## *Секция I*

# ПЕРСПЕКТИВЫ, СТРАТЕГИЯ РАЗВИТИЯ И НОВЫЕ ТЕХНОЛОГИИ ХИМИЧЕСКИХ И НЕФТЕХИМИЧЕСКИХ ПРОИЗВОДСТВ. ИНВЕСТИЦИОННЫЕ ПРОЕКТЫ

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## INTENSIFICATION OF PETROLEUM OILS PRODUCTION TECHNOLOGICAL PROCESSES

The growing needs of various sectors of the economy in fuels, organic solvents, lubricant oils, bitumen binders, etc. make it necessary to intensify the processing of crude oil as the main source of raw materials for petrochemical synthesis. An important direction in solving this problem is the development of technological methods that ensure fuller use of the potential of crude oil and improvement of petroleum products quality.

Traditionally, the above-stated tasks were carried out through the improvement of technological schemes of main and auxiliary equipment, etc. However, this method requires considerable material and time costs and may be constrained by a lack of new engineering developments.

In this regard, a very promising technological technique is the use of modifying additives to regulate phase transitions in the processes of crude oil processing in order to intensify them.

Production of base petroleum oils is a multi-stage process [1], the efficiency of which is influenced by a lot of factors, including the completeness of the extraction of oil fractions in atmospheric-vacuum distillation of oil, the selectivity of the removal of low-index components (resinous-asphaltene substances, sulfur- and oxygen-containing compounds, polycyclic aromatic hydrocarbons with short side chains) from oil distillates, as well as the clarity of the separation of the latter into the base oil and concentrate of solid hydrocarbons – gatch.

This is confirmed by the results of studies presented in the paper [2]. Experimental data show that the increasing the productivity of solvent extraction units and dewaxing plants with simultaneous improvement of the quality of produced oils significantly depends on the efficiency of the atmospheric-vacuum distillation, namely, on the yield and quality of oil distillates. A wide fractional composition of distillates makes it difficult to select the right conditions for selective phenol purification and dewaxing, reduces the yield of the target products.

Our earlier studies of the atmospheric-vacuum distillation of oil have showed that distillation in the presence of modifying additives (tetrahydrofurfuryl alcohol, tetramethylene sulfone, etc.) can increase the selection of distillate fractions, including the selection of oil distillates during vacuum distillation of fuel oil [3, 4].

In this paper, the influence of modifying additive on the processes of selective purification and dewaxing in the production of base oils has been studied. Cyclohexanol, an intermediate product obtained by oxidation of cyclohexane synthesis in ε-caprolactam, has been used as a modifying additive to solvents of selective purification and dewaxing processes.

At the first stage of the research it has been found that cyclohexanol as an additive to the base solvents of selective purification of oils and extractive crystallization can improve the performance of these processes: the yield of raffinate increases, its viscosity index, oil loss decreases at the dewaxing stage [5].

This paper presents the findings of influence cyclohexanol on the performance of clean separation of oil distillate carried out by “inverse” scheme, i.e., first distillate is subjected to dewaxing, and then dewaxed oil is purified from misconducting components with liquid extraction.

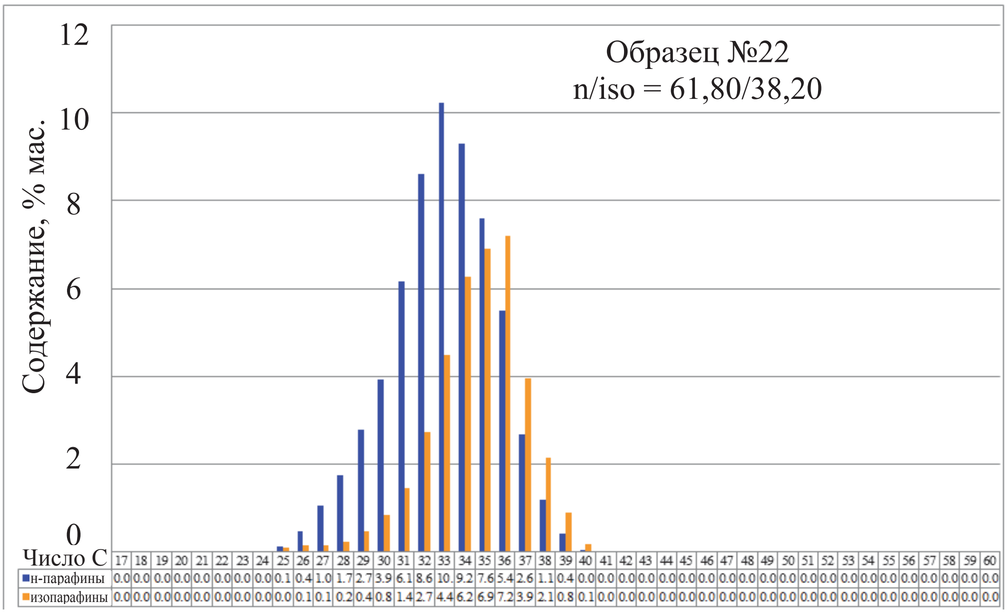
Table 1 shows the data characterizing the vacuum distillate dewaxing.

**Table 1 – The results of dewaxing a vacuum distillate VD-3 ($n_D^{50}$ =1,5019 ) (ratio solvent : raw material is 3 : 1 (volume part))**

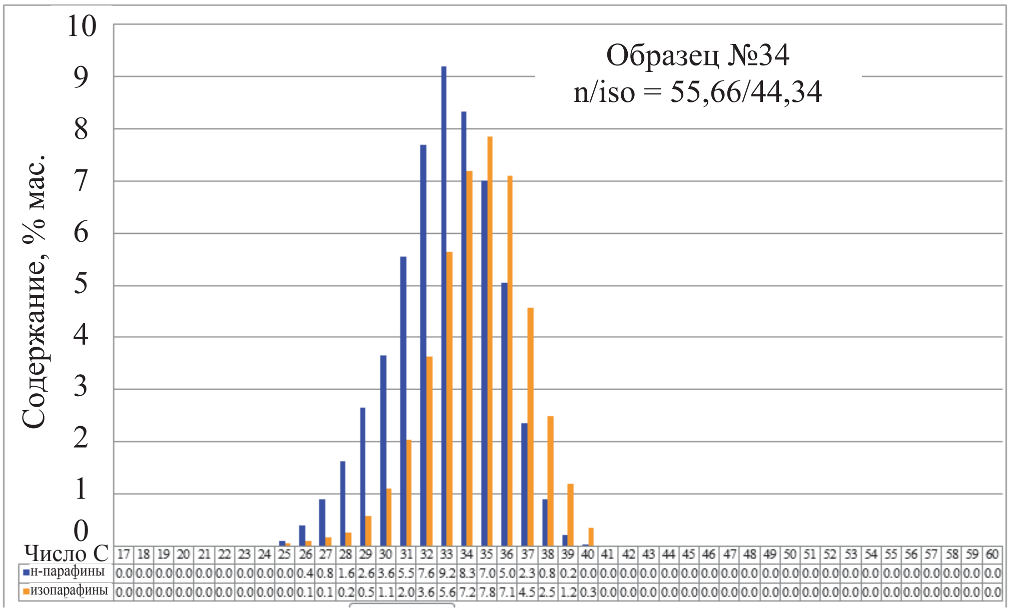
| Experiment number | Solvent | Gatch | | | |
|---|---|---|---|---|---|
| | | output, mass. % | $t_{пл}$ | $n_D^{50}$ | n-paraffins / *i*-paraffins |
| 1 | Acetone – toluene (60 : 40)(mass. p.) | 6,9 | 57 | 1,4639 | 1,62 |
| 2 | Acetone – toluene + 1,5 mass. % cyclohexanol | 6,25 | 63 | 1,4344 | 1,26 |

The figure shows the distribution of paraffin hydrocarbons of normal and isostructure in the obtained samples of gatches.

As it can be seen from the above data, the introduction of cyclohexanol in the composition of the dewaxing solvent leads to a decrease in the output of paraffin concentrate, but its melting point increases from 57 °C to 63 °C.




*A*




*B*

*A* – gatch obtained by experience 1; *B* – gatch obtained by experience 2

**Figure – Distribution of paraffin hydrocarbons of normal and isostructure in gatch**

This is due to the higher content of paraffin hydrocarbons in the gatch, since the refractive index of the gatch of experiment 2 is less than for the gatch of experiment 1.

Table 2 presents the results of selective purification of the samples of dewaxed oils.

**Table 2 – Results of selective purification of dewaxed oil with N-methylpyrrolidone (ratio solvent : raw material is 2: 1 mass. p., temperature 50 °C)**

| Indicator | Dewaxed oil | |
|---|---|---|
| | experiment 1 | experiment 2 |
| Raffinate output, mass. % | 62,2 | 61,1 |
| Refractive index of the raffinate, $n_D^{50}$ : | 1,4860 | 1,4845 |
| Spectral coefficients: | | |
| $C_{A_1} = \frac{D1600}{D720}$ | 1,24 | 1,64 |
| $C_{A_2} = \frac{D810}{D1600}$ | 1,30 | 0,85 |
| $C_{\Pi} = \frac{D720}{D1460}$ | 0,88 | 1,36 |
| $C_{P} = \frac{D1380}{D1460}$ | 1,08 | 1,10 |

According to the table 2, the raffinate isolated from dewaxed oil in experience 2, in the degree of purification from undesirable components exceeds the raffinate obtained with selective clearing of dewaxed oil in experience 1.

Due to the higher degree of paraffinicity ($C_{\Pi}$), degree of branching ($C_P$) and a smaller conditional ratio of polycyclic aromatic compounds to the total content of aromatic structures, the refractive index ($n_D^{50}$) of the base oil of experiment 2 is lower than experiment 1.

Thus, implementing the "reverse" scheme of separation and purification of the oil fraction, the introduction to solvent extractive crystallization (acetone – toluene) of modifying additive (cyclohexanol) allows to intensify the process of obtaining the base oil during the processing of the vacuum distillate.

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