COMPARATIVE INHIBITORY CAPACITY OF CO_2 – CORROSION INHIBITORS ON THE BASE OF SUNFLOWER AND COTTONSEED OILS

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One of the effective methods of oil recovery increasing of layers is carbon dioxide pumping into layer.

Carbonic acid, creating by dissolving of CO_2 in water, dissolves some types of cement and stratum rocks and increases their permeability. In CO_2 presence the swelling ability of clay particles decreases. Carbon dioxide dissolves in oil 4-10 times better than in water, therefore, it can pass from an aqueous solution to oil. During transition the interfacial tension between them considerably reduces and displacement is increasing.

Furthermore, carbon dioxide in water contributes the wash of film oil covering grains and rocks and decreases the probability of water film breaking. Hereupon, oil drops in low interfacial tension passes in pore channel freely and oil relative permeability is increasing.

During CO_2 dissolving in oil the oil viscosity is reducing, density is increasing, but the volume is extending considerably: oil is swelling (sui generis).

Increasing of oil volume 1.5-1.7 times by dissolving CO_2 in it makes a major contribution to rise of layer oil recovery during development of deposits which contain low-viscosity oils.

Though, along with listed advantages, the use of carbon dioxide promotes the intensification of corrosion process of metallic surface, so it is required to use appropriate corrosion inhibitors. In this case, using of surfactants, which has low toxicity, high molecular weight and hydrophobicity, are reasonable.

Use of common surface-active substances (SAS), contain one hydrophilic group in hydrophobic chain, as corrosion inhibitors was studied sufficiently. It was revealed that mechanism of action of amphiphilic compounds consists in formation of protective layer on metal surface [1-3]. Examples of SAS using are salts of fatty acids used for steel protection in neutral medium [4-7]. The shortcomings of these SAS are low solubility and formation of insoluble soaps in hard water.

There are information in literature about using as inhibitors the steel of various modifications of fatty acids permitting to avoid above-listed shortcomings [8,9].

In presented work it was researched comparative inhibitory capacity of Na-salts (I) and monoethanolamine complexes (II) of sulfoderivatives of fatty acids of cottonseed and sunflower-seed oils.

For obtaining of above-listed sulfoderivatives, vegetable oils were saponified with the following sulphurization of obtained fatty acids.

Physicochemical properties of fatty acids of cottonseed and sunflower-seed vegetable oils and their sulfacids, also Na-salts and monoethanolamine complexes of sulfoderivatives of fatty acids of cottonseed and sunflower oils are presented on Tables 1 and 2.

Table 1

Physicochemical properties of fatty acids of cottonseed and sunflower-seed vegetable oils and their sulfacids

Measures	Cottonseed oil		Sunflower oil	
	Fatty acids	Sulfacids	Fatty acids	Sulfacids
Acid number, mqKOH/q	142,5	269	145,6	280
Apparent molecular weight	275	373	279	377
Iodine number, q J_2/q of product	112	--	117	--
Density on 20 °C, kq/m³	913,0	917,0	907,5	901,1
Konstant of refraction η_{20}^{D}	1,4676	1,4590	1,4680	1,4610

Table 2

Physicochemical properties of synthesized sodium salts and monoethanolamine complexes of sulfoderivatives of fatty acids of cottonseed and sunflower oils

Structural formula of sodium salts and monoethanolamine complexes of fatty acids' sulfoderivatives	Measures		
	Molecular weight	Density on 20 °C, kq/m³	Chilling point, °C
	On base of sunflower oil		
$R\text{-}(CH_2)_n\text{-}CH(O\text{-}SO_3Na)\text{-}(CH_2)_n\text{-}COONa$ (I)	421	985,0	-25
$R\text{-}(CH_2)_n\text{-}CH(O\text{-}SO_3\text{-}NH\text{-}CH_2\text{-}CH_2OH)\text{-}(CH_2)_n\text{-}CO\text{-}NH\text{-}CH_2\text{-}CH_2OH$ (II)	463	965,0	-14
	On base of cottonseed oil		
$R\text{-}(CH_2)_n\text{-}CH(O\text{-}SO_3Na)\text{-}(CH_2)_n\text{-}COONa$ (I)	417	989,0	-29
$R\text{-}(CH_2)_n\text{-}CH(O\text{-}SO_3\text{-}NH\text{-}CH_2\text{-}CH_2OH)\text{-}(CH_2)_n\text{-}CO\text{-}NH\text{-}CH_2\text{-}CH_2OH$ (II)	459	959,0	-17

Anticorrosion properties of obtained derivatives of sunflower and cottonseed oils have been studied on apparatus ACM GİLL AC with using of electrods of carbon steel with grade 080A15 and area 7,9 sm^2 . Protective actions of synthesized compounds were investigated in CO_2 – contain background solution with 1% NaCl, prepared by dissolution of chemically pure NaCl in distilled water and with adding to this solution 25-100 ppm of synthesized inhibitors on 50 ^oC. The results of corrosion inhibition efficiency of steel electrods are shown on Table 3.

Table 3
The results of corrosion inhibition efficiency of steel electrods
in presence of synthesized corrosion inhibitors

Inhibitor	Concentration of inhibitor, ppm	Metal loss mq sm^2/q	Corrosion rate, mm/q	Braking efficiency, %
Without inhibitor	--	$7,46 \times 10^{-3}$	3,78	--
	Salts and complexes on basis of sunflower oil			
(I)	25	$4,258 \times 10^{-4}$	0,223	94,2
	50	$3,255 \times 10^{-4}$	0,132	95,6
	75	2.478×10^{-4}	0.098	96.3
	100	$1,106 \times 10^{-4}$	0,066	98,5
(II)				
	25	$3,017 \times 10^{-4}$	0,109	96,0
	50	$2,519 \times 10^{-4}$	0,059	97,0
	75	$1,486 \times 10^{-4}$	0.014	98.2
	100	$3,008 \times 10^{-5}$	0,003	99,6
	Salts and complexes on basis of cottonseed oil			
(I)	25	1.025×10^{-3}	0,515	86,4
	50	5.833×10^{-4}	0,0296	92,2
	75	4.080×10^{-4}	0,207	94,57
	100	2.480×10^{-4}	0,126	96,7
(II)				
	25	$8,800 \times 10^{-4}$	0,447	88,2
	50	$4,931 \times 10^{-4}$	0,250	93,4
	75	$2,640 \times 10^{-4}$	0,134	96,4
	100	$2,238 \times 10^{-5}$	0,010	99,7

As follows from Table 3, synthesized corrosion inhibitors provide effective protection of steel surface already on inhibitor concentration 25-50 ppm. Moreover, monoethanolamine complexes of sulfoderivatives of fatty acids on base of sunflower and cottonseed oil were found more effective inhibitors of corrosion process of steel electrods than analogous soda salts.

It should be noted that if for more concentration (75-100 ppm) the inhibitors' activity, obtained on base of sulfoderivatives of sunflower and cottonseed vegetable oils, approximately identical and compose 96,3-99,7%, for low concentrations it is observing inhibitors' advantage on base of sunflower oil, what probably connected with most unsaturation of fatty acids of sunflower oil.

For instance, for inhibitors on base of sunflower oil with concentration 25 ppm the braking efficiency of corrosion composes 94,2-96,0%, in the same concentration the value of braking efficiency for inhibitors based on cottonseed oil is less by 7,8% and composes 86,4-88,2 %.

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Biography

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