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APPLICATION OF PARAFFIN EMULSION AS APOLAR CO-REAGENT DURING SYLVINITE FLOTATION PROCESS

The research is devoted to finding more affordable apolar reagent paraffinic base for their use in the process of potash ore flotation, as well as improve the form in which the reagent is introduced into the flotation process. Found that the introduction of paraffinic oil flotation system in the form of emulsions provides extraction of potassium chloride at a level comparable to the same period of the industrial process.

Introduction. The main method of extraction of potassium chloride from sylvinite ore is flotation, which has relatively high efficiency and simplicity. The process involves many steps, but the main is sylvinite flotation, where a large number of different flotation reagents are used. The basic reagent is a gatherer, which is a system consisting of a base component – aliphatic amines and a coreactant of apolyar type (for example, liquid paraffins, slop-vox, hydrotreated vacuum gas oil, etc.) [1, 2].

As it is known, the effect of the amine reagent -gatherer is most effectively intensified by paraffinic hydrocarbons of normal structure [1]. However, with the growing demand for petrochemicals in liquid paraffin for the production of surfactants and their lack of production in the Republic of Belarus a very urgent task is to find possibilities of replacing liquid paraffins on available petroleum products containing normal paraffins.

Main part. We have previously shown [3] that the increase of the flotation activity of the reagent - gatherer in the flotation conditions at elevated temperature can be achieved by improving the ways in which the reagent is introduced into the flotation process. For example, one can introduce reagent in an apolar flotation system in the form of an emulsion. This will ensure a more uniform distribution in the amount of flotation pulp, reduce time for sylvinite flotation and increase system performance.

In this study we investigated the possibility of obtaining emulsions based on a number of homemade petroleum of paraffin base, followed by a comparison of their flotation activity during the sylvinite flotation with analogous indexes of industrial apolar reagent. Tests were carried out with hydrotreated vacuum gas oil (JSC "MOR"), residual product of oil mild hydrocracking (OJSC "Naftan"), residual oil product of hydrocracking ("Naftan") oil run-off (OJSC "PMW"); slack wax ("Naftan").

Chromatographic method was used to investigate the component composition of paraffinic hydrocarbons contained in the test oil. For the analysis was used the method of internal normalization. Table 1 shows the contents of normal and isostructure compounds in the test petroleum.

Table 1 shows that most part of paraffins containes in the slack vax and oil run-off and the less part is in the hydrotreated vacuum gas oil and residual product of mild hydrocracking.

Table 1

Content of paraffinic hydrocarbons

Oil product	Content of hydrocarbons in paraffin, wt. %	
	n-paraffins	*iso*-paraffins
Hydrotreated vacuum gasoil	5.8	94.2
Residual product of mild hydrocracking	5.6	94.4
Residual product of hydrocracking	7.3	92.7
Oil run-off	27	73
Slack vax	41	59

Composition of normal and iso-paraffins, the subjects included in the oil composition are shown in table 2.

Table 2

Composition of paraffinic hydrocarbonspetroleum

Oil product	Composition of *n*-paraffins	Composition of *iso*-paraffins
Hydrotreated vacuum gasoil	C_{21}–C_{30}	C_{20}–C_{39}
Residual product of mild hydrocracking	C_{22}–C_{26}	C_{20}–C_{30}
Residual product of hydrocracking	C_{24}–C_{32}	C_{21}–C_{39}
Oil run-off	C_{20}–C_{32}	C_{24}–C_{39}
Slack vax	C_{33}–C_{42}	C_{33}–C_{44}

It was established that the composition of the hydrotreated vacuum gas oil, residual product of mild hydrocracking, residual product of hydrocracking and run-off included mainly normal paraffins C_{20} to C_{30} , and slack-vax – normal paraffins $C_{33} – C_{42}$. Compositions of iso-paraffins in the test samples are similar, except slack-vax. There are hydrocarbons $C_{20} – C_{39}$.

On the basis of the above oil products emulsions were obtained. As the emulsifier, we have used the nonionic active surfactants, technical details of which are given in table 3. Concentration of emulsifier and oil in water was constant at 3.2 and 32 wt %, respectively.

Table 3

Specifications of SAS of nonionic type

Indicator	Value
Content of active component, %	100
Content of water, %	0.5
pH-rate (10 %)	6.0
HLB-balance	10
Dencity, g/cm^3	0.94
Solubility	can be dissolved in acetone, ethyl alcohol, the iso-propyl alcohol, can be dispersed in water

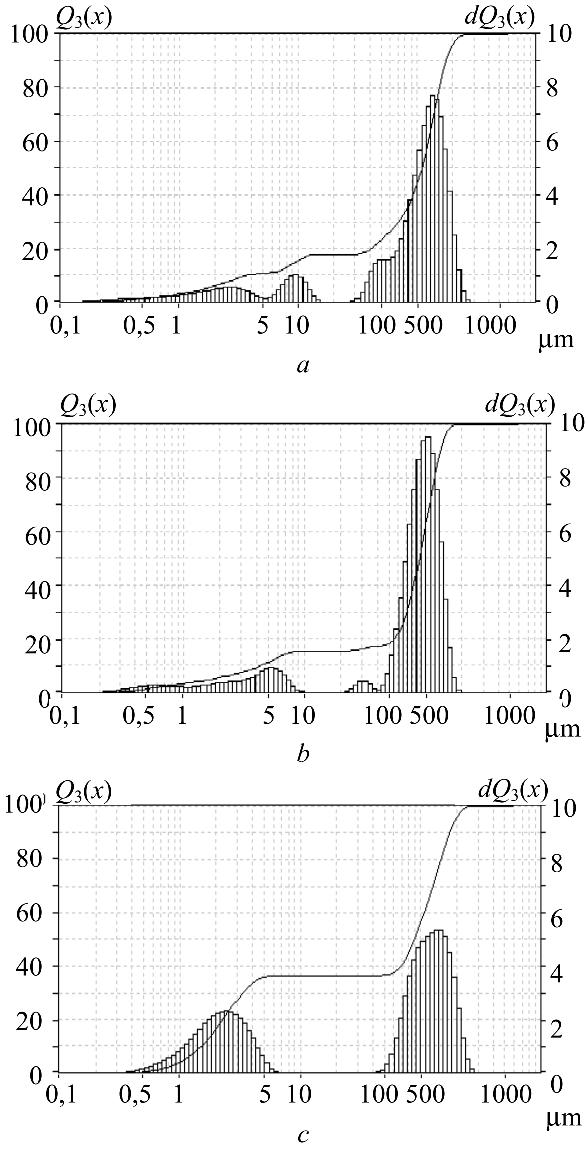
Emulsions were prepared in a laboratory unit equipped with a mechanical stirrer, gradually adding water to the premixture of oil and emulsifier. Stirring was carried out for 25 minutes at 50 revs stirrer min^{-1}. Process temperature was maintained between 70–75°C.

Emulsions derived from hydrotreated vacuum from gas oil, residual mild hydrocracking product, the residual product of hydrocracking and slack vax were stable. Unusable were slack emulsion (solid) and the oil run-off (not stable). Stable emulsions were analyzed by a laser analyzer of particle size Analyzette 22 MicroTec Fritsch GmbH (Germany) to assess their dispersion (Figure). As can be seen from the figure, emulsions are polydispersed. All emulsions are mainly represented by groups of particles: 0.05–10.00 and 50–200. However, only in the emulsion based on the residual product of mild hydrocracking distribution of dispersed particles largely corresponds to the distribution of the emulsion particles in industrial apolar reagent.

The resulting emulsions samples were tested as co-reactants of aliphatic amines in sylvinite flotation process (Table 4).

Flotation experiments were conducted on flotation machine FML 240. Expenditure of emulsions for all samples was 12 g / ton of ore. Ore containing 27.76 wt % KCl, 2,5wt % of insoluble residue with a size – 1.25 mm was served as a raw material.

According to the comparative analysis of the results of flotation, flotation activity of the test emulsions is slightly inferior to emulsion based on liquid paraffins. It once again confirms the fact that normal paraffins primarily have positive effect on hydrophobization of floatable particles of potassium chloride. However, emulsions prepared on the basis of residual oil products, on its flotation activity are not actually inferior to emulsion of hydrotreated vacuum gas oil – industrial reagent.



Distribution of particles of a disperse phase in the emulsion received on a basis:
a – hydrotreated vacuum gasoil;
b – residual product of mild hydrocracking;
c – hydrocracking rest

Table 4

Results of sylvinite flotation

Indicator	Emultions on the based of			
	liquid paraffins	hydrocleared vacuum gas	residual product of mild hydrocracking	residue of hydrocracking rest
Yield, %				
Rough concentrate	31.73	26.26	29.10	26.01
Tailings	68.27	73.75	70.90	73.99
Original	100.0	100.0	100.0	100.0
Mass fraction KCl, %				
Rough concentrate	81.24	86.04	81.03	83.86
Tailings	2.21	6.55	5.51	7.62
Original	27.28	27.42	27.48	27.44
Mass fraction H.O., %				
Rough concentrate	2.10	2.09	1.45	1.34
Tailings	3.02	3.02	2.59	2.46
Original	2.73	2.78	2.26	2.17
Removing KCl, %				
Rough concentrate	94.47	82.38	85.80	79.46
Tailings	5.53	17.62	14.20	20.54
Original	100.0	100.0	100.0	100.0
Removing H.O., %				
Rough concentrate	24.38	19.79	18.71	16.04
Tailings	75.62	80.21	81.29	83.96
Original	100.0	100.0	100.0	100.0

Conclusion. It is found that the introduction of oil products of flotation system in the form of emulsions can provide extraction of potassium chloride at a level comparable to the same period of the industrial process. Apparently, it is possible to improve achieved flotation results by increasing the flow of apolar reagent emulsion in the form of emultion.

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