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О природе меркаптанов, содержащихся в прямогонных фракциях реактивного топлива

Показана зависимость содержания меркаптанов в прямогонном реактивном топливе от технологического режима колонны К-1 установки первичной переработки нефти. С повышением температуры низа колонны К-1 увеличивается количество разлагающихся нестойких сернистых соединений, при этом продукты разложения (меркаптаны и сероводород) удаляются с бензиновой фракцией в колонне К-1 и нестойкие сернистые соединения в меньшей степени попадают в колонну К-2, что снижает содержание меркаптанов в прямогонном керосине. Проведено сравнение содержания меркаптанов в узких фракциях нефти и прямогонного реактивного топлива. Показано, что их содержание в прямогонном реактивном топливе выше и они приходят как из нефти, так и вследствие разложения нестойких сернистых соединений, по-видимому, в первую очередь дисульфидов.

Ключевые слова: реактивное топливо, сернистые соединения, меркаптаны, первичная переработка нефти, термическое разложение

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Nature of Mercaptans Contained in Straight-Run Fractions of Jet Fuel

Dependence of mercaptans content in straight-run jet fuel on process mode of column K-1 of crude oil processing unit is shown. When temperature of column K-1 increases the quantity of decomposing unstable sulfuric compounds is also increased, while the decomposition products – mercaptans and hydrogen sulfide are removed with gasoline fraction in column K-1 and unstable sulfur compounds in a lesser degree are moved to column K-2, which decreases the mercaptans content in straight-run kerosene. The comparison of mercaptans content in closed fractions of oil and straight-run jet fuel is performed. It is shown that their content in straight-run jet fuel is higher, and they come both from oil and as a result of decomposition process of unstable sulfur compounds, more likely, disulfides in the first place.

Key words: *jet fuel, sulfur compounds, mercaptans, crude oil processing, thermal decomposition.*

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Получение водорода из тяжелого нефтяного сырья

В разных отраслях водород используется и как основное сырье, и как вспомогательный материал, и как топливо. Предприятия нефтепереработки и нефтехимии потребляют до 50% получаемого водорода. Предложен перспективный способ получения водорода, заключающийся в предварительном термолизе тяжелого нефтяного сырья с последующей каталитической конверсией парогазовых продуктов, который позволяет сократить затраты на производство водорода. Способ позволит увеличить глубину переработки сырья и расширить сырьевую базу НПЗ.

Ключевые слова: предреформинг, реформинг, пропанбутановая фракция, гексановая фракция, метан, топливный газ, водородосодержащий газ, короткоцикловая адсорбция.

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Production of Hydrogen from Heavy Petroleum Feedstock

In various industries, hydrogen is used both as the main raw material, and as an auxiliary material, and as a fuel. Oil refining and petrochemical enterprises consume up to 50% of the produced hydrogen. The authors proposed a promising method for producing hydrogen, which consists in the preliminary thermolysis of heavy oil feedstock, followed by catalytic conversion of gas-vapor products, which makes it possible to reduce the cost of hydrogen production. The method will increase the depth of processing of raw materials and expand the raw material base of the refinery.

Key words: preforming, reforming, propane-butane fraction, hexane fraction, methane, fuel gas, hydrogen containing gas, pressure swing adsorption.

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Оценка эффективности процесса одностадийной дегидроароматизации природного и попутного нефтяного газа

Для оценки эффективности процесса дегидроароматизации метана последовательно решены следующие задачи: разработана кинетическая модель дегидроароматизации метана и математическая модель промышленного аксиального реактора с фиксированным слоем катализатора, предложена технологическая схема и рассчитан ее материально-тепловой баланс. По результатам проведено сравнение показателей процесса дегидроароматизации метана с промышленными технологиями-аналогами получения водорода.

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Evaluation of One-Stage Natural and Oilwell Gas

Dehydroaromatization Efficiency

The following sequential problems were solved in article for methane dehydroaromatization feasibility validation: a methane dehydroaromatization kinetic model and a mathematical model of an industrial axial reactor with a fixed catalyst bed were developed, a process flow diagram was proposed, corresponded material and heat balances were calculated. Based on the results, methane dehydroaromatization performance was compared with related commercial hydrogen production technologies.

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Метод интегральной оценки уровня эксплуатационных свойств

горюче-смазочных материалов

Представлен простой расчетный метод прогнозной оценки уровня эксплуатационных свойств горюче-смазочных материалов (ГСМ), который позволяет выполнить многомерную «свертку» и затем сравнение всей количественной информации об эксплуатационных свойствах, полученной в ходе испытаний (применения) ГСМ и представленной в математических моделях химмотологических процессов, а также обеспечивает повышение объективности оценки результатов испытания и применения ГСМ. Приведены примеры, иллюстрирующие содержание нового метода применительно к оценке свойств дизельных топлив, автобензинов, гидравлических жидкостей.

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Method for Fuels and Lubricants Performance Properties Integral Evaluation

The simple calculation method for fuels and lubricants performance properties integral predictive evaluation is described. Method allows multidimensional convolution and comparison of all quantitative information about performance properties received during testing (exploitation in equipment) of fuels and lubricants and then represented in mathematical models of chemmotological processes. Method also allows to rise objectiveness of fuels and lubricants performance properties laboratory testing and evaluation during exploitation in equipment. Some

illustrations of application of proposed method with regards to diesel fuels, automotive gasoline and hydraulic fluids are provided.

Key words: *fuels and lubricants, integral evaluation, chemmotological process, modeling, informativeness, forecasting.*

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Получение 2-этилгексаноата никеля — прекурсора катализаторов крекинга тяжелого углеводородного сырья

В статье описан способ получения прекурсора наноразмерного катализатора каталитического крекинга прямогонного мазута, вакуумного газойля, тяжелых нефтей и тяжелых нефтяных остатков – 2-этилгексаноата никеля. Способ заключается во взаимодействии алифатической карбоновой кислоты с водным раствором аммиака, взятых в эквимолекулярном соотношении, в водной фазе при температуре 20–65°С в течение 20–60 мин с получением растворимой в воде аммонийной соли карбоновой кислоты на первой стадии. На второй стадии вводят водный раствор хлорида металла к раствору аммонийной соли карбоновой кислоты и проводят экстракцию образовавшейся соли металла алифатической карбоновой кислоты органическим растворителем. Выход 2-этилгексаноата никеля в зависимости от условий проведения реакции составляют 89–98%.

Ключевые слова: 2-этилгексаноат никеля, наноразмерный катализатор, получение наноразмерных катализаторов.

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Production of Nickel 2-Ethylhexanoate – a Precursor of Cracking Catalysts of Heavy Hydrocarbon Feedstock

This article describes a method for producing a precursor of a nanoscale catalyst for catalytic cracking of straight-run fuel oil, vacuum gas oil, heavy oils and heavy oil residues – nickel 2-ethylhexanoate. The method for obtaining nickel 2-ethylhexanoate salts consists in the interaction of an aliphatic carboxylic acid with an aqueous solution of ammonia, taken in an equimolecular ratio, in an aqueous phase at a temperature of 20–65°C for 20–60 min to obtain a water-soluble ammonium salt of a carboxylic acid in the first stage, introducing an aqueous solution of metal chloride to a solution of an ammonium salt of a carboxylic acid in the second stage, extracting the resulting metal salt of an aliphatic carboxylic acid with an organic solvent, characterized in that 2-ethylhexanoic acid is used as an aliphatic carboxylic acid, and as a metal chloride – nickel chloride, an organic solvent. The yields of nickel 2-ethylhexanoate, depending on the reaction conditions are 89-98%.

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Термографические исследования деасфальтизата в присутствии 2-этилгексаноатов цинка, никеля и железа

В работе представлены результаты термографических исследований деасфальтизата, полученного деасфальтизацией гудрона западносибирской нефти бутаном с добавлением 2-этилгексаноатов цинка, никеля и двухвалентного железа, а также без добавок. Установлено влияние металлсодержащих добавок на процесс потери массы и изменение величины тепловых потоков при термическом воздействии. Влияние на потерю массы образцов деасфальтизата, содержащих соли двухвалентного железа, при повышении температуры, существенно отличается от влияния таких добавок как соли цинка и никеля.

Ключевые слова: термографические исследования, деасфальтизат, деструкция, 2-этилгексаноат цинка, 2-этилгексаноат никеля, 2-этилгексаноат железа.

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Thermographic Studies of Deasphaltizate in the Presence of Zinc, Nickel, and Iron 2-Ethylhexanotes

The results of thermographic studies of the deasphalted oil obtained by deasphalting West Siberian oil tar with butane with the addition of zinc, nickel, and ferrous iron 2-ethylhexanoates, as well as without additives, are presented. The effect of metal-containing additives on the process of weight loss and the change in the magnitude of heat fluxes during thermal exposure has been established. The effect on the weight loss of samples of deasphalted oil containing salts of ferrous iron, with increasing temperature, differs significantly from the effect of such additives as zinc and nickel salts.

Key words: *thermographic studies, deasphalted oil, degradation, zinc 2-ethylhexanoate, nickel 2-ethylhexanoate, iron 2-ethylhexanoate.*

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Оптимизация состава ингибитора коррозии на основе имидазолинов для защиты оборудования в углекислотной и кислотной средах

В работе рассмотрены защитные свойства ингибитора коррозии на имидазолиновой основе с введением в его состав добавок тиомочевины и йодида калия. В качестве агрессивных сред выступали модель

пластовой воды, насыщенной углекислым газом, а также соляная и сульфаминовая кислоты. Эффективность ингибитора оценивалась гравиметрическим методом в динамических и статических условиях в углекислотной и кислотной средах соответственно. В результате эксперимента получены закономерности влияния индивидуальных соединений на механизм ингибирования металла в средах с различными свойствами.

Ключевые слова: углекислый газ, соляная кислота, сульфаминовая кислота, имидазолин, тиомочевина, йодид калия, скорость коррозии.

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**Optimization of the Composition of an Imidazoline-Based Corrosion Inhibitor
to Protect Equipment in Carbon Dioxide and Acidic Environments**

This study focuses on the protective properties of an imidazoline-based corrosion inhibitor with the introduction of thiourea and potassium iodide additives into its composition, depending on the nature of the environment. The aggressive environment was a model of reservoir water saturated with carbon dioxide, as well as hydrochloric and sulfamic acids. The effectiveness of the inhibitor was evaluated by gravimetric method under dynamic and static conditions in carbon dioxide and acidic environment, respectively. As a result of the experiment, regularities were obtained for the influence of individual compounds on the mechanism of metal inhibition in environment with different properties.

Key words: *carbon dioxide, hydrochloric acid, sulfamic acid, imidazoline, thiourea, potassium iodide, corrosion rate.*

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**Особенности разложения газовых гидратов
в присутствии метанола при атмосферном давлении**

Исследование процесса разложения газовых гидратов при атмосферном давлении и температурах ниже 0°C позволило выявить, что метанол может по-разному влиять на данный процесс в зависимости от его насыщения компонентами среды. За счет поглощения метанолом метана из гидрата начало разложения последнего наблюдается при более низких температурах. Тем не менее разложение протекает более заторможено по сравнению чистым гидратом метана. В случае, когда метанол, окружающий гидрат метана, насыщен другими компонентами среды, разложение гидрата происходит при равновесном значении температуры (при пересечении кривой гидрат–лед–газ в системе без добавок) независимо от концентрации спирта. С гидратом, полученным из метан-пропановой газовой смеси, наблюдается похожая ситуация, однако в условиях эксперимента лед начинает плавиться при более низкой температуре по сравнению с температурой разложения метан-пропанового гидрата (в случае гидрата метана ситуация обратная:

гидрат менее стабилен). При высокой концентрации метанола (выше 40% мас.) это приводит к значительному снижению температуры начала разложения гидрата. Полученные данные показывают, что метанол в низких дозировках (до 10% мас.) может быть использован для хранения и транспортировки газа, поскольку при определенных условиях не смещает равновесную кривую гидратообразования и замедляет процесс разложения гидрата метана.

Ключевые слова: газовые гидраты, метанол, хранение газа, лед.

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Peculiarities of Decomposition of Gas Hydrates in the Presence of Methanol at Atmospheric Pressure

The study of the decomposition process of gas hydrates at atmospheric pressure and temperatures below 0°C revealed that methanol could affect this process in different ways, depending on its saturation with environmental components. Indeed, due to the absorption of methane from the hydrate by methanol, the onset of its decomposition is observed at lower temperatures. Nevertheless, decomposition proceeds more slowly than with pure methane hydrate. When the methanol surrounding the methane hydrate is saturated with other medium components, the hydrate dissociation occurs at the equilibrium temperature (when intersecting the hydrate–ice–gas curve in a system without additives) regardless of the alcohol concentration. A similar situation is observed with hydrate obtained from a methane-propane gas mixture; however, under experimental conditions, ice begins to melt at a lower temperature compared to the dissociation point of methane-propane hydrate (in the case of methane hydrate, the situation is reversed: the hydrate is less stable). High concentrations of methanol (above 40 mass%) lead to a significant decrease in the temperature of hydrate decomposition. The data obtained show that methanol in low dosages (about 10 mass%) can be used for gas storage and transportation since, under certain conditions, it does not shift the equilibrium curve of hydrate formation and slows down the process of methane hydrate decomposition.

Key words: *gas hydrates, methanol, gas storage, ice.*

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Влияние низших спиртов на образование гидрата метана при температуре ниже точки плавления льда

В работе выявлено, что большинство водорастворимых соединений имеют двойственную природу (термодинамическое промотирование или ингибирование гидратов) в зависимости от термобарических условий. За счет понижения температуры плавления льда водорастворимые органические соединения расширяют область существования жидкой фазы, содержащей воду при температуре ниже 0°C. Рассмотрены такие типичные термодинамические ингибиторы гидратообразования как спирты (метанол,

этанол и изопропанол). *Установлено, что даже метанол не проявляет свойств ингибитора при температурах ниже линии кристаллизации льда и никак не влияет на равновесные условия образования гидрата метана. При этом наблюдаемое четырехфазное равновесие гидрат–лед–раствор–газ по температуре лежит либо на линии гидрат–лед–газ для системы вода – метан (в случае метанола), либо выше ее (в случае этанола и изопропанола). Это позволило предположить, что практически любые водорастворимые органические соединения будут либо проявлять свойства термодинамических промоторов в некотором диапазоне температур ниже 0°С, либо не будут влиять на равновесие гидрат–лед–газ. Помимо этого, наличие в системе смеси льда и водосодержащей жидкости ускоряет рост гидрата (по сравнению с ростом гидрата из объемной фазы льда). В отличие от традиционных термодинамических промоторов, в присутствии метанола происходит формирование гидрата метана кубической структуры I, которая является более выгодной по емкости газа. Полученные данные могут способствовать развитию гидратных технологий хранения газа и разделения газовых смесей.*

Ключевые слова: газовые гидраты, метан, низшие спирты, фазовые равновесия.

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Effect of Lower Alcohols on the Formation of Methane Hydrate
at Temperatures below the Melting Point of Ice

This work revealed that most water-soluble compounds have a dual nature (thermodynamic promotion or hydrate inhibition) depending on thermobaric conditions. Indeed, by lowering the melting point of ice, water-soluble organic compounds expand the region of water-containing liquid phase existence below 0°C. This work considered typical thermodynamic hydrate inhibitors as alcohols (methanol, ethanol, and isopropanol). It turned out that even methanol does not exhibit inhibitory properties below the ice crystallization line, and it does not affect the equilibrium conditions of methane hydrate formation. In this case, the observed four-phase hydrate-ice-solution-gas equilibrium either corresponds to the hydrate-ice-gas line for the water-methane system (in the case of methanol) or lies at higher temperatures (in the case of ethanol and isopropanol). This allowed us to assume that practically any water-soluble organic compounds will either exhibit the properties of thermodynamic hydrate promoters in a specific temperature range below 0°C or will not affect the hydrate-ice-gas equilibrium. In addition, the presence of the ice and an aqueous liquid mixture in the system accelerates the hydrate growth (compared to the hydrate growth from the bulk phase of ice). It should also be noted that, unlike conventional thermodynamic promoters, methanol does not alter the methane hydrate's structure and gas capacity, which is more favorable. The data obtained can contribute to developing hydrate-based technologies for gas storage and separation of gas mixtures.

Key words: *gas hydrates, methane, lower alcohols, phase equilibria.*

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**Исследование ингибирующей, смазочной и эмульгирующей способности продуктов
на основе сырья растительного происхождения для дальнейшего применения
в буровых растворах**

Исследована ингибирующая и эмульгирующая способность продуктов на основе сырья растительного происхождения и их производных для дальнейшего применения в буровых растворах. В работе использованы производные имидазолиниевых соединений на основе жирных кислот — отходы масложировой фракции (ОМФ) и сложные эфиры жирных кислот, полученные на основе ОМФ и различных спиртов C_4–C_{12}. Для изучения эмульгирующей способности ОМФ и ее производных были исследованы эмульсии и эмульсионные буровые растворы, где варьировалось содержание углеводородной фазы в диапазоне 15–81%, содержание эмульгатора и содержание глинопорошка.

Ключевые слова: буровой раствор, ингибитор набухания глин, ингибитор коррозии, коэффициент трения, эмульсия, растворы на углеводородной основе.

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**Research of Inhibitory, Lubricating and Emulsifying Ability of Products
Based on Raw Materials of Plant Origin for Further Use in Drilling Fluids**

In this work inhibiting and emulsifying ability of products based on raw materials of plant origin and their derivatives for further use in drilling fluids has been studied. Derivatives of imidazolinium compounds based on fatty acids — waste oil and fat fraction and fatty acid esters obtained on the basis of waste oil and fat fraction and various C_4–C_{12} alcohols have been studied. To study the emulsifying ability of waste oil and fat fraction and its derivatives different emulsions and emulsion drilling fluids were studied, where content of the hydrocarbon phase was varied in the range of 15–81%, content of the emulsifier and clay powder.

Key words: *drilling fluid, clay swelling inhibitor, corrosion inhibitor, coefficient of friction, emulsion, hydrocarbon-based solutions.*

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Теплопроводность нефтей при высоком давлении

Приведены результаты измерения коэффициента теплопроводности и относительного объема двух образцов нефтей при изменении давления до 1 ГПа при комнатной температуре. Показано, что зависимость теплопроводности от давления представляет собой линейную функцию, зависит от изотермической сжимаемости жидкости и всегда увеличивается при увеличении давления.

Ключевые слова: нефти, теплопроводность, относительный объем, высокое давление, метод нагретой нити, параметр Бриджмена.

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Thermal Conductivity of Crude Oils at High Pressure

The results of measuring the thermal conductivity and the relative volume of two samples of crude oils with a pressure change of up to 1 GPa at room temperature are presented. It is shown that the dependence of thermal conductivity on pressure is a linear function, depends on the isothermal compressibility of the liquid, and always increases with increasing pressure.

Key words: *crude oil, thermal conductivity, relative volume, high pressure, hot-wire method, Bridgman parameter.*

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Direction Optimization Model of Trenchless Horizontal Hole
in Fractured Formation

Whether the hole is in safe state is quite essential in the construction technology of trenchless directional horizontal hole. Many consequences caused by hole wall instability will seriously affect the normal construction of trenchless engineering. It is proved by theory and practice that when the underground excavation passes through the natural cracks in the stratum, the instability issue of the hole wall is serious. It is necessary to select mud with appropriate density to inject into the hole for auxiliary drilling, so as to ensure that no collapse or slurry leakage happens within the hole. In this paper, aiming at the trajectory optimization of trenchless horizontal well in fractured formation, a mechanical model is built, and the optimal drilling direction of horizontal well under specific working conditions is given with the help of programming calculation.

Keywords: *trenchless horizontal hole, hole safety, fractured formation, direction optimization.*

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In-situ Stress Determination in Anisotropic Formation Underground
with the Help of Wellbore Breakout Observations

The in-situ stress information underground is of crucial importance for drilling and reservoir development. As the cost of direct stress measurements is high and only limited information can be obtained, the application of wellbore imaging devices made it possible to interpret the local stress state more economical. Breakout azimuths revealed by

well logs are widely used to determine principal stress directions in traditional method, however strength anisotropic related to bedding planes may greatly affect breakout azimuth, width and depth, which can result in misleading for in-situ stress interpretations. Based on weak-plane borehole stability model and Mogi-Coulomb matrix strength criterion, we analyzed the relationship between in-situ stress and breakout geometry (azimuth, width and depth) both in isotropic and anisotropic formation. The results show that the azimuth of breakout is controlled by weak plane's azimuth, while steep dipping bedding plane widen the breakout and make it extending into rocks. For specific strata with determined property, breakout geometry will change regularly with the increase of the principal stress ratio. A breakout accident observed in well WFSD-2 help to illustrate the method and the magnitude of the maximum horizontal principal stress is determined.

Keywords: *well logs, in-situ stress; anisotropy formation, wellbore breakout.*

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Design of Oil Shale In-situ Extraction Heater Structure
and Numerical Simulation of the Fracturing Process

Downhole continuous spiral folded plate heaters that generate high temperature air to heat oil shale are an efficient method of in-situ oil shale extraction. In this paper, the physical model of downhole continuous spiral folded plate heater and the physical model of oil shale heating are established respectively, and Fluent software is used to numerically simulate the above physical model. The heat transfer characteristics, outlet temperature, and comprehensive performance of this heater under different mass flow rates and heating powers are studied, and the heater performance is analyzed by the above indexes. The heating parameters were used to heat the physical model of oil shale. The optimal working parameters were determined by heating time and cost, and the working parameters were used to heat the other four physical models of oil shale. The oil production rate, heating rate, and accumulated power consumption of oil shale were analyzed, and the results were analyzed. The results show that the continuous type spiral folded plate heater has the best performance with the operating parameters of 10 kW power and 0.01624 kg/s mass flow rate, and the model IV has the shortest heating time, the fastest oil yield, and the lowest cumulative power consumption.

Keywords: *oil shale, oil yield, numerical simulation, spiral-folded plate, cumulative power consumption.*

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Evaluation of Optimal Fungi Strains for Development
of Mycelium-Based Biopolymeric Matrices

Biopolymeric materials appear as promising eco-friendly and biodegradable matrices for the preparation of composite materials. In this work, G. lucidum, T. hirsuta, P. eryngii, F. velutipes, G. applanatum, L. edodes, H.

erinaceus fungi strains were studied and the fastest-growing fungi strains were revealed. The growth rate and the morphology of formed mycelium were studied depending on the fungi strain type and employed feeding substrate (malt agar, cellulose microcrystals, cellulose microfibrills). It was shown that the mycelium of G. lucidum and T. Hirsuta grown on cellulose microfibrils appears as intertwined hyphae with narrow diameter size distribution and has an optimal morphology as a substrate for the preparation of fibrous composite materials. .

Keywords: *fungal mycelium, fungi based-materials, mycelium-based materials, biopolymers, biopolymeric substrates, cellulose.*

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Study of Rock Damage Behavior Based on Configurational Mechanics

In the process of oil and gas drilling, under the action of mechanics, the wall rock will produce complex and high incidence of stress concentration, deformation, damage, cracking, fracture and other damage behaviors, resulting in the wall instability phenomenon. It may lead to complex accidents underground, resulting in huge economic losses. Therefore, it is of great theoretical and practical significance to grasp the failure behavior law of wellbore rock under mechanical action and study its failure mechanism. The early research on the instability and failure behavior of wellbore rocks was mainly based on the theory of fracture mechanics. Later, the theory of damage mechanics was introduced, which were all based on the theory of continuum. The development and change process of rock mechanical failure from small to large and from quantitative change to qualitative change caused by the accumulation of multiple defects in the internal microstructure of the rock can be described. This paper adopts the theory of configuration mechanics, which can well describe the complex microstructure and multi-defect evolution of materials such as inclusions, holes, dislocations, cracks, plastic flow, discontinuity, heterogeneity and anisotropy, and can be used to describe fracture mechanics. It provides a new idea for solving the complex defect problem.

Keywords: rock damage, configurational mechanics

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Research on Optimization of Water Quality Index System
for Low Permeability Reservoir Water Injection Development

In the process of water injection development of low permeability reservoirs, unreasonable water injection quality leads to the decrease of reservoir permeability, the increase of water injection pressure and the decrease of water absorption capacity. Taking the low permeability reservoir in Wenxi 3 area of Tuha oilfield as the research object, based on the basic characteristics of the reservoir, the single factor influence simulation experiment of solid particle

size, particle concentration, suspended dirty oil and bacteria in injected water on core permeability change was carried out by using the water quality adaptation degree method. The water quality index suitable for this block was preliminarily proposed, and the optimized water quality index was evaluated considering the influence of multiple factors. The results show that the damage rate of core permeability increases with the increase of solid particle size, particle concentration, suspended dirty oil and bacteria content of injected water, and the damage rate of lower permeability increases more obviously. Taking 20% core permeability damage rate as the standard, the water quality index of low permeability reservoir in Wenxi 3 area of Tuha oilfield is recommended: solid particle median □ 1.5 μm, particle concentration < 2 mg/L, oil content < 6 mg/L, SRB bacteria is 0/mL. The optimized water quality index can provide a reliable basis for the protection of oil and gas reservoirs and the water quality index of water injection in Tuha Oilfield, and also provide a reference for the formulation of water quality standards for water injection development in other similar blocks.

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Research of a Self-Adaptive High-Performance Re-Fracturing Technology with Knot Temporary Plugging in a Thin Reservoir with High Stress

The K1g1 reservoir in the Jiudong Basin has many small thin layers, with strong interlayer heterogeneity and significant interlayer stress difference in the longitudinal direction. A low pumping rate and a large section of general fracturing were adopted in the early stage. The stimulation effect was unsatisfactory, and the production decreased rapidly. Therefore, improving the degree of longitudinal transformation is the key to the next fracturing. However, Complex conditions limited the selection of the layered fracturing technology. For example, the repeated fracturing wells have been perforated in large sections, the combination casing completion method is used, and the pumping pressure is high. This research summarized the applicable conditions of layered fracturing technologies. Combined with the geological conditions of Jiudong's repeated fracturing wells, the temporary plugging layered fracturing technology is preferred. The temporary plugging agent is preferably the adaptive high-efficiency knot temporary plugging agent, and its degradation time experiment and ground plugging experiment are evaluated. The field application of adaptive high-efficiency knot temporary plugging re-fracturing technology was carried out in well C19-3. Based on three kinds of pressure rise performance during the fracturing process, it was judged that the fracturing obtained good temporary plugging and stratification effect. In addition, well C19-3 has achieved good production results after fracturing, which further verifies the applicability in the transformation of high-stress thin interbedded reservoirs in the Jiudong K1g1 reservoir. It provides ideas and references for the fracturing of similar thin interbedded reservoirs..

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Quantitative Study of Diagenesis and Dissolution Porosity

in Conglomerate Reservoirs

In order to clarify the diagenesis of the conglomerate reservoir in the Lower Wuerhe Formation in Mahu 1 well area, Junggar Basin, the reservoir in the study area was studied in detail on the basis of core observation, thin section identification and analysis data. The results show that the Lower Wuerhe Formation is a reservoir with low porosity and low permeability. The pore types are mainly residual intergranular pores, followed by dissolution pores, and occasionally structural fractures and microfractures. The reservoir physical property is closely related to the rock facies type, among which the fine conglomerate is the best, the small conglomerate is the second, and the middle conglomerate is the worst. The Lower Wuerhe Formation in the study area mainly experienced diagenesis such as compaction, cementation and dissolution. In the later stage of diagenesis, zeolite minerals were transformed and dissolved, and a large number of dissolution pores were formed, which had a positive effect on reservoir physical property and oil content. Through three solution pore porosity intersection method to establish evaluation model, and solution pore zeolites in the studied area development situation to carry on the quantitative evaluation, fine recognition, effectively guide the advantage dessert for reservoir evaluation and subsequent development provides new ideas and methods, as well as neighbors area and the development of other clastic rock area reservoir development for reference.

Keywords: *Mahu 1 well area, Upper Wuerhe Formation, conglomerate, dissolution pore.*

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Study on the Distribution Law of Casing External Load

in Deep Wells Considering the Cementing Quality Damage

In view of the difficulty of well cementation in Tarim oilfield, the complex environment of cement sheath, and the mechanism and law of the effect of cementing quality on casing loss are not well understood. In this paper, based on ABAQUS finite element software, a three-dimensional numerical simulation model of casing-cement sheath-strata considering the cementing quality is established. By simulating and analyzing the stress state of casing under different damage conditions of cement sheath, the influence mechanism of cementing quality on casing safety and reliability is revealed. It is found that the effective stress of casing under the condition of damaged cement sheath is significantly higher than that under the condition of intact cement sheath and intact cementation, and the risk of casing collapse is increased. The crack condition of cement sheath has little influence on the stress concentration of casing, while the lack of cement sheath and the lack of interface cause the stress concentration of casing to be larger. The influence

degree of cementing quality on casing external load from big to small is: the second interface missing, the first interface missing, cement sheath body missing, cement sheath crack.

Keywords: *cementing quality, casing load, effective stress, finite element.*

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Stability, Treatment, And Enhance Oil Recovery Ability

Of Fluorescent Preformed Gel CQDs@PPG, And Its Migration Status Study

The application of polymer gels in Enhance Oil Recovery has been developed for years. However, the methods of tracing and positioning them within the layers are lacking. The traditional tracers added into the treatment fluid would be affected by the size, potential, and viscosity differences with polymer gels. As a result, the monitoring results of the tracer and the actual movement of polymer gels are various. Therefore, by synthesizing fluorescent components with polymer gels, driving and tracking are integrated, which can play the role of a tracer while flooding. The stability of the fluorescent CQDs@PPG has been tested under reservoir conditions. The fluorescent peak value of CQDs@PPG would not be affected by swelling, salinity, pH, and temperature. Further, the CQDs@PPG has been used in a specific reservoir condition in east China to test its flooding and treatment ability. The plugging rate of the CQDs@PPG within 1000 mD porous media could reach 90% with a resistant factor Rf of 15 and a residual resistant factor Rff of 10. When applied CQDs@PPG into heterogeneous porous media, the Enhanced Oil Recovery achieved 25.33%. In addition, with the help of a fluorescence spectrophotometer, the concentration of CQDs@PPG in a different position is directly obtained. Finally, the plugging status of the CQDs@PPG has been studied, and the scanning electron microscope images show that it has elastic deformation properties.

Keywords: *preformed particle gel, carbon quantum dot, fluorescent polymer gel, EOR, profile modification.*

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Research on Quantification and Visualization of Fracturing Scale

Fracturing technology is one of the important technical means to ensure oil and gas production stability, and it is an important link for oil and gas exploration and development to accurately evaluate the fracturing effect. First of all, based on the logging curve formed by three-dimensional acoustic logging data, the best correlation logging curve is selected by using the corresponding relationship between logging curve and radial velocity profile; Then, the pre-evaluation curve of fracturing is constructed by using curve construction method to achieve the purpose of

pre-evaluation of fracturing effect. Furthermore, the results of two-dimensional radial velocity profile were integrally differentiated and the brittle fracture index was used as quantitative evaluation index to achieve quantitative analysis. Importantly, the bilinear interpolation method is used to interpolate the acoustic velocity logging data, and the point cloud model is established by Mesh mode to achieve three-dimensional visualization of fracture scale. Finally, an application example shows that the pre-evaluation curve constructed in this paper has a good indication for fracturing effect of medium, low and high porosity and permeability sandstone reservoirs; The visualization of the 3D model can comprehensively observe the fracturing effect at all depths and contribute to the evaluation of fracturing effect.

Keywords: *fracturing effect evaluation, fracture detection, fracture pre-evaluation curve, 3D visualization.*

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Forecast of Fossil Fuel Demand Based on Low Carbon Emissions

from the Perspective of Energy Security

Fossil fuel is a key factor related to national energy security. Studying and judging the development trend of China's future demand for fossil fuel and obtaining fossil fuel stably and adequately is of great significance to ensuring China's political stability, normal operation of the national economy and national military security. Under the background of low carbon emissions in China, starting from the perspective of energy security, based on China's carbon emissions and GDP data from 1997 to 2019, four methods, namely Ridge Regression, ARIMA Time Series Model, BP Neural Network and Linear Regression, are used to forecast and analyze the demand for six fossil fuels: raw coal, coke, crude oil, kerosene, diesel and natural gas, providing a reference for national energy policy formulation and fossil fuel security early warning.

Keywords: *fossil fuel, demand forecast, low carbon emissions, energy security.*

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Pyrolysis of oil shale based on electromagnetic heating technology –

A Review

To meet the current and future demand for energy, unconventional energy has gradually attracted the attention of scholars around the world. Oil shale has become one of the most important members of the unconventional energy family because of its rich resource reserves and considerable comprehensive utilization value. The traditional mining method can only mine the shallow oil shale resources, and there are problems such as high cost and low efficiency. For this reason, the researchers have proposed electromagnetic heating technology, which is used to thermally crack oil shale underground by electromagnetic heating. It has the advantages of high oil production rate and low environmental pollution. This paper reviewed the electromagnetic heating technology, electromagnetic heating device and oil shale cracking research to provide a reference for future oil shale mining.

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Thermal Conductivity of Oil Fractions at High Pressure

The results of measuring the thermal conductivity of samples of Usinsk and Kumkolsk oils and their heavy fractions in the pressure range from atmospheric pressure up to 1 GPa at temperature of 20 and 45°C are presented. It is shown that the dependence of thermal conductivity on pressure is a linear function and always increases with increasing pressure. The thermal conductivity of heavy fractions is higher than the thermal conductivity of oils.