and liquid loading type (LL). Furthermore, the charts of optimal shut-in time for different types of intermittent wells were established by analyzing the relationships among the shut-in time, the pressure recovery degree, and the gas productivity growth rate. Finally, research results would reveal the reasonable and optimal shut-in time in a well according to the optimal shut-in time chart, which provide the way to production pattern optimization of the intermittent well in Sulige gas field.

Keywords: gas field, stripper well, intermittent production, pressure recovery rate, productivity growth rate.

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Modelling Industrial Catalytic Reforming of Low-Octane Gasoline

Naphtha reforming is one of the most important industrial processes in refineries in which reformate as high octane additive to gasoline and aromatic hydrocarbons - benzene, toluene and xylenes are produced. It is necessary to create new naphtha reforming units to increase the efficiency of the processes. In this work a mathematical model of catalytic reforming of low-octane gasoline fractions into high-octane fractions for commercial gasoline based on the kinetic equations is described in case of industrial-scale conditions at the first time. The equations describe the dependence of the content of paraffinic, naphthenic and aromatic hydrocarbon fractions obtained in the presence of the platinum-rhenium catalyst on γ-Al_2O_3 upon process parameters (volumetric feedstock rate, temperature). The mathematical model had been validated by comparing calculated results with the industrial data obtained from commercial naphtha reforming reactor.

Keywords: reforming, mathematical modelling, reformed gasoline, catalysts, kinetic equation, kinetic model, activation energy, fuel fractions, octane number.

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A Study on Characteristics of Unsaturated Sandy Soils Based on the CT Scanning Method

In the hydrologic cycle, sandy soil is an important junction of surface water and groundwater, especially in arid areas which is lack of water. Therefore, it is meaningful to study the soil water in the unsaturated zone for water soil conservation and ecological environment protection. At present, in the field of soil physics, CT scan is used to study the soil hydraulic properties that is in a blank state. Applying industrial CT high-resolution instruments to do a quantitative research about the microstructure of porous media and fluid motion law has become a new research direction in the field of materials science. Basing on the latest industrial CT scan instrument called XTH225ST, this study scans the five samples of sand (quartz sand, CUGB coarse sand) to focus on the soil microstructure. This test uses the VG - Studio and Image J software to handle the image data. The software can identify the solid particles, water and air, and analyze particle size distribution and moisture content of cross sections. Contrasting four quartz sand sections, it can be concluded that the optimal particle size is 1 to 2 mm under CT scan. According to the quantitative analysis of the porosity, with the decreasing particle size, the same soil's total porosity also will increase. Using the artificial recognition and VG - Studio software's transferring phenomenon module handle the CT scan image, and we can have a conclusion that for the different particle size of sand column, the size of the average pore diameter also increases with the increase of particle size in the same other conditions. The research select 1-2 mm CUGB coarse sand to do the moisture absorption and emancipation experiment. When it reached the stability, we can get the unsaturated characteristic curve of soil moisture by CT scanning analysis. Because of the existence of the lag phenomenon, the characteristic curve of soil moisture will be a "circle".3D distribution of capillary water in the sand column is complex, and its winding path likes many "worms" creeping in the soil. The method of CT scan can skip over the traditional experiment, and directly find out the relationship between moisture content and matrix suction called characteristic curve of soil moisture. Furthermore, it can improve the efficiency. And it provides a new way of getting the water distribution characteristics of unsaturated soil.

Key words: CT scans, capillary water, porosity, characteristic curveof soil moisture.

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The Surge and Swab Pressure Calculation Considering Casing Coupling

The control of surge and swab pressure is an important guarantee to realize the safety, cost saving and high efficiency of well control operation, so the calculation of surge and swab pressure is very important. If the drilling speed is not properly handled, there will be surge and swab pressure and well loss during the drilling process. Similarly, there will be blowout during the drilling process. In order to avoid the occurrence of complicated downhole conditions in the drilling process, the surge and swab pressure should be calculated accuracy. This paper considered the effect of

casing coupling when calculated the surge and swab pressure, and using a case to shows that when considering the impact of coupling, the calculated surge and swab pressure value is higher than ignoring the coupling. Therefore, neglecting the impact of coupling could cause a large error when calculating the surge and swab pressure.
Keywords: surge and swab pressure, coupling, casing, closed pipe.

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Experimental Study on Enhancing Wellbore Stability of Coal Measures Formation with Surfactant Drilling Fluid

The development of self-cleavage of coal and rock leads to poor continuity, and a high degree of heterogeneity of coal-rock matrix, which leads to the problem of wellbore stability in the drilling process of coal measures strata has become one of the key scientific problems to be solved urgently. For this reason, the single-agent selection and compounding tests of surfactants were carried out, and the surfactant compounding scheme which can effectively reduce the surface tension of drilling fluid and increase the contact angle between drilling fluid and coal and rock was selected. Combined with the basic performance test of water-based drilling fluid, expansibility test, rolling recovery test and shale pressure transfer test, the effect of drilling fluid wettability on wellbore stability of coal measures strata is evaluated. The results show that the composite surfactant can effectively reduce the surface tension of drilling fluid by 80.83% and increase the contact angle with coal by 54.17%. The recovery rate in composite surfactant water-based drilling fluid is as high as 96.2%. The compound surfactant drilling fluid can significantly slow down the transfer rate of shale pore pressure, reduce the invasion degree of drilling fluid to coal and rock, prevent hydration erosion of coal and rock, and effectively enhance the stability of coal and rock sidewall.
Keywords: surface active agent, coal measures strata, drilling fluid, sidewall stability.

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Experimental Study on the Influence of Positive Electricity Glue Drilling Fluid on Shale Wellbore Stability

Due to the diversity and heterogeneity of shale composition, the surface of shale is negatively charged and contains clay minerals. It is prone to hydrolysis when exposed to water, which is not conducive to the stability of shale formations. Therefore, the formulation of the positive gel drilling fluid that can effectively reduce the surface tension of the drilling fluid and increase the contact angle between the drilling fluid and the shale was optimized, and the basic performance test, swellability test, and rolling recovery test of water-based drilling fluid were carried out. Studies have shown that: organic positive gel MMH-1 and inorganic positive gel MMH-2 can effectively reduce the electrical properties of shale water-based drilling fluid; drilling fluid with composite positive gel 0.6% MMH-1 + 1.5% MMH-2 The surface tension of the shale is reduced by 15.2%, and the composite positive adhesive increases the

contact angle of the shale by 22.1%; the temperature resistance of the drilling fluid B is good, and the rolling recovery rate is as high as 98.4%, which can more effectively enhance the stability of the shale formation.
Keywords: positive charge glue, shale, drilling fluid, stability, contact angle.

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Study on the Minimum Flow Pore Throat Radius and the Lower Limit of Petrophysical Properties of the Reservoir under Three Seepage States

Through the analysis of seepage capacity of reservoir and high pressure mercury intrusion porosimetry, the minimum flow pore throat radius and the lower limit of petrophysical properties under three seepage states include theoretical seepage, production seepage and filling seepage are studied. Results show that the minimum flow pore throat radius and lower limit of petrophysical properties of theoretical seepage are the lowest in the three seepage states. The minimum flow pore throat radius and lower limit of petrophysical properties of theoretical seepage can be used to distinguish between reservoir and non-reservoir. They can be used to distinguish between utilized reservoir and non-utilized reservoir under production seepage and to distinguish between oil-bearing reservoirs and non-oil-bearing reservoirs under filling seepage. It has reference significance for the identification of reservoirs and oil-bearing reservoirs and the study of reserves utilization degree.

Keywords: lower limit of petrophysical properties, determination method, minimum flow pore throat radius, seepage state, reservoir.