

#5-6-2022

## PETROCHEMISTRY: TECHNOLOGY, PROCESSES

Pp. 6–11

**Gimaletdinov R. R.**

(PJSC “LUKOIL”, Moscow)

### Effects of a reaction chamber on visbreaking product stability

**Keywords:** visbreaking; reaction chamber; stability; visbreaking residue; total sediment potential.

**Abstract.** The paper reviews theoretical aspects and experience of industrial operation of the Visbreaking Unit equipped with a reaction chamber. A comparative analysis of density, viscosity, fractional composition, total sediment potential and spot stability was carried out for the initial feedstock, intermediate product and Visbreaking residue. The analysis of the obtained results showed a noticeable change in the colloidal stability of the residual reaction products during their residence in the reaction chamber.

Pp. 12–15

**Ismayilova G. G.**

(Institute of Chemistry of Additives named after Academician Ali Guliyev of Azerbaijan National Academy of Sciences, Baku)

### Synthesis and research of xanthogenic acid derivatives with different polar groups as additives to transmission oils

**Keywords:** xanthates; extreme pressure and antiwear properties; additives; epichlorohydrin; lubricating oil.

**Abstract.** Derivatives of xanthogenic acids containing amine and hydroxyl groups were synthesized on the basis of epichlorohydrin. The three-component reaction of epichlorohydrin with various potassium alkylxanthogenates and a secondary amine, whereby the secondary amine was taken strictly according to the calculations, was to obtain  $\beta$ -hydroxy- $\gamma$ -dibutylaminopropyl esters of alkylxanthogenic acids. The structure of  $\beta$ -hydroxy- $\gamma$ -dibutylaminopropyl esters of alkylxanthogenic acids was confirmed by IR spectroscopy. Alkylxanthogenic acid derivatives have been investigated as additives for transmission oils. All derivatives had effective tribological characteristics, that is, extreme pressure and antiwear properties. An increase in the alkyl radical leads to some change in extreme pressure properties, reducing the scuffing index from 570N to 530N and the critical load from 1260N to 1190 N. The connections were tested in SN-1200 base oil and I-40A industrial oil. In both oils, they showed better efficiency than additives LZ-23k and ABES, especially in terms of antiwear properties. The study of the effect of the test duration on the antiwear properties revealed their better response over a long period of time  $\square$  6 and 8 hours than the ABES additive.

Pp. 16–19

**Mehdiyeva G. M., Bayramov M. R., Agayeva M. A., Javadov M. A., Aliyeva G. M., Hasanova G. M.**

(Baku State University, Azerbaijan)

### Study of propargyl ethers of aminomethylated alkenylphenols as corrosion inhibitors of ferrous metals

**Keywords:** inhibitors; metal corrosion; acid corrosion; degree of surface filling; adsorption energy; chemisorption.

**Abstract.** The article presents the results of studies on the evaluation of the adsorption properties of three aromatic compounds containing simultaneously several active centers in the structures – fragments with double and triple bonds and an aminomethyl group: 1-propenyl-2-propargyloxy-3-diethylaminomethylbenzene (I), 1-allyl-2-propargyloxy-3-diethylaminomethylbenzene (II) and 1-allyl-2-propargyloxy-3-morphoaminomethylbenzene (III).

Based on the data of gravimetric studies, the adsorption-desorption constants ( $K_{ads}$ ), as well as the adsorption energy ( $\Delta G_{ads}$ ) were calculated, confirming the mechanism for protecting the steel surface from acid corrosion by forming chemisorbed adsorption layers on it.

**Pp. 20–23**

**Efremova E. A., Kovalsky B. I., Bezborodov Yu. N.**  
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**The results of the study of the effect oxidation processes on the viscosity-temperature characteristics of partially synthetic motor oils.**

**Keywords:** optical density; potential resource; viscosity-temperature characteristic criterion.

**Abstract.** Based on the analysis of control methods and processes occurring in motor oils, the main indicators characterizing their quality are thermal-oxidative stability, temperature resistance, anti-wear and anti-friction properties and viscosity, which determine the resource of motor oil. However, these indicators are mainly used in the quality control of oils in production and have not been widely used in the operation of various equipment.

The paper presents the results of a study of the effect of oxidative processes on the viscosity-temperature characteristics of partially synthetic motor oils: Castrol Magnatec 10W-40 SL/CF and Rosneft Maximum 10W-40 SL/CF at thermostating temperatures of 180, 170 and 160°C.

**Pp. 24–27**

**Gasimova F. I., Jafarov R. P., Rasulov Ch. K., Aghamaliyev Z. Z., Farzalizade O. M.**

(Institute of Petrochemical Processes named after Academician Y. H. Mammadaliyev of Azerbaijan National Academy of Sciences, Baku)

**Study of the kinetic regularities and mechanism of the cycloalkylation reaction of phenol with 1-methylcyclopentadiene**

**Keywords:** phenol; 1-methylcyclopentadiene; catalyst; cycloalkylation; *p*-(1-methylcyclopentenyl) phenol; kinetics; mechanism; adequately.

**Abstract.** The article presents the results of the reaction of phenol with 1-methylcyclopentadiene in the presence of the KU-23 catalyst. Cycloalkylation of phenol have been carried out in a batch laboratory installation. After the reaction, the alkylate is separated from the catalyst and rectified. Firstly, during rectification at atmospheric pressure MCP and phenol that did not enter into the reaction were distilled off (up to 200°C), and then, under vacuum (666.5 Pa), the target reaction product was isolated and its purity and physicochemical parameters were determined. The kinetic regularities of the reaction were studied, and the probable mechanism of its occurrence was established. A kinetic model of the phenol cycloalkylation reaction, consisting of a system of differential equations, that describes the change in the concentration of the initial substances and reaction products over time has been developed. The kinetic constants of differential equations were estimated using a modified random search method with automatic step selection. For this purpose, the developed package of applied programs was used. The orders,

activation energies, and rate constants of individual stages are determined. It is shown that the proposed model adequately describes the experimental data.

**Pp. 28–31**

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**Evaluation of the possibility of TOFA in the composition of anti-wear additive to diesel fuel with other vegetable oils**

**Keywords:** antiwear additive; fatty acids; DGMK-531; lubricity.

**Abstract.** The article presents the results of a study of the compatibility of laboratory samples of antiwear additives of the Kompleksal-ECO “D” type based on sunflower oil and oleic acid with oil and water using DGMK-531 methods, as well as their lubricity. It has been established that additives based on sunflower oil and oleic acid meet the necessary requirements and along with TOFA can be used in the development of antiwear additives for commercial diesel fuels in order to expand the resource and raw material base.

**Pp. 32–35**

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**Optimization of the process of acylation of para-(1-methylcyclohexyl) phenol with acetic acid in the presence of the nano-catalytic system**

**Keywords:** para-(1-methylcyclohexyl) phenol; acetic acid; catalyst; acylation; acetophenone; optimization; regression model; adequacy.

**Abstract.** Determining the theoretical optimal conditions for the acylation of para-(1-methylcyclohexyl) phenol with acetic acid creates the basis for evaluating the prospects of this process. For the carrying out the acylation process, para-(1-methylcyclohexyl) phenol (AP) and acetic acid (AcOH) were used as a feedstock. To determine the optimal conditions for the acylation reaction of AP with the help of AcOH in a pilot plant, the effects of temperature, molar ratio of initial compounds, reaction time on the yield and selectivity of the target product were studied. The study of the acylation reaction was carried out in the temperature range of 120-1600 C, the reaction time was 20-50 minutes, the molar ratio of AP:AcOH was within 1:0.5÷3.

To determine the coefficients of the equation, the S-plus 2000 Professional program was used, which allows us to automatically calculate statistical analysis data: quadratic effect coefficients, regression model coefficients and pair correlation coefficients. Applying Student’s criterion, significant and insignificant coefficients of the equation were found. To test the adequacy of the model, the Fisher criterion was used, which makes it possible to prove the adequacy of the description of the response surface by regression equations.

**CHEMISTRY AND TECHNOLOGY OF FUEL AND HIGH-ENERGY SUBSTANCES**

**Pp. 38–40**

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### **Production of alkylsalicylic acids by carboxylation of alkylphenols**

**Keywords:** alkylsalicylic acids; salicylate additives; carboxylation; alkylphenols; Kolbe–Schmitt reaction; carbon dioxide.

**Abstract.** An important stage in the industrial process for obtaining salicylate additives for oils and fuels is the synthesis of alkylsalicylic acids from alkylphenols, which is based on the addition reaction of carbon dioxide CO<sub>2</sub> to organic substances with the formation of a carboxyl group – COOH (Kolbe–Schmitt reaction). This work is devoted to optimizing this stage of the process in terms of increasing the rate of the main reaction while achieving the maximum equilibrium yield of alkylsalicylic acid. As a result of the experimental studies carried out, the process conditions appropriate in this respect for alkyl (C<sub>16</sub>–C<sub>18</sub>) phenols were determined. At present, the parameters established in this way have been proposed to produce alkyl salicylate additives at LLC “Novokuibyshevsk Plant of Oils and Additives” of Rosneft Oil Company, where they form the basis of the current technological regulations.

## **OIL REFINING AND PETROCHEMISTRY LIBRARY**

**Pp. 41–49**

**George E. Totten**

**Fuels and Lubricants Handbook: Technology, Properties, Performance, and Testing**

**Pp. 50–53**

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**The necessity for achieving conformity of the Russian turbine oil analysis regulations with the modern international standards**

**Keywords:** turbine oils; lubricants; import substitution; power industry modernization; oil analysis; oil degradation; elemental composition; oxidation stability; varnish potential.

**Abstract.** The problems of operation of imported turbine units under the current circumstances are considered. A comparison is drawn between the existing Russian and international regulatory documents on the use of turbine oils and power-generating equipment. The necessity for the development of a Russian regulatory framework conforming to the internationally accepted standards, as well as for taking account of this conformity when creating a new generation of Russian turbines and related lubricants, is formulated.

## **CHEMISTRY AND TECHNOLOGIES OF OIL-REFINING**

**Pp. 54–57**

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## **Improvement of physico-chemical properties of the straight run diesel by means of a magnetic field**

**Keywords:** oil; magnetic field; pre-activation; primary distillation; diesel fraction; density; cetane number; kinematic viscosity; fractional composition; flash temperature.

**Abstract.** The article discusses issues related to unconventional methods of activation of hydrocarbon raw materials, which include: the use of electromagnetic and ultrasonic fields, magnetic pulse and other. The purpose of the presented work is to study the influence of the magnetic field on the oil of the North Caspian field during its primary processing and to analyze the physico-chemical properties of the obtained light distillates. As a result of fractional distillation, a diesel fraction with improved performance characteristics was obtained. It was found that when exposed to magnetic induction of 0.3 Tl and a linear flow velocity of 0.2 m/s, the cetane number increases by 6 units, density and kinematic viscosity decrease by an average of 15%.

## **LUBRICANTS**

**Pp. 58–61**

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## **Comparative study of protective and anticorrosive properties of sulfonate and phenolate greases**

**Keywords:** greases; corrosion; protective properties; anticorrosive properties.

**Abstract.** The work is based on the study and comparison of protective and anticorrosive properties of sulfonate and phenolate greases. Laboratory tests were carried out on steel (protective properties) and copper (anticorrosive properties) metal plates in accordance with the rules and recommendations of GOST 9.054–75 and GOST 2917–76 methods. The results showed that all tested samples of greases provide long-term protection of steel plates in seawater. The best protective properties were shown by a sample of sulfonate grease SK-25. According to the results of studies of anticorrosive properties, all tested samples can be classified as non-corrosive to non-ferrous metals.

## **PETROLEUM PRODUCTS: COMPOSITION, PROPERTIES AND APPLICATION**

**Pp. 62–68**

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## **Comparison of fire-resistant oils analysis methods performed by various oil laboratories**

**Keywords:** fire-resistant turbine oils; analysis technique; acid number; deaeration time.

**Abstract.** The article presents a comparison of methods for analyzing fire-resistant oils carried out in the following companies: the central chemical laboratory of Energy company No. 1, the Teplotekhnik testing center of OAO VTI, the laboratory of CHPP-A of Energy company No. 1, the laboratory of CHPP-B of Energy company No. 1, the TPP-B and TPP-G laboratories, central chemical laboratory of the Energy company No. 3, testing laboratory of MIT's GSM LLC. Methods for determining the deaeration time, foam formation, varnish formation potential, acid number, demulsification time, kinematic viscosity, content of water-soluble acids and alkalis, corrosion on steel plates, mass fraction of dissolved sludge,

flash point in an open crucible, industrial purity class, water content, pH of water extract, water according to KF, mass fraction of mechanical impurities.

## **CHEMOTOLOGY**

**Pp. 69–73**

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### **Evaluation of physic-chemical parameters of the sealing liquid AG-4I from the hot water tank of JSC “GSR CHP”**

**Keywords:** sealing liquid; hot water storage tank; physic-chemical parameters; structural and group composition; metal content; demulsifying properties; leachability of aromatic hydrocarbons; acid number.

**Abstract.** To find out the reason for the high oxygen content in the water from the tank of the hot water supply accumulator No. 2 of JSC GSR CHP, the physic-chemical parameters of the sealing liquid AG-4I (TU 2513-018-72205759-2014) produced by Standard LLC, were determined, as well as the content of metals and other elements in it, the structural and group composition of the base base of the sealing liquid, water washability from its composition of aromatic hydrocarbons.

It is established that the sealing liquid AG-4I (TU 2513-018-72205759-2014) produced by Standard LLC cannot be used in the hot water tank of JSC GSR CHP, because it does not comply with the regulatory and technical documentation on its composition and operational indicators and its use harms the health of the consumer.