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# Study of the dispersing properties of microemulsion mercaptan-containing collectors based on oil products

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**ABSTRACT**
The article discusses the production of flotation reagents based on domestic sulfur-containing oil products using the ultrasonic cavitation method. Particular attention is paid to the selection of oil products based on the analysis of their qualitative and quantitative composition. Mercaptans (thioalcohols) are known to be the most effective sulfhydryl collectors. This study utilizes sulfur-containing oil products with the same sulfur content but differing in the form of sulfur presence in the starting materials: refined oil, mercaptan-containing product, and an intermediate product obtained during oil demercaptanization. Compositions were developed using these oil products and butyl xanthate. During ultrasonic cavitation, the dependence of emulsion stability over time on ultrasonic power and component ratios was determined. Optimal conditions for ultrasonic cavitation and the appropriate proportions of components in the compositions were established. Despite having the same sulfur content, it was found that only sulfur-containing products with specific structural characteristics are suitable for flotation reagent production. Additionally, ultrasonic cavitation's role in modifying the compositions' properties was identified, significantly influencing their efficiency as collectors.

***Keywords:*** refined oil, mercaptan-containing product, butyl xanthate.

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## Introduction

Flotation reagents play a key role in the flotation process, determining its efficiency and future development prospects. The success of flotation largely depends on their proper selection and economically justified application. One of the key characteristics of flotation reagents is their selective influence on phase boundaries, particularly on the surface of various minerals, due to the conditions created in the aqueous pulp medium. Of particular interest is the combined use of ionic and apolar collectors, which demonstrate high flotation efficiency [[1], [2], [3]].

In recent years, research by domestic scientists has intensified interest in the use of heteroorganic oil compounds for the beneficiation of polymetallic ores. Technologies are actively being developed to extract sulfur-containing compounds from oil products, including mercaptans, sulfides, and thiophenes, with the latter accounting for 80–95% of the total. It has been established that oil sulfides are predominantly represented by cyclic compounds, homologs of alkyl-substituted thiophenes, and thiocycloalkanes. As the boiling point of oil fractions increases, the proportion of condensed monocyclic sulfides decreases, while that of polycyclic sulfides rises. These compounds exhibit high surface activity, making them promising apolar reagents that do not require additional surfactants.

Studies by V. A. Glembotsky, L. Ya. Shubov, V. A. Esepkin, S. I. Chernykh, and others have shown that the most effective apolar reagents contain aromatic hydrocarbons and their homologs. These findings highlight the need for a more in-depth investigation of such compounds as flotation reagents.

This study aims to evaluate the potential use of sulfur-rich oil concentrates containing aromatic and heteroatomic compounds as selective apolar collectors. These substances remain insufficiently studied in the context of ore flotation [4].

Many collectors possess a complex heteropolar molecular structure, incorporating both polar and apolar fragments. The polar part of the molecule interacts with water, while the apolar part, represented by a hydrocarbon radical, exhibits hydrophobic properties. During adsorption on the mineral surface, the polar part of the molecule attaches to the mineral, while the apolar part extends into the aqueous phase, facilitating hydrophobization and subsequent flotation of the mineral [5].

The selective properties of collectors depend on their chemical composition and molecular structure. They are classified based on their interaction mechanism with minerals, their degree of dissociation into ions, and the type of ion responsible for the hydrophobizing effect (anion or cation). Collectors are generally divided into three main groups (Figure 1):

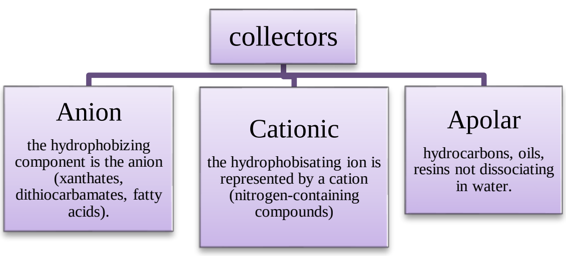



**Figure 1 -** A main group of collectors

One of the key directions for improving flotation efficiency is the development of new sulfur- and phosphorus-containing reagents that ensure high performance while reducing consumption.

In Kazakhstan, the production of flotation reagents, particularly collectors and foaming agents, is limited. Imported reagents are often expensive, of inconsistent quality, and have restricted applicability to different ore types. This situation necessitates the development of domestically produced flotation reagents from local raw materials, as well as the optimization of reagent regimes for their effective use in beneficiation processes [6].

According to the literature, xanthates, dithiophosphates, dixanthates, and their mixtures are widely used as collectors. For instance, butyl xanthate is the primary reagent in Russia, while amyl xanthate is more commonly used abroad [[7], [8], [9]]. It has been established that an increase in the hydrocarbon radical enhances the reactivity and oxidizability of xanthates [10].

For selective flotation, weak collectors such as aeroflots, or their combinations with xanthates, are recommended. The research of A. Abramov focuses on the development of new selective collecting reagents to improve the flotation efficiency of non-ferrous metals [11].

Flotation reagents used in mineral processing can be derived from crude oil. Crude oil contains not only water and salts but also a wide range of organic compounds, including sulfur-containing components, which are of particular interest for flotation. Compounds such as mercaptans, sulfides, and thiophenes have the potential to serve as effective collector reagents with selective effects on minerals.

The extraction of such compounds can be integrated into the early stages of oil processing, particularly during the breakdown of stable water-in-oil emulsions. This process offers a dual advantage: on one hand, the removal of these compounds enhances oil quality and reduces corrosiveness caused by sulfur-containing components; on the other, the recovered compounds can be utilized in the synthesis of innovative flotation reagents, which is especially valuable for polymetallic ore beneficiation [[12], [13], [14]].

Thus, the development of technologies for extracting sulfur-containing components from oil presents both environmental and industrial benefits. Environmentally, it improves oil properties and reduces pollution; industrially, it enables the creation of cost-effective and highly efficient flotation reagents from local raw materials.

The presented data confirm that advancing the composition of sulfur-containing reagents used as flotation collectors is a dynamic area of research. However, the challenge of selecting suitable initial components and optimizing their compositions for effective flotation of refractory ores remains unresolved. This is because reagent efficiency is directly influenced by the qualitative and quantitative composition of the raw material, as well as its structural characteristics, necessitating an individualized approach in each specific case [15].

Additionally, with the declining quality of raw materials and increasing flotation reagent consumption, reducing costs becomes essential. In this context, the synthesis of flotation reagents from inexpensive domestic raw materials, such as sulfur-containing oil products, is of particular importance, offering opportunities for the development of more economical and efficient flotation technologies [16].

## Experimental part

For this study, three samples of oil and oil products from the Kenkiyak deposit, provided by Aktobeoilgas, were selected. The samples included dehydrated oil, purified oil, mercaptan-containing products, and a byproduct obtained during oil demercaptization.

At this stage of the research, the focus was on the raw oil from the Kenkiyak deposit and oil that had undergone the first stage of treatment. The physical and chemical characteristics, as well as the composition of oil with a water content of up to 30%, are presented in Table 1.

**Table 1 -** Physical and chemical characteristics of oil in the Kenkiyak deposits

| Description of indicators | Averaged values |
|---|---|
| Viscosity, MPa × $^0$C, at 200 $^0$C - 500 $^0$C | 4.13 – 2.18 |
| Density, g/cm$^3$ | 0.8259 |
| Asphaltene, % | 0.4 |
| Paraffin, % | 3.3 |
| Pour point, 0S | 8.70 ~ 14.0 |
| Mass fraction of sulfur, % | 0.70 ~ 1.21 |

The data presented in Table 1 indicate that the composition of the source oil is characterized by a sulfur content exceeding 1%. Sulfur is present in the form of both hydrogen sulfide and mercaptans. To effectively remove stable sulfur-containing compounds, a second purification stage is employed, utilizing specialized reagents—absorbers. This method is currently the most effective for reducing sulfur-containing components such as hydrogen sulfide and mercaptans in oil.

This study examined oil after the first and second refining stages. The first stage of oil treatment, based on existing technology, includes heating followed by electrostatic dehydration. This process relies on the destruction of petroleum emulsions through a thermochemical method combined with exposure to a high-voltage electric field.

The thermochemical method involves preheating the oil to a temperature of 48–50 °C with the addition of a demulsifier. As the temperature rises, the oil's viscosity decreases, facilitating better mixing of the emulsion with the demulsifier and enhancing the separation of oil and water. An essential condition for effective separation is the residence time of the emulsion in the apparatus. The demulsifier penetrates the surface layer of water droplets in the oil, breaking the protective coating composed of asphaltenes, resins, and paraffins. This process promotes the coalescence (fusion) of water droplets. The degree of dehydration achieved through thermochemical treatment ranges from 80% to 90% [17].

More stable water-in-oil emulsions are disrupted using a high-voltage electric field of 20–25 kV at an industrial frequency of 50 Hz in an electric dehydrator. Under the influence of an alternating electric field, dispersed water droplets in the oil coalesce, merging with other droplets and increasing in size. The enlarged water droplets settle in the intermediate layer below the lower electrode before passing into the drainage water layer.

When subjected to an electric field between two horizontally positioned lattice electrodes, the protective shell of the water emulsion droplets breaks down. As a result, water and the dissolved salts it contains separate from the oil due to differences in density and accumulate at the bottom of the electric dehydrator. Dissolved mineral salts are also removed from the oil along with the separated water [18].

Mercaptans can be considered hydrogen sulfide derivatives in which one hydrogen atom is replaced by a hydrocarbon radical. Their general formula is RSH.

With alkalis, they form mercaptides:

$$RSH + NaOH \rightarrow RSNa + H_2O \quad (1)$$

At the first stage of the second stage of purification, a 2-5% solution of alkali NaOH of hydrogen sulfide, naphthenic acids and part of methyl, -ethylmercaptans is selectively extracted from oil by the following reactions:

$$H_2S + 2NaOH \rightarrow Na_2S + 2H_2O \quad (2)$$

$$RSH + NaOH \rightarrow RSNa + H_2O \quad (3)$$

$$RCOOH + NaOH \rightarrow RCOONa + H_2O \quad (4)$$

At the second stage of the second purification stage, there is additional extraction of methyl, - ethyl mercaptans, partial extraction of propyls, -isopropyl mercaptans with alkali solution 6.5-14.3 wt%. If necessary, mercaptides are oxidised into disulphide oil with air oxygen in the presence of a catalyst - cobalt phthalocyanine. The extraction and oxidation of mercaptans occurs according to the reactions:

$$RSH + NaOH \rightarrow RSNa + H_2O \quad (5)$$

$$2RSNa + 1/2O_2 + H_2O \rightarrow RSSR + 2NaOH \quad (6)$$

Reaction (4) shows that the oxidation of RSNa completely regenerates the consumed alkali.

To maintain effective purification, the alkaline solution should never contain a significant amount of unoxidized RSNa. For this reason, the amount of air introduced into the oil must always exceed the stoichiometric air flow rate for complete oxidation RSNa.

Table 2 presents the physical and chemical parameters that oil should have after the first and second stages of the second purification stage.

**Table 2** - Physical and chemical parameters of oil after the second stage of treatment

| Name products | Value of indicators | |
|---|---|---|
| | I oil treatment | II oil treatment |
| Mass fraction of sulfur, % | no more 0.8 | no more 0.6 |
| Density (at 20 $^0$C), kg/m$^3$ | no more 850 | no more 850 |
| Fraction yield to temperature, %<br>200$^0$C<br>300$^0$C<br>350$^0$C | <br>no more 27<br>no more 47<br>no more 57 | <br>no more 27<br>no more 47<br>no more 57 |
| Mass fraction of paraffin, % | no more 6.0 | no more 5.0 |
| Mass fraction of hydrogen sulfide, ppm | no more 80 | no more 1 |
| Mass fraction of methyl-ethyl mercaptans in total, ppm | no more 100 | no more 40 |
| Water mass fraction, % | no more 0.5 | no more 0.5 |
| Chloride salt concentration, mg/dm$^3$ | no more 100 | no more 90 |
| Mass fraction of mechanical impurities, | no more 0.05 | no more 0.05 |
| Saturated vapour pressure, kPa | no more 66.7 | no more 66.7 (500) |

According to Table 2, the content of hydrogen in oil should not exceed 1 %, and the content of mercaptans - 40 ppm.

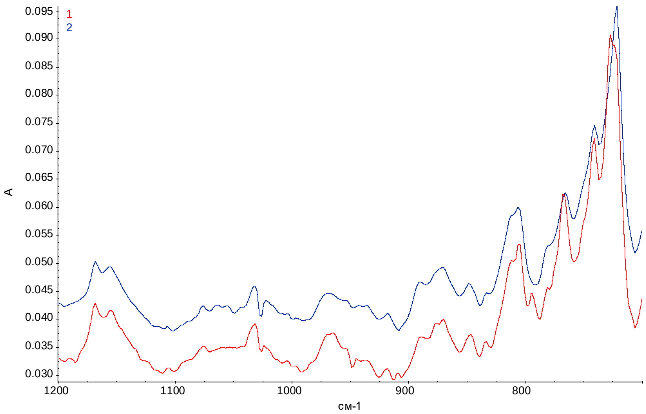



**Figure 2 -** Comparative figures of IR spectra of oil (Kenkyiak deposits) after stages 1 and 2 of treatment. (1 - the first stage of oil purification, 2 - the second stage of oil purification)

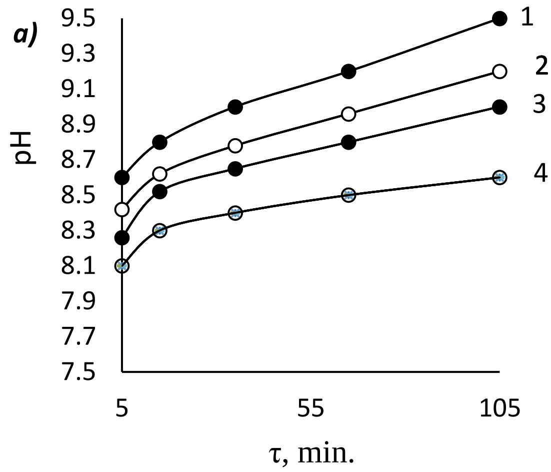
Figure 2 compares the spectra of oil samples after the first and second cleaning stages. A significant difference in spectral profiles is noted, which indicates changes in the ratio of compounds present. The second fraction contains a higher concentration of compounds including S = O groups, as well as sulfur compounds of aromatic and naphthenic structures.

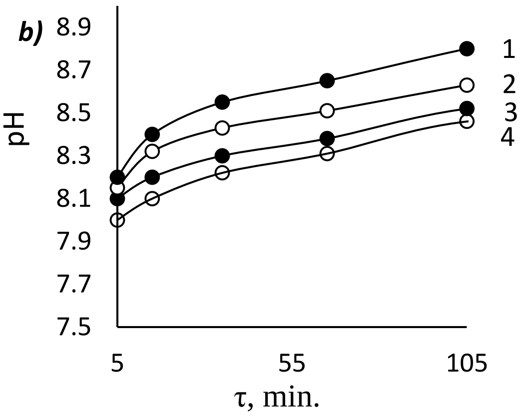
One promising fine dispersion technique is ultrasonic cavitation. This process makes it possible to obtain stable mixtures of substances and significantly accelerate various chemical and mass exchange processes. Ultrasonic dispersion helps to obtain highly dispersed, homogeneous and pure chemical nanosuspensions and nanoemulsions.

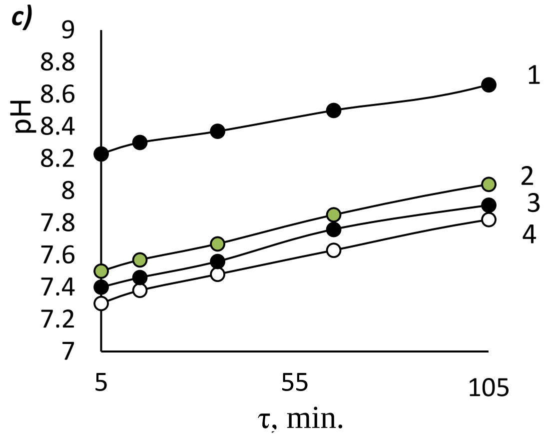
In our study, ultrasonic cavitation is considered an advanced technology for dispersing solid materials. This method is highly effective in breaking down solid particles through mechanisms such as shock waves and frictional flows generated by collapsing cavitation bubbles. The dispersion of insoluble components simultaneously facilitates the formation of stable mixtures and enhances chemical processes, enabling the production of nanosuspensions and nanoemulsions with high dispersion and purity.

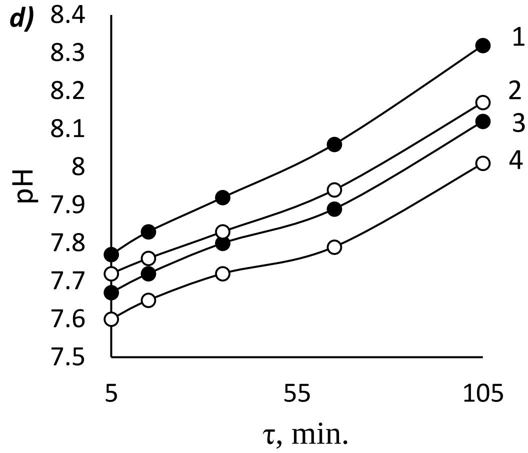
Additionally, ultrasonic treatment is applied in the pretreatment of crude oil, demonstrating high efficiency in demulsification and dewatering. This method not only improves oil refining quality but also enhances environmental safety by reducing waste volumes. The use of ultrasound in such processes underscores its role as a sustainable and environmentally friendly approach in modern industrial practices.

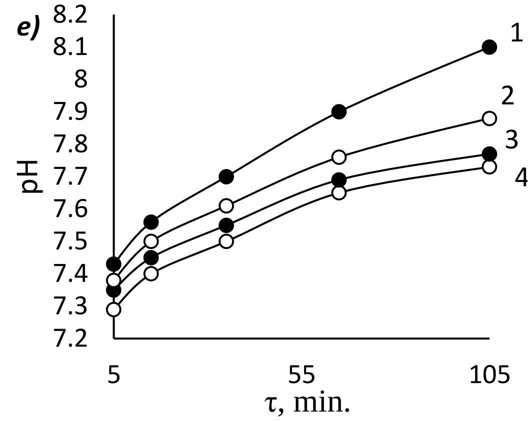
To obtain emulsions, oil-based compositions after the first stage of purification were used along with aeroflot and dispersed using the JY99-Ultrasonic Homogenizer. The model used was JY99-IIDN, with an ultrasound power of 1800 W, an operating frequency of 20–25 kHz, and a power supply of 220/110 V, 50/60 Hz.



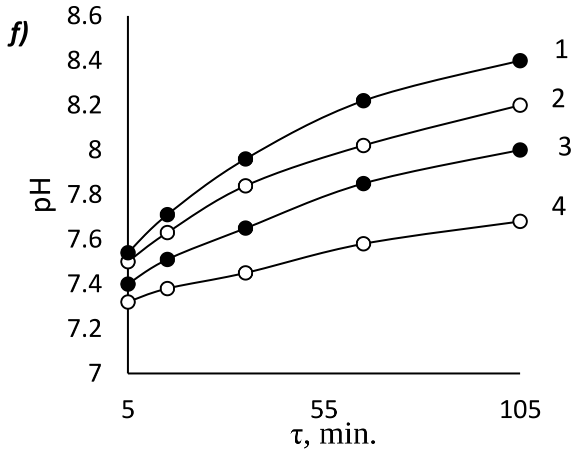




**Figure 3 -** Change in medium pH over time at different ultrasonic power (1 - 720 W; 2 - 600 W; 3 - 400 W; 4-234 W) for the oil composition after the second stage of purification with butyl xanthate at different ratios a) oil after the 1st stage of purification with BKx-1:1; b) oil after the 1st purification stages with BKx-1:2; c) oil after the 1st purification stages with BKx-1:3; d) oil after 2 stages of treatment with BKx-1:1; e) oil after the 2nd purification stages with BKx-1:2; f) oil after the 2nd purification stages with BKx-1:3;

The emulsification process was carried out using the JY99-Ultrasonic Homogenizer, as illustrated in

Figure 3, following this procedure: 50 ml of distilled water and 0.5 g of the test mixture were placed in a beaker. To evaluate the stability of the resulting microemulsions, three different ratios of oil (after the first purification stage) to butyl xanthate were selected: 1:1, 1:2, and 1:3. A titanium ultrasonic probe in the form of a cone concentrator was immersed in the sleeve, ensuring its tip was positioned in the central part of the liquid volume. The treatment was conducted at an operating frequency of 25 kHz, with adjustable net power in the liquid medium ranging from 234 W to 720 W. The sonication time varied from 5 to 105 minutes, and the temperature of the resulting microemulsion after sonication reached 45–50 °C.

Studies were conducted to determine the optimal sonication conditions for each mixture. The dependence of the pH variation of the emulsion medium overtime on ultrasonic power and the ratio of components (oil after the first purification stage with butyl xanthate) was established (Figure 2). The pH change plays a crucial role in flotation processes, as it influences the chemical state and behavior of reactants in the emulsion. The pH of the medium directly affects the surface charge of particles, altering their ability to adsorb flotation reagents, including butyl xanthate, thereby impacting flotation efficiency.

Ultrasonic treatment can modify the pH by influencing the dissociation of chemical bonds and the distribution of ions in solution, which affects the acid-base properties of the medium and, consequently, the adsorption of reagents and their interaction with minerals. These modifications can significantly impact selectivity and the recovery of valuable components during flotation.

Figure 4 presents the results of pH variation over time during the ultrasonic dispersion of microemulsion collectors, obtained from oil after the first and second purification stages in combination with sulfur-containing components and butyl sodium xanthate. The graphs illustrate the dependence of pH on processing time at different ultrasound power levels (720 W, 600 W, 400 W, and 234 W). The pH tends to increase as dispersion time progresses, with higher ultrasound power contributing to a more significant rise in pH.

The influence of collector composition on pH dynamics is also evident: an increase in the butyl sodium xanthate content (from 1 to 3) leads to a notable shift in the system's acid-base balance.

In further studies, the composition of the compositions was complicated. The collector used was a mercaptan-containing mixture consisting of oil, a sulphur-containing product and sodium butyl xanthate in ratios of 0.5: 0.5: 0.33; 0.5: 0.5: 0.5 and 0.5: 0.5: 1.0. The results are presented in Figure 3.

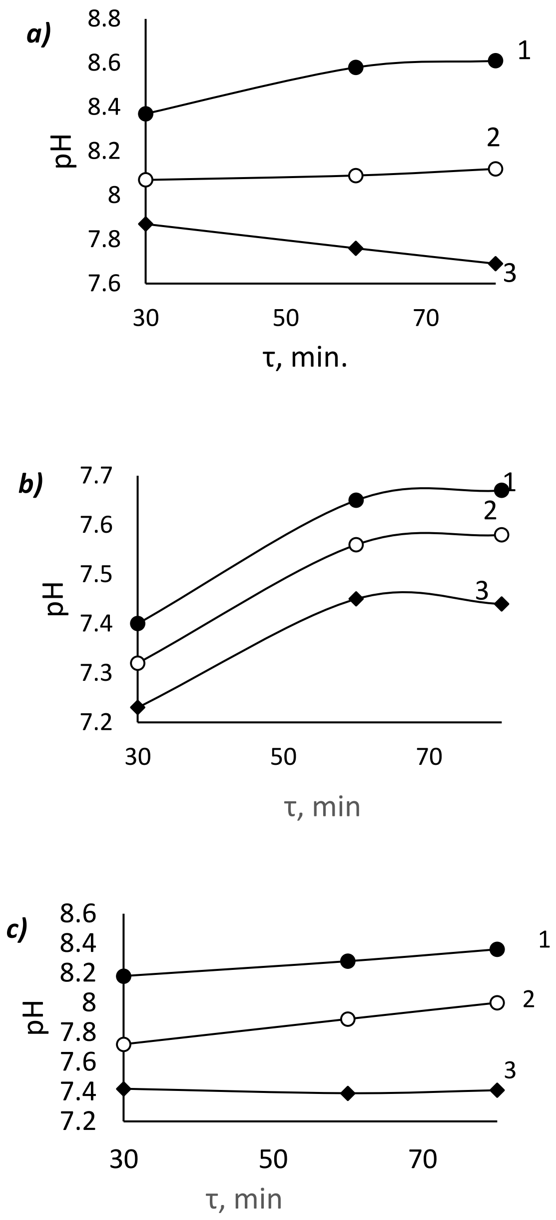



**Figure 4 -** Change in medium pH over time at different ultrasonic power (1-600 W; 2 - 400 W; 3-234 W) for a mercaptan-containing collector composition consisting of oil, sulfur-containing product and butyl xanthate, with the following ratios: a) 0.5: 0.5: 0.25; b) 0.5: 0.5: 0.5; c) 0.5: 0.5: 1.0.

The particle size measurement of the emulsions was performed using a Photocor Compact analyzer as shown in Table 3. The analyzer operates on the principles of static and dynamic light scattering known as photon correlation spectroscopy. The size of the particles dispersed in the liquid, as well as the molecular weight of the polymers, were determined by analyzing the correlation function of fluctuations in the intensity of scattered light and its total scattering intensity. Measured sizes range from 1 nm to 100 µm.

In previous studies, it was found that the use of a composition of oil and xanthate in equal proportions of 1:1 allows to achieve high flotation efficiency [19]. Paper [20] shows the results of experiments to determine the size of the dispersed phase in emulsions with different ratios of oil and xanthate (1:1; 1:2; 1:3) during ultrasonic treatment with different power (234, 400, 600 W) and at different time intervals (35, 65, 105 minutes). Analysis of the data shows that the minimum particle size, 10.73 nm, was observed at a power of 600 W and a treatment time of 65 minutes or more, especially at the ratio of oil to 1:3 xanthate. These results confirm the effectiveness of increasing ultrasound power and processing time to achieve fine particle sizes in predetermined proportions. With an increase in the concentration of xanthate, the size of the microemulsion decreases and its stability increases accordingly. Also, the presence of sulfur compounds in the oil emulsion, which can be natural emulsifiers, most likely has a significant effect on the stability of the microemulsion.

Additional experiments were performed using refined oil, mercaptan-containing product and butyl xanthate in a ratio of 1:1:0.5; 1:1:1 and 1:1:2. The results of these studies are presented in Table 3.

Table 3 shows the results of experiments to determine the size of the dispersed phase in emulsions using refined oil and butyl xanthate in three different proportions (1:1:0.5, 1:1:1, 1:1:2). The emulsions were sonicated at different powers (234, 400 and 600 W) and measured 30, 60 and 80 minutes after the start of the experiments.

It can be seen from Table 3 that with increasing processing time and ultrasonic power, the particle size decreases in most cases. This is especially noticeable in experiments with the proportion of 1:1:2, where the particle size decreased to 6.61 nm with a power of 600 W and a processing time of 60 minutes. This data may indicate that the optimum conditions for achieving the minimum particle size can be achieved with a higher power and processing time. Increasing the power of the exposure process increases cavitation and reduces the size of the dispersed phase of the emulsion.

This leads to the conclusion that it is important to select appropriate processing conditions to obtain emulsions with the desired particle size characteristics, which is important for the practical application of such systems in various processes.

**Table 3** - Influence of ultrasonic treatment power and exposure time on disperse phase size in emulsions with different ratios of oil and xanthate

| No. | Time to reach, min. | Dispersed phase value, nm | | | Experimental conditions |
|---|---|---|---|---|---|
| | | Power, W | | | |
| | | 234 W | 400 W | 600 W | |
| [Refined oil + mercaptan]: butyl xanthate – 1:1:0,5 | | | | | |
| 1 | 30<br>60<br>80 | 59.71<br>59.43<br>61.45 | 43.65<br>18.95<br>21.97 | 31.09<br>24.81<br>30.79 | 0.5g/0.5g/0.25g |
| [Refined oil + mercaptan]: butyl xanthate – 1:1:1 | | | | | |
| 2 | 30<br>60<br>80 | 47.92<br>41.93<br>38.6 | 21.73<br>19.8<br>12.36 | 15.63<br>23.58<br>25.58 | 0.5g/0.5g/0.5g |
| [Refined oil + mercaptan]: butyl xanthate – 1:1:2 | | | | | |
| 3 | 30<br>60<br>80 | 28.39<br>18.95<br>13.51 | 15.79<br>7.16<br>7.73 | 17.58<br>6.61<br>9.63 | 0.5g/0.5g/1.0g |

## Conclusions

Based on the presented data and analysis of the experimental results, it was established that ultrasonic cavitation significantly enhances the efficiency of dispersing and modifying the properties of petroleum products for the production of flotation agents. The application of ultrasound enables control over emulsion stability, improving their characteristics by adjusting exposure power and processing time.

Additionally, the content and chemical form of sulfur in sulfur-containing oil products, particularly mercaptans, have a crucial influence on the properties of collectors. Experiments using refined oil, a mercaptan-containing product, and butyl xanthate in ratios of 1:1:0.5; 1:1:1; and 1:1:2 demonstrated that the 1:1:2 ratio yielded the best results, achieving a particle size reduction to 6.61 nm at 600 W and a treatment time of 60 minutes.

It was also found that ultrasonic cavitation influences not only particle size but also the colloidal properties of the compositions, significantly enhancing their efficiency as collectors. This finding opens up new prospects for the development of advanced mineral processing technologies. These conclusions underscore the importance of innovative approaches in optimizing the production and application of flotation reagents.

***Conflicts of interest.***

The correspondent author declares that there is no conflict of interest on behalf of all authors.

***CRediT author statement:*** **B. Kenzhaliyev**: Conceptualization; **A. Mukhanova**: Conceptualization, Methodology, Software; **D. Turysbekov**: Methodology; **N. Samenova**: Data curation, Writing-Original draft preparation, Software, Validation; **Zh. Kaldybaeva, K. Toktagulova, S. Yussupova**: Visualization, Investigation.

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# Мұнай өнімдері негізінде алынған құрамында меркаптан бар микроэмульсиялық жинағыштардың диспергирлеу қасиеттерін зерттеу

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**ТҮЙІНДЕМЕ**

Мақалада ультрадыбыстық кавитация әдісін қолдана отырып, құрамында күкірті бар отандық мұнай өнімдері негізінде флотореагенттер алу мәселесі қарастырылады. Зерттеу барысында мұнай өнімдерінің сапалық және сандық құрамы талданып, олардың негізінде реагенттерді іріктеуге ерекше мән берілді. Сондай-ақ, неғұрлым тиімді сульфгидрильді жинағыштар меркаптандар (тиоспирттер) екені белгілі. Жұмыста құрамындағы күкірт мөлшері бірдей, бірақ бастапқы материалдардағы күкірттің химиялық формасы әртүрлі болатын мұнай өнімдері қолданылды. Оларға тазартылған мұнай, құрамында меркаптан бар өнім, сондай-ақ мұнайды демеркаптанизациялау арқылы алынған аралық өнім жатады. Аталған мұнай өнімдері мен бутил ксантогенаты негізінде композициялар жасалды. Ультрадыбыстық кавитация процесінің әсерінен уақыт өте келе эмульсиялардың тұрақтылығының өзгеруі, ультрадыбыстық әсер ету қуаты және компоненттердің әртүрлі қатынастағы тәуелділігі зерттелді. Ультрадыбыстық кавитация мен композициядағы компоненттердің пропорциясын оңтайландыру шарттары анықталды. Күкірт мөлшерінің бірдей болуына қарамастан, тек белгілі бір құрылымдағы күкіртқұрамды өнімдер ғана флотореагенттер алу үшін жарамды екені дәлелденді. Сондай-ақ, композициялардың қасиеттерін модификациялауда ультрадыбыстық кавитацияның маңызды рөл атқаратыны анықталды. Бұл фактор олардың жинағыш реагент ретіндегі тиімділігіне айтарлықтай әсер етеді.

***Түйін сөздер:*** тазартылған мұнай, құрамында меркаптан бар жинағыш, бутилді ксантогенат.

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# Изучение диспергирующих свойств микроэмульсионных меркаптансодержащих собирателей, полученных на основе нефтепродуктов


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**АННОТАЦИЯ**

В статье рассматривается получение флотореагентов на основе отечественных серосодержащих нефтепродуктов с применением метода ультразвуковой кавитации. Особое внимание уделено подбору нефтепродуктов, основанному на анализе их качественного и количественного состава. Известно, что наиболее эффективными сульфгидрильными собирателями являются меркаптаны (тиоспирты). В работе использованы серосодержащие нефтепродукты с одинаковым содержанием серы, но различной формой ее присутствия в исходных материалах: очищенная нефть, меркаптансодержащий продукт, а также промежуточный продукт, полученный при демеркаптанизации нефти. На основе указанных нефтепродуктов и бутилового ксантогената были созданы композиции, для которых в процессе ультразвуковой кавитации определялись зависимости изменения устойчивости эмульсий во времени от мощности ультразвукового воздействия и соотношения компонентов. Были разработаны оптимальные условия ультразвуковой кавитации и пропорции компонентов в композициях. Установлено, что, несмотря на одинаковое содержание серы, для получения флотореагентов пригодны только серосодержащие продукты определенной структуры. Также выявлена роль ультразвуковой кавитации в модификации свойств композиций, что существенно влияет на их эффективность в качестве собирателей.



***Ключевые слова:*** очищенный нефть, меркаптан-содержащий продукт, бутиловый ксантогенат.



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