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PHYSICO-CHEMICAL PROPERTIES OF COMPLEX SALTS FORMED BY HEXADECANE, OCTADECANE AND CIS-9-OCTADECENE ACIDS WITH MONOETHANOLAMINE

Abstract

In the article, the results of the study of the quaternary ammonium salt formed by hexadecanoic acid, a monobasic carbonic acid, with monoethanolamine, in laboratory conditions, in distilled, drinking, and sea waters contaminated with Balakhani oil with different degrees of mineralization, are given. The surface activity property of the products of different concentrations of this complex was studied using a tensiometer, the element composition was calculated by calculation, and the composition and structure were confirmed by infrared spectroscopy. The result of investigating the composition of the complexes formed by hexadecanoic acid with monoethanolamine by infrared spectroscopy proves that the reaction proceeds according to the scheme indicated in the article.

As a result of the research, it was determined that the mass share of carbon in the salt obtained on the basis of hexadecanoic acid and monoethanolamine is 68%, the share of hydrogen is 12.6%, the share of oxygen is 15%, and the share of nitrogen is 4.4%. The salt obtained on the basis of hexadecanoic acid and monoethanolamine shows high surface activity by reducing the surface tension at the water-air interface from 71.98 mN/m to 30.9 mN/m. The synthesized reagent has strong oil-collecting and oil-dispersing properties. With the application of this complex, it is possible to remove thin layers of oil from the water surface. The obtained complex is well soluble in ethyl and isopropyl alcohols.

Keywords: *oil collection, oil dispersion, surface tension, surfactant, carbonic acids*

Introduction

One of the most serious environmental problems facing humanity today is the pollution of the world's oceans. Examples of these sources of pollution include tankers carrying oil, accidents during oil extraction and transportation. Oil stains on the surface of the water lead to the deterioration of water quality and the balanced connection of the upper water layers with the atmosphere, disrupting the effect of oxygen on living things. Surfactant substances (SAM) used to remove thin layers of oil from the water surface are divided into oil dispersants and oil collectors (Abbasov, 2002: 6-10; Ahmadova, Abilova, Rahimov, Asadov, Ahmadbayova, 2018: 205, 416-422;

Asadov, Rahimov, Ahmadova, Huseynova, Ahmadbayova, 2017: 229-235; Asadov, Ahmadova, Rahimov, Abilova, Nazarov, Zubkov, 2017: 3297-3305; Asadov, Huseynova, Rahimov, Ahmadova, Zubkov, 2017: 244, 533-539; Asadov, Ahmadova, Rahimov, Abilova, Zargarova, Zubkov, 2018: 21, 247-254; Asadov, Ahmadova, Rahimov, Huseynova, Quliyev, Aliyev, Agamaliyeva, Ahmadbayova, 2019: 861-870; Asadov, Ahmadova, Rahimov, Huseynova, Suleymanova, Ismailov, Zubkov, Mammadov, Agamaliyeva, 2018: 550, 115-122; Asadov, Ahmadova, Zubkov, Rahimov, 2018: 214-219; Humbatov, Dashdiyev, Asadov, Askerov, Hasanov, 2001: 448; Rozen, 2004: 444; Rustamov, Abbasov, Mamedova, Piriev, 2008: 717).

Methodology of the experiment. Hexadecanoic acid is a white crystalline, odorless, saturated monobasic carbonic acid with general formula $C_{15}H_{31}COOH$, relative molecular mass 256.4 g/mol, melting point 62.9 °C, boiling point 351 °C, insoluble in water.

Monoethanolamine (MEA) is a colorless, clear, viscous liquid with a molar mass of 61.1 mol/g and an ammoniacal odor. The surface activity of substances was determined at the air-water interface using a KSV Sigma 702 (Finland) tensiometer using a Du Nui ring.

Conduct of Research.

The reaction between hexadecanoic acid and MEA was carried out in laboratory conditions in a 1:1 molar ratio at 65°C for 1 day with intensive stirring.

The scheme of the reaction is as follows:

$C_{15}H_{31}COOH + NH_2C_2H_4OH \rightarrow$

$[C_{15}H_{31}COO^- \; N^+ \; H_3C_2H_4OH]$

In the salt obtained on the basis of hexadecanoic acid and MEA, the mass share of carbon is 68%, the share of hydrogen in ash is 12.6%, the mass share of oxygen is 15%, and the mass share of nitrogen is 4.4%.

Results and their discussion.

The IR spectrum of the salt formed by hexadecanoic acid with MEA was recorded on FT-IR, Spectrum BX and ALPHA (Bruker) spectrometers using a KBr disk. In the IR-spectrum of the obtained complex, C-H valence at 2848, 2915, cm^{-1}, COO-valence in complex ether fragment at 1405, 1533 cm-1, C-H strain at 1464 cm^{-1}, 2552, 2636 cm^{-1} There are bands of N+-H oscillations. The values of specific electrical conductivity of aqueous solutions of different concentrations of salts formed by MEA of hexadecane, octadecane and cis-9-octadecene acids were determined with the help of a conductometer (picture 1). As can be seen from Figure 1, as the concentration of SAMs in the solution increases, the values of specific electrical conductivity increase.

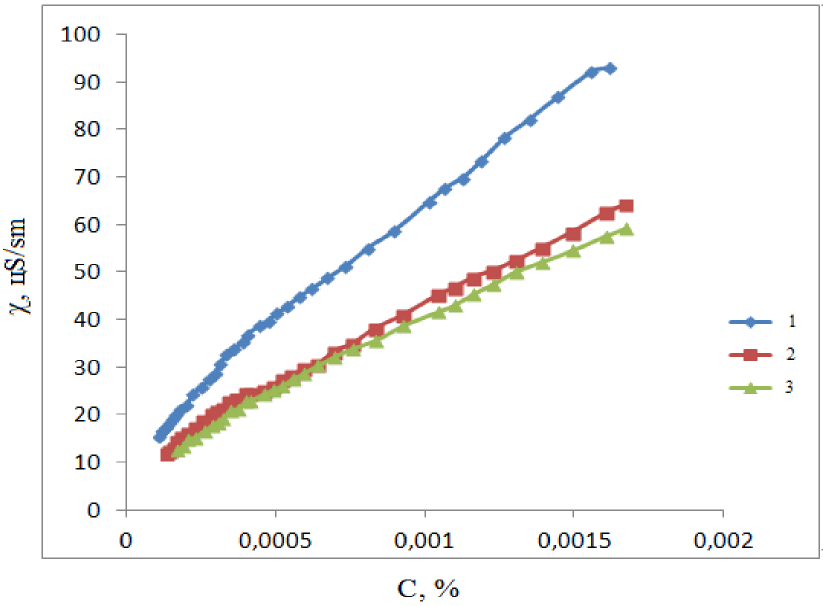

Figure 1. Electrical conductivity curves of hexadecane (1), octadecane (2) and cis-9-octadecene (3) salts formed by MEA

Surface tension isotherms were constructed based on the surface tension values measured by the tensiometric method (Fig. 2)

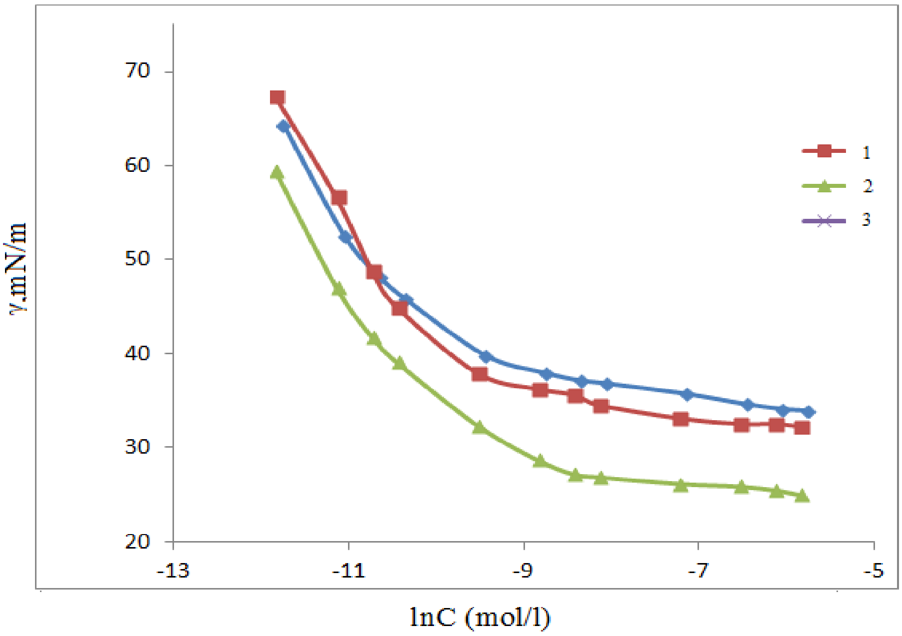

Figure 2. Electrical conductivity curves of salts of hexadecane (1), octadecane (2) and cis-9-octadecene (3) acids formed by MEA

Based on this picture, the dγ/dlnC value was determined by a graphical method (5). The surface tension at the water-air boundary in a non-reagent environment is equal to 72.0 mN/m. Electrical conductivity curves of salts of hexadecane, (1), octadecane (2), and cis-9-octadecene acids (3) formed by MEA, respectively stabilization of surface tension values occurs at 34.0, 32.2, 25.0 mN/m. The colloid-chemical parameters of the synthesized SAMs were calculated according to the equation given in (5) and the results are listed in table 1.

Table 1. Colloid-chemical parameters of salts formed by MEA of hexadecane, octadecane and cis-9-octadecene acids.

SAM	KMQ×10^{-3}, mol·dm^{-3}	G_{max}×10^{-10}, mol·sm^{-2}	A_{min}×10^{-2}, nm^2	γ_{KMQ}, mN·m^{-1}	π_{KMQ}, mN·m^{-1}	pC_{20}	ΔG_{mis}, kC/mol^{-1}	ΔG_{ad}, kC/mol^{-1}
1	1.57	1.99	83.6	34.7	37.3	4.77	-25.69	-44.47
2	1.45	1.78	93.6	32.5	39.5	4.73	-25.89	-48.14
3	1.46	2.37	69.9	25.9	46.1	4.53	-25.87	-45.31

Note: KMQ is the critical micelle formation density, γKMQ is the surface tension of the solution during KMQ, Γmax is the maximum adsorption, Amin is the minimum surface area of the polar group, πKMQ is the surface pressure or efficiency, pC20 is the efficiency value, ΔGmis is the enthalpy change during micelle formation. , ΔGad is the enthalpy change during the adsorption process.

Complexes formed by hexadecane and heptadecano acids with TEA were studied as an oil collecting and oil dispersing agent in cleaning the water surface clouded with an oil layer with a thickness of 0.17 nm. The effectiveness of this reagent was studied in the laboratory on waters with different degrees of mineralization using the Balakhani light oil sample. The reagent was used both in its pure form and in the form of a 5% aqueous solution. The reduction of the area of the primary oil layer due to the penetration of the reagent into oil-contaminated waters determines its effectiveness. The oil accumulation coefficient is a quantity that characterizes this effect. K is calculated as the ratio of the initial area of the oil layer to the area of the oil spot formed by the effect of the reagent.

Table 2 – Research results of oil collection and oil dispersing ability of hexadecanoic acid and monoethanol complex (Balakhan oil; thickness 0.17 mm).

The case of giving the reagent to the surface of the oil	Distilled water		Drinkable water		Sea water	
	τ, time	K(K_D,%)	τ, time	K(K_D,%)	τ, time	K(K_D,%)
Undiluted product	0-24 48-72 72-96	8.0 9.0 9.0	0-24 48-72 72-96	9.7 9.1 9.1	0-24 48-72 72-96	Disp. 70%
5% aqueous dispersion	0-24 48-72 72-96	9.6 9.0	0-24 48-72 72-96	Disp.	0-24 48-72 72-96	Disp. 70%

As a result of the research, it was determined that the undiluted and 5% solution of the reagent shows oil-dispersing properties in seawater. The reagent keeps its effectiveness for 4 days.

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