The results in Table 1 indicate that asphaltic oil associates in Yaregskoye field are highly susceptible to the destructive influence of the shear flow. Their mean radii in low shear rate area decrease from the colloidal particle size (~ 50 nm) to values close to the molecular size (~ 1 nm). Stronger particles (microcrystals paraffin) of oil in Yaraktinskoye field (Table 2) practically do not reduce their dimensions in the wide range of shear rates.

***Table 1***

***Activation energy ($E_a$), pre-exponential value (A) and average particle radius (r) of asphaltic oil at various shearrates (γ).***

| Parameters | Shear rates $\gamma$, $c^{-1}$ | | | |
|---|---|---|---|---|
| | 5,4 | 16,2 | 48,6 | 145,8 |
| $E_a$, kJ/mol·K | 30,6 | 37,2 | 45,1 | 51,3 |
| $A \cdot 10^8$, Pa.c | 715 | 41,4 | 1,8 | 0,2 |
| $r$, nm | 47,8 | 10,9 | 1,9 | 1,1 |

***Table 2***

***Activation energy ($E_a$), pre-exponential value (A) and average particle radius (r) of paraffinic oil at various shear rates (γ).***

| Parameters | Shear rates $\gamma$, $c^{-1}$ | | | |
|---|---|---|---|---|
| | 48,6 | 81,0 | 146 | 243 |
| $E_a$, kJ/mol·K | 36,2 | 34,3 | 33,6 | 34,3 |
| $A \cdot 10^8$, Pa·c | 0,47 | 0,9 | 1,1 | 0,73 |
| $r$, nm | 4,5 | 4,9 | 4,4 | 3,1 |

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## IMPACT OF SLOPS FLOW ON THE PROCESS EFIICIENCY IN THE CATALYTIC CRACKING REACTOR

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The properties of raw materials and catalyst, process conditions, type of reaction system and also the quantity and quality of recycled fractions are determined the conversion of the feedstock, the yield of target products and their quality. Reinjection of sludge’s portion (not more than 20 $m^3$/h) from the separation column to the central portion of the riser reactor is implemented on the KT-1/1 unit, on C-200 section. The slops contain a high proportion of polycyclic aromatic hydrocarbons, which leads to loss the catalyst activity and reduced the rate of secondary cracking reactions [1]. In this case the slops recycle allows optimize thermal mode of "riser-reactor-regenerator" system in processing of raw materials rich in saturated hydrocarbons by increasing the load on thecoke.

The quantity of generated coke determines the quantity of heat generated by burning the coke from the catalyst surface, and it effects on the temperature conditions of "lift reactor - regenerator" system. The connection of reactor and regenerator production conditions provides the regulation of this process by changing the catalyst circulation ratio.

Furthermore, during the processing of raw materials rich on paraffinic and naphthenic hydrocarbons, favorable for obtaining a high yield of gasoline fraction and gas, the coke yield is significantly lower than in case of converting materials with a high content of aromatic hydrocarbons.

The software-based mathematical model of catalytic cracking was used for the process parameters calculation. Figure 1 shows the main working window of this program. Using the mathematical model allows to predict the composition of the stream after the reactor, output of wet gas, gasoline fractions, light and heavy gas oil depending on the composition of the feedstock and also allows to optimize process conditions depending on the production objectives (increase in the yield of wet gas, gasoline and diesel fraction). Besides is possible the process conditions correction depending on the feedstock composition and on the amount of coke on the catalyst, that formed in the riser reactor.

The preliminary calculations were carried out to assess the effects of group composition of a vacuum distillate on group composition of gasoline fraction, the octane number of gasoline and outputs unstable gasoline, light and heavy gas oil, wet gas and coke.

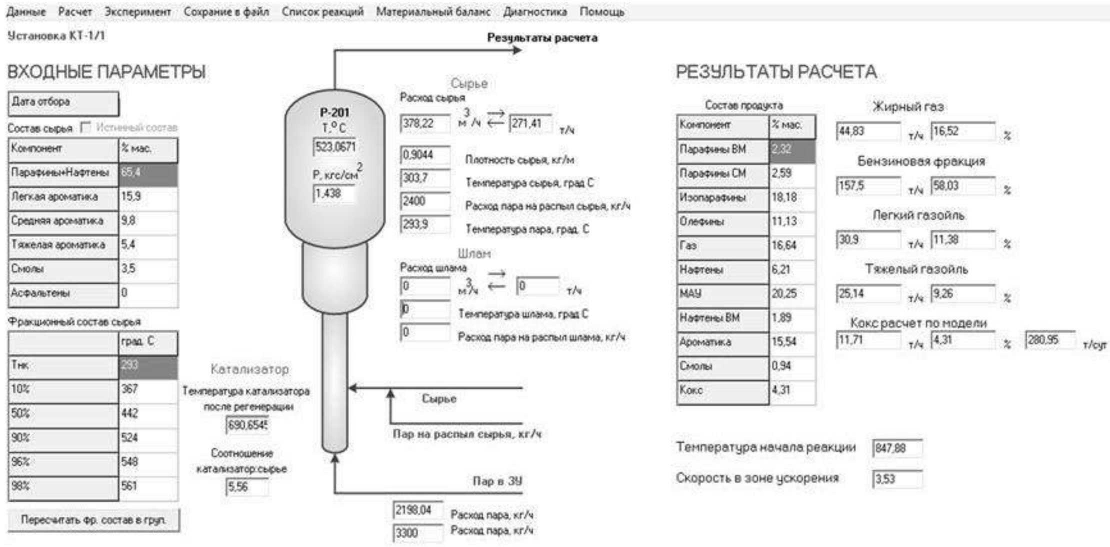



***Fig. 1. The working window of the simulation program***

Four types of raw materials were selected for the calculations (Table). The compositions of raw materials are selected in such a way that it was possible to evaluate the effect of different hydrocarbon groups on the performance of a catalytic cracking process.

***Table***

***Composition of raw materials for the calculation of model, % wt.***

| Group composition of raw materials | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Paraffins,% wt | 43,23 | 40,45 | 44,72 | 49,00 |
| Naphthenes, wt% | 23,50 | 18,40 | 20,34 | 23,50 |
| Aromatics, wt% | 29,91 | 38,00 | 30,94 | 24,40 |
| Resins w% | 3,37 | 3,15 | 4,00 | 3,10 |

It was established that when using the feedstock № 4 the coke content is low (3.6%), therefore when passing the next cycle, the catalyst temperature at the exit of the regenerator will be lower. It is the causes of feedstock conversion decline.

This process can be controlled by varying the catalyst circulation ratio, increasing the circulating flow rate of the heavy residue, increasing the coke load, and rising the inlet feedstock temperature in the riser. Figure 2 shows dependence of change amounts of coke in the reactor from the reactor temperature regime for the two types of raw materials. Feedstock № 4 characterized by a high content of paraffin and naphthenic hydrocarbon, feedstock №3 characterized by high fraction of aromatic hydrocarbons and resins.

As seen in Figure 2, the rise of temperature in the catalytic cracking for feedstock № 4 to 535 °C provides slight increase of coke amount to 3.9%. In this case, the recommendation is to increase the circulation rate of the heavy residue in order to increase the coke loading in the riser reactor of a catalytic cracker and regenerator.

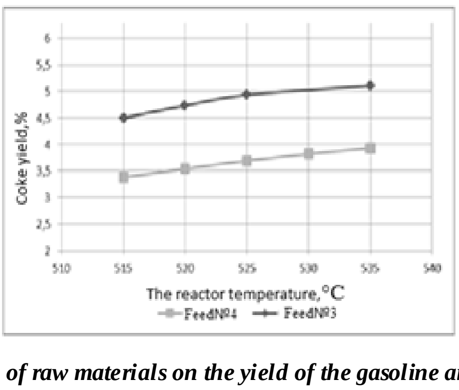
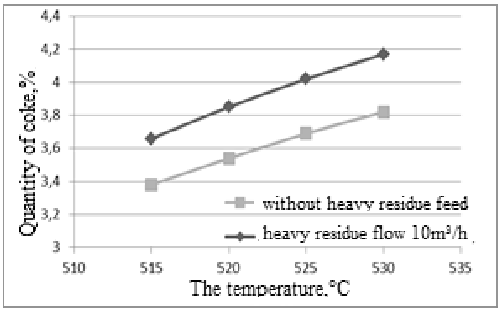
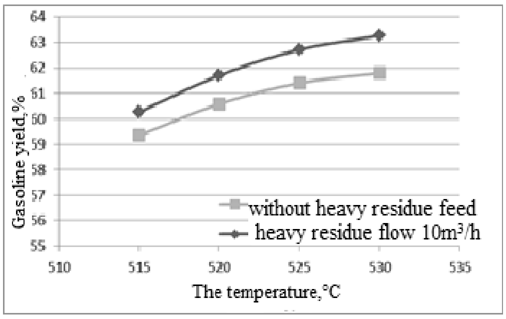



***Fig. 2. Effect of the composition of raw materials on the yield of the gasoline and diesel fraction of the vacuum distillate***

According to Figure 3a, keeping up the flowrate of heavy residue in the riser at 10 $m^3$/h provides the increase of coke amount in riser reactor due to leakage of polycondensation reactions involving heavy hydrocarbons (aromatic hydrocarbons and resins). When the process temperature is increased to 521,4°C to 530,0°C the coke amount is increased from 3.6% to 4.2% (Figure 3a).




*a)*




*b)*

***Fig. 3. a) The dependence of coke yield from the catalytic cracking process temperature.***
***b) The dependence of gasoline yield from the catalytic cracking process temperature***

Thus, increasing the load of coke while maintaining the flow rate of the heavy residue in the riser at 10 $m^3$/h and process temperature at 525°C (maintaining the catalyst circulation ratio at 5.7) lead to increasing the concentration of coke to 4.0% and accordingly increased the temperature of cracking catalyst after regeneration. The yield of high octane gasoline increasing (Figure 3b) from 60.1 to 62.7% (the octane number of gasoline by motor method 87 p.), the output of wet gas rich in propane-propylene and butane-butylene fraction was 18.3% for raw materials.

Thus, optimization the thermal regime of processing of raw materials with a high content of paraffins and naphthenes by increasing slops flow rate (10 $m^3$/h) in the catalytic cracking reactor allows to increasing the yield of coke and 4.0%, and respectively increasing the catalyst temperature after the regenerator, without increasing the reactor temperature to 535°C.

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## IDENTIFICATION METHOD OF INDICATOR DIAGRAM BY INTERPRETING THE MEASURED RESULTS OF GAS-DYNAMIC WELL TESTING

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Development of a method for identification and interpretation of the measured results of gas-dynamic well testing (GDWT) by indicator diagram (ID) allows taking into account additional prior information, improving the accuracy of the reservoir pressure and flow parameters determination, reducing testing time.

Stabilized flow gas-dynamic well testing is one of the main methods to determine the flow parameters and the productivity of a gas well. A major limitation of traditional methods of identification and interpretation GDWT is a large number of flow periods to obtain the required stabilized data to provide the accuracy of results [1].

To ensure the sustainability and improve the accuracy of the methods of interpretation GDWT by ID it is recommended to use the method of the integrated system of ID models based on a priori information about the parameters of the reservoir, which allows us to integrate the raw data, additional prior knowledge, experience and knowledge into a single system model that provides stability assessments and significantly increases their accuracy [2, 3].

Models ID and interpretation algorithms with a priori information**.** The method of interpretation of stabilized flow GDWT used an integrated system model of ID $p_{пл}^2 - p_з^2 = aq_i + bq_i^2$ (Forchheimer) with variable parameters based on a priori information about the reservoir pressure $P_{пл}$

$$\begin{cases} y_i^* = \alpha_1 + \alpha_2 q_i + \alpha_3 q_i^2 + \xi_i, \\ \bar{\alpha}_1 = \alpha_1 + \eta, i = \overline{1,n} \end{cases} \leftrightarrow \begin{cases} Y^* = F\alpha + \xi, \\ \bar{\alpha}_1 = \alpha_1 + \eta \end{cases}, \qquad (1)$$

where $y_i^* = P_{i,з}^2$, $q_i$ - the square of the bottomhole pressure and flow rate obtained within well test period $i$; $F = (1, -q_i, -q_i^2, i = \overline{1,n})$ - matrix of the known values of flow rates; $\alpha = (\alpha_1 = P_{пл}^2, \alpha_2 = a, \alpha_3 = b)$ - vector of unknown