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Содержание

GRAVIMETRIC DETERMINATION OF THE INHIBITORY PROPERTY AGAINST METAL CORROSION OF SUBSTANCES OBTAINED ON THE BASIS OF THIAINDAN AND THIOCHROMAN A-AMINO KETONES

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ГРАВИМЕТРИЧЕСКОЕ ОПРЕДЕЛЕНИЕ ИНГИБИРУЮЩЕГО СВОЙСТВА ПРОТИВ КОРРОЗИИ МЕТАЛЛОВ ВЕЩЕСТВ, ПОЛУЧЕННЫХ НА ОСНОВЕ ТИАИНДАНОВЫХ И ТИОХРОМАНОВЫХ А-АМИНОКЕТОНОВ

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АННОТАЦИЯ

Исследованы антикоррозионные свойства α-аминокетоны тиаинданового и тиохроманового ряда в растворе 15%-ной соляной и 20%-ной серной кислоты. Установлено, что исследуемые соединения в этих средах проявляют высокие защитные свойства при кислотной коррозии.

ABSTRACT

The anticorrosion properties of the α-aminoketones of the thiindane and thiochromane series in a solution of 15% hydrochloric and 20% sulfuric acid were investigated. It has been established that the studied compounds in these environments exhibit high protective properties under acid corrosion.

Ключевые слова: морфолин, пиперидин, тиаиндан, тиохроман, ингибитор, аминокетоны, коррозия, гравиметрия, вторичный амин

Keywords: morpholine, piperidine, thiaindan, thiochroman, inhibitor, amino ketones, corrosion, gravimetry, secondary amine.

Introduction

The use of corrosion inhibitors is one of the most effective ways to prevent the corrosion process. The corrosion process proceeds slowly (accumulation of slag on the surface) or by accelerating the process (increasing the work of microgalvanic pairs in pure metals due to active reaction products, impurities). In such cases, the gravimetric method is determined by measuring the average rate of corrosion over a period of time. Experiments are carried out by dropping metal samples into inhibitor solutions in chemical beakers. If the melting reaction of the metal proceeds vigorously and the surface of the acid is in contact with air, then the depolarization solubility of hydrogen in steel is 93-95%. In such cases, the experimental results are reduced by 5-7%.[3;P. 413-418]

In the course of this study, the inhibitory properties of the following synthesized compounds were studied at different temperature ranges and concentrations of different aggressive media. For research, α-piperidino-2-methyl-5-acetyl-1-thiain (AIT-1), α-morpholino-2-methyl-5-acetyl-1-thiain (AIT-2), α-piperidino-6-acetyl-1-thiochroman (AIT-3) and α-morpholino-6-acetyl-1-thiochroman (AIT-4) substances were selected. The inhibitory properties of these compounds were determined by gravimetric method on ARMKO-iron electrode made of tubular steel St-80, size 40x20x5 mm, height 30 mm, surface area 0.0314 cm^2. 20% HCl and 25% H2SO4, 1M HCI and 1M H_2SO_4 solutions were used as corrosive-aggressive media. The data obtained as a result of the studies are presented in Table 1 below.

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Table 1.

Efficiency level of AIT-1 and AIT-2 type inhibitors in 20% HCl and 25% H_2SO_4 solution at 25 ^{0}C

Inhibitor password	The amount of inhibitor, mg/l	time, hour	20% HCl		25% H_2SO_4	
			$K_{g/м^2 \cdot h}$	Z%	$K_{g/м^2 \cdot h}$	Z%
1	2	3	4	5	6	7
AIT-1	50	4	0,84	95,80	1,84	93,99
		6	0,89	95,76	0,97	96,73
		8	0,84	96,33	0,95	96,85
	100	4	0,46	97,70	0,87	97,22
		6	-	-	0,93	96,86
		8	-	-	0,92	96,95
	250	4	0,48	97,60	0,50	98,40
		6	0,33	98,12	0,45	98,48
		8	0,38	98,34	0,45	98,50
	500	4	0,48	97,60	0,48	98,46
		6	0,36	98,28	0,36	98,78
		8	0,31	98,64	0,39	98,70
	1000	4	0,55	97,25	0,38	98,78
		6	0,45	97,85	0,34	98,85
		8	0,39	98,29	0,36	98,80
AIT-2	25	4	1,15	94,25	0,95	96,96
		6	1,16	94,47	-	-
	100	4	0,89	95,55	0,89	97,15
		6	0,78	96,28	-	-
	250	4	0,59	97,05	0,53	98,30
		6	0,49	97,66	-	-
	500	4	0,48	97,60	0,34	98,91
		6	0,39	98,14	-	-
	1000	4	0,35	98,25	0,20	99,36
		6	0,38	98,19	-	-

From the data in Table 1, it can be seen that the inhibition efficiency of AIT-1 and AIT-2 in 20% HC1 and 25% H_2SO_4 solutions at a temperature of 25^{0}C increases in parallel with the increase of inhibitor concentration and time. Based on the results, it can be said that the inhibitory properties of AIT-1 and AIT-2 inhibitors in sulfuric acid solution are higher than in hydrochloric acid solution.

Figure 1 below shows the concentration dependence of the protection level of AIT-1 and AIT-2 inhibitors against corrosion of St.80 metal alloy in the environment of 25% H_2SO_4+ 20% HCl solution. [1;P.63-68]

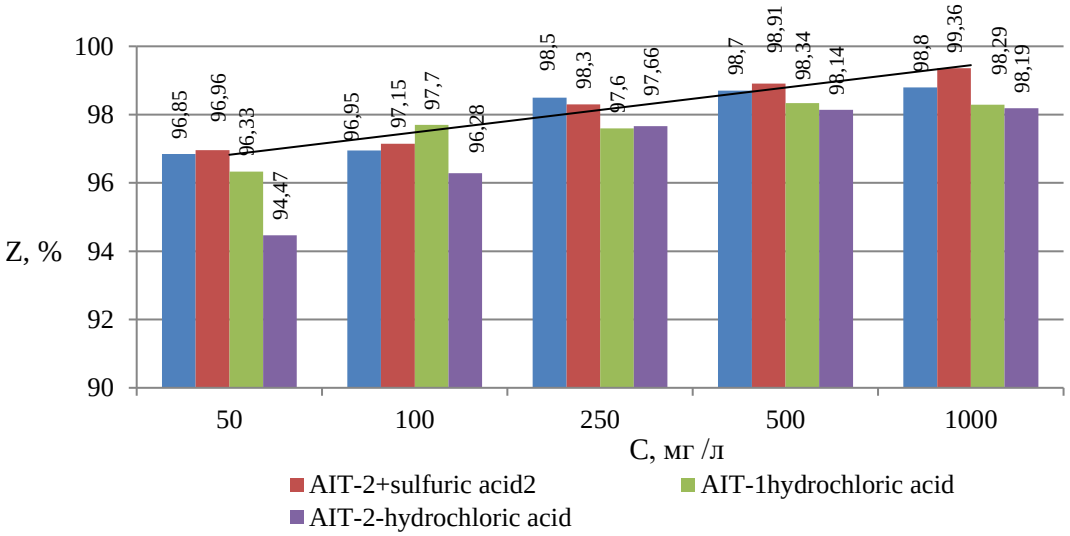


Figure 1. Concentration dependence of the level of protection of AIT-1 and AIT-2 inhibitors in the medium of 25% H_2SO_4+ 20% HCl solution of St.80 metal alloy

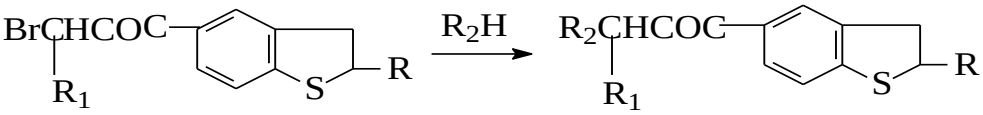
Table 2 below provides information on the degree of protection of AIT-3 and AIT-4 inhibitors. As can be seen from the data in Table 2, the inhibitors identified under the code AIT-3 and AIT-4 have high inhibitory properties even at a very low concentration, i.e. 50 mg/l, in 20% HCl and 25% H_2SO_4 solution selected as an aggressive medium (92 -98%) shows. In a 20% hydrochloric acid solution, which is considered an aggressive environment, the efficiency of the AIT-4 type inhibitor, that is, the inhibitor containing the morpholine radical, is 98.7%, while the efficiency of the piperidine-containing representative of the same compound, AIT-3, is 97.42%.

Table 2.

Effectiveness level of AIT-3 and AIT-4 type inhibitors in 20% HCl and 25% H_2SO_4 solution at 25 ^{0}C

Inhibitor password	The amount of inhibitor, mg/l	time, hour	20% HCl		25% H_2SO_4	
			$K_{g/м^2 \cdot h}$	Z%	$K_{g/м^2 \cdot h}$	Z%
AIT-3	50	2	1,77	91,15		
		4	1,50	92,86		
		6	1,17	94,90		
	1000	2	0,94	95,30	0,40	98,72
		4	0,68	96,76	0,35	98,82
		6	0,59	97,42	0,52	98,91
AIT-4	50	2	0,68	96,60	0,44	98,59
		4	0,58	97,23	0,26	99,12
		6	0,48	97,90	0,33	98,91
	1000	2	0,50	97,50	0,17	99,46
		4	0,30	98,57	0,15	99,49
		6	0,30	98,69	0,14	99,54

Chemical structure of the inhibitors experience above:

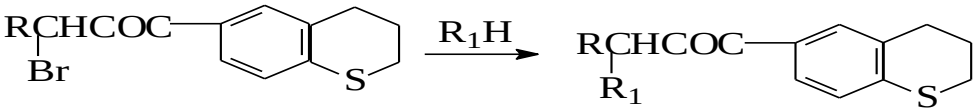


R=H; R_1=H; R_2= Piperidine

R=CH_3; R_1=H; R_2= Piperidine

R=CH_3; R_1=H; R_2= Morpholine

R=CH_3; R_1=CH_3; R_2= Piperidine



R=H; R_1= Morpholine. R=H; R_1= Piperidine

This indicates that the inhibitor containing the morpholine radical shows a higher inhibition efficiency compared to the inhibitor containing piperidine in the molecule. When comparing the inhibitory efficiency of the same compounds in 25% sulfuric acid, which is an aggressive medium, the efficiency level of the inhibitor containing the morpholine radical was 98.91% at 50 mg/l, while the efficiency level of the AIT-3 inhibitor containing the piperidine radical was the same at 50 mg/l showed that it was at a very low non-significant level. However, it was found that the efficiency of AIT-3 inhibitor is 98.91% and the efficiency level of AIT-4 inhibitor is 99.54% in the working system of 1000 mg/l of these substances. Based on the research results, it can be said that the role of morpholine radical inhibitors in protecting metals from corrosion is somewhat higher than that of piperidine radical inhibitors. The inhibitory efficiency of the investigated AIT-3 and AIT-4 type inhibitors was higher in sulfuric acid than in hydrochloric acid, which is considered an aggressive medium. [2;P. 54-59]

Thus, during the gravimetric study of the anti-corrosion property of the researched inhibitors, it was found that it is a good inhibitor of the corrosion process in an acidic environment. Bonding of sulfur atom in all synthesized inhibitors with aromatic group on one hand and semi-aromatic group on the other hand shows that inhibitor molecules are able to form strong chemisorption type bonds with structural materials in these aggressive corrosive systems.

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