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PETROCHEMISTRY: TECHNOLOGY, PROCESSES

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Study of bitumen cooling process in an above-ground tank in order to develop technologically and energetically efficient methods of maintaining its temperature

Keywords: bitumen, energy efficiency, heating, cooling, modeling, tank, storage, Kaluga.

Abstract. The article is devoted to the study of the process of bitumen BND-60/90 cooling in an elevated vertical steel tank. Attention to this issue is dictated by the fact, that the specific properties of the product — increasing viscosity and tendency to solidification during cooling — create difficulties in its operational turnover for the operators, and storage at high temperature leads to deterioration of the commodity properties.
The relevance of the study comes from the need to find an energy-efficient solution for enterprises which accept, store and promptly dispense bitumen on an industrial scale. The work was conducted in order to explore the possibility of reducing energy consumption, while heating the product, by optimizing the design of the heater.
The object of the research was an insulated tank RVS-3000 with a fixed roof, the prototype of the same volume of which was built by Himstalcon-Engineering LLC in Kaluga. It is assumed, that this tank was filled with bitumen heated to a temperature of 160 °C.
In this work the distribution of the temperature field, as well as the field of velocity of bitumen movement over the volume of the tank, were obtained. This allowed us to formulate preliminary conclusions about promising directions for the development of technologically and energetically efficient methods of maintaining its temperature.

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Optimization of the process of phenol alkylation by isoprene cyclodimer in the presence of KU-23 catalyst at a continuous operation plant

Keywords: optimization; alkylation; phenol; cyclodimer; isoprene; regression model; selectivity; correlation; adequacy; experiment; statistical analysis; criterion.

Abstract. Determining the theoretical optimal conditions for the phenol alkylation process creates the basis for evaluating the prospects of this process as well. For the alkylation process used phenol and isoprene cyclodimers as feedstock.
To determine the optimal reaction conditions for the catalytic alkylation of phenol with isoprene cyclodimers in a continuous pilot plant, the effects of temperature, molar ratio of initial reagents, and space velocity on the yield and selectivity of the target product were studied. The study was carried out in the temperature range of 80–150°C, the molar ratio of phenol to CDI was 0.5:1–2:1 and the space velocity was within 0.25–1.0 h^{-1}.
To develop a regression model of the process, it is necessary to identify the functional relationship between the process parameters and use it for further process prediction. Considering that the number of experiments is m = 13, and the output variables are n = 3, the functional relationship can be represented as a non-linear polynomial.

To determine the coefficients of the equation, the S-pluse 2000 Professional program was used, which allows us to automatically calculate statistical analysis data: regression model coefficients and pair correlation coefficients, as well as quadratic effect 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.
When comparing the found values of F_{es} of the criterion with the tabular ones at the chosen confidence probability of 95% and the numbers of degrees of freedom $f_1 = 6$ and $f_2 = 2$, it can be seen that the calculated values of F_{es} are less than $F_t = 19.3$, and this indicates the adequacy of the description of the response surface by regression equations.
Using the developed regression model on a PC, calculations were made to study the influence of each input factor on the output parameters.
To solve the optimization problem, the Matlab-6.5 program was used, which contains modern algorithms for solving the linear programming problem.
As a result, the solution of the optimization problem was found that at a temperature of 140°C, a ratio of components of 1:0.5 and a space velocity of 0.25 h^{-1}, the selectivity value is 91%, while the yield of the target product reaches 69%.

Keywords: gas condensate, solvent for extraction vegetable oils, rectification, phlegm, distillation, hydrocarbons, technology.

Abstract. To obtain an extraction solvent ГКЭКС-С3-60/95 for the extraction of vegetable oils, stable gas condensates of the Shurtan natural gas field were used. The method of rectification was successfully carried out and hydrocarbon fractions were obtained on the apparatus for rectifying oil (ARN-2). Fraction sampling from gas condensate was carried out up to 95°C. Based on the analysis of the parameters (temperature regime, reflux ratio, number of theoretical plates, etc.) for obtaining solvents at ARN-2., a basic technological scheme for the industrial production of an extraction solvent from gas condensate was developed and their physicochemical properties were studied.

CHEMISTRY AND TECHNOLOGIES OF OIL-REFINING

Keywords: TAIF, HRCC, VCC, hydrocracking, heavy oil upgrading, refining depth, light oil products draw-off, advanced oil refining using hydrogenation processes.

Abstract. This article is devoted to the experience of TAIF-NK JSC Refinery in the application of hydrogenation processes in the processing of heavy residues of oil distillation – Vacuum Residue. The complex of TAIF-NK JSC, which operates on the basis of Veba Combi Cracking (VCC) technology, is the only one in the world that allows processing of heavy residues (Vacuum Residue) obtained by

primary distillation from crude oil, with maximum production of high-quality light oil products. Implementation of hydrocracking technology on the basis of VCC technology at TAIF-NK JSC ensured the achievement of oil refining depth and light product yields for 2021 – 85.1% and 80.7% respectively. The article demonstrates the retrospective dynamics of indicators of oil refining depth and light oil products draw-off from implementation of the project, the change in the food basket, as well as highlights the problems that arose in the course of implementation of the project.

Keywords: AUTOMAXX 9100 pilot plant; determination of the properties of narrow fractions; coking gas oil; diesel fuel; high-pressure hydrotreating plant; sulfur content; nitrogen; aromatics; low-temperature properties; jet fuel.

Abstract. Currently, the main products of the delayed coking plant in the Russian Federation (after hydrotreating) are gasoline and diesel fuel summer. The paper presents the results of a study of the properties of narrow fractions of coking gas oil and hydrotreated coking gas oil, which showed the prospect of organizing production based on the coking process of more marginal aviation kerosene and winter diesel fuel. The separation of products into narrow 20 degree fractions was carried out on an automatic distillation unit AUTOMAXX 9100. The dependences of nitrogen, sulfur, aromatics, density, and low-temperature properties on the boiling temperatures of narrow fractions of the composition of light coking gas oil and hydrotreated light coking gas oil have been studied. Analysis of the properties of narrow fractions of hydrotreated light coking gas oil has shown the theoretical possibility of obtaining fractions of jet fuel and winter diesel fuel on its basis, instead of summer diesel fuel.

CHEMOTOLOGY

Keywords: diesel; gasoline engine; engine oils; properties; specification; test method.

Abstract. Analytical information is presented on the development and implementation of new technical requirements for the performance properties of motor oils and new methods of testing them in the specifications for promising automotive engines, taking into account global trends in environmental protection.
Taking into account the latest diesel designs, the European Association of Automakers (Association des Constructeures Europe'enes d' Automobiles – ACEA) has updated the specifications for engine oils for high-power diesels this year, including low-viscosity oils with an extended shift interval. The changes do not directly concern the assessment of the energy-saving properties of motor oils – saving fuel consumption when using them. ACEA is updating its specifications for heavy-duty heavy-duty diesel engines three years later than their originally planned adoption by the end of 2018. Two new oil

categories E8 and E11 have been added to the 2022 ACEA specification with simultaneous replacement of categories E6 and E9, respectively, declared obsolete.
The possibility of using potentially new methods for evaluating their properties – the ability of oils to reduce high-temperature engine wear and the amount of deposits in the turbocharger – is being considered when testing oils of the new GF-7 category. The use of upgraded methods is proposed: a new Noack test to determine the volatility of oils to assess their volatility and consumption, an updated Ford method to assess the pre-ignition of the fuel mixture at low speeds and high torque to ensure engine protection during the service life of the oil. Finally, a number of Original Equipment manufacturers (Original Equipment Manufacturer – OEM) assume the use of low–viscosity oils of classes 0W-8 and 0W-12 according to SAE for their engines, and these brands are likely to be included in the list of tested oils of the GF-7 category according to the new ILSAC specification.

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Stabilization of processes of thermal oxidative destruction of sealed liquids during operation

Key words: sealing liquids; hot water storage tank; thermo-oxidative stability; dynamic viscosity; antioxidant additives.

Abstract. Is shown that it is possible in principle to increase the thermal and oxidative stability of sealing liquids in operation by introducing "fresh" into the spent sealing liquid, taken in certain ratios. It has been established that topping up the sealing liquid with a higher viscosity to the spent sealing liquid can significantly increase the dynamic viscosity of the operational material and extend the period of its use in the hot water storage tank. The introduction of the antioxidant additive Agidol-1 into the composition of the sealing liquid reduces its dynamic viscosity, but significantly increases the thermo-oxidative stability.

Pp. 50–52

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Status and possible prospects for the development of the domestic methodology for testing and evaluating motor oils

Keywords: internal combustion engine (ICE); motor oils; model; modeling installations; qualification tests; evaluation methods.

Abstract. Before being used in internal combustion engines, motor oils are evaluated and tested according to generally recognized criteria and parameters. The article considers the evolution and trends in the general aspects of the assessment of motor oils for automotive vehicles in the Russian Federation.

OIL REFINING AND PETROCHEMISTRY LIBRARY

Стр. 53–58

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Fluid Catalytic Cracking Handbook: An Expert Guide to the Practical Operation, Design, and Optimization of FCC Units