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Inhibiting Corrosion of Iron and Aluminum Involved in Working in a Galvanic Cell in a Neutral Environment Using Citrus Juice

Sikachina Andrei A*

Municipal Autonomous Educational Institution "Gymnasium No. 1 of Sovetsk-town", Russian Federation

***Corresponding author:** Sikachina Andrei A, Municipal Autonomous Educational Institution "Gymnasium No. 1 of Sovetsk-town", Russian Federation

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ABSTRACT

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Introduction

The use of steel [1,2], aluminum [3,4], copper [5,6] is constantly used to build model galvanic elements, since only in this way the corrosion tendency of the metal planned for the manufacture of the product can be determined, and the degree of inhibitory corrosion of such metal with various substances and in various environments (in most articles in acidic [1,3,5,7-12], including when heated [10]. For this, numerous researchers around the world were used [12,11,5] and The following interpretations of the work of galvanic cells are used: gravimetric methods (including subsequent quantum-chemical modeling of the relationship "protective effect against corrosion-quantum descriptors") [4-9], the construction of polarization curves for the analysis of the cathode and anode mechanism of inhibiting the reaction [10,1], spectral analysis of the inhibitor-metal adsorption complex [5 9]. Earlier, the author used the method by which the dependence of the AM was studied Voltage feather, with parallel by analog millivoltmeter and milliammeter [13]. In this article, the same method is implemented. As corrosion inhibitors in various environments, extracts of natural plant objects are very often used [2,7-10,3,12,1], single chemicals of various classes (in the vast majority of nitrogen-containing ones) are less common [5], or their mixtures in various proportions in various proportions [6,2]. Of course, the search for quantum -chemical interconnection can only be performed if the inhibitor is an individual, purified substance that has a clearly defined chemical formula. Very rarely for inhibition purposes are used inorganic substances [8]. The novelty of this scientific work is that the neutral medium of the electrolyte solution, the fruits of the citrus fruits are used.

Materials and Methods

The electrolyte was prepared Next (Figure 1), the inhibitor added in an amount of 0.7 ml and 1.3 ml was added when mixed. The measurement unit without an inhibitor in the text was called control. ING inhibitor is fresh tangerine juice that does not have storage history, not diluted. The analog millivoltmeter TVT -322 and a milliammeter of 91C4 -200 were used (Figure 2). Thus, very simple galvanic cells were: —

Each measurement cycle was drawn for 30 minutes, and the distance between neighboring points on the following graphs is 1 minute. The dimensions of all quadrangular electrodes were selected the same: 49 × 17 × 0.5 millimeters. Air oxygen will be present in an aqueous solution, because, to approach real conditions, the solutions did not boil and the electrochemical cell was not filled with inert gas. Thus, the expected chemical reactions will be (the possibility of direct transfer of copper from the copper electrode to

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steel or iron) is not excluded (Figure 3). The adhesion of copper to the surface of metal samples was determined at a qualitative level: adhesion was checked by a double immersion of the sample by the edge under the surface of distilled water at a yes/no level (average adhesion/no adhesion), the sample was held by plastic tweezers. If some part of the copper did not go into the solution of the surface of the metal, the adhesion was recognized as average, if all the copper went, and the surface of the metal was cleansed-adhesion was recognized as zero.

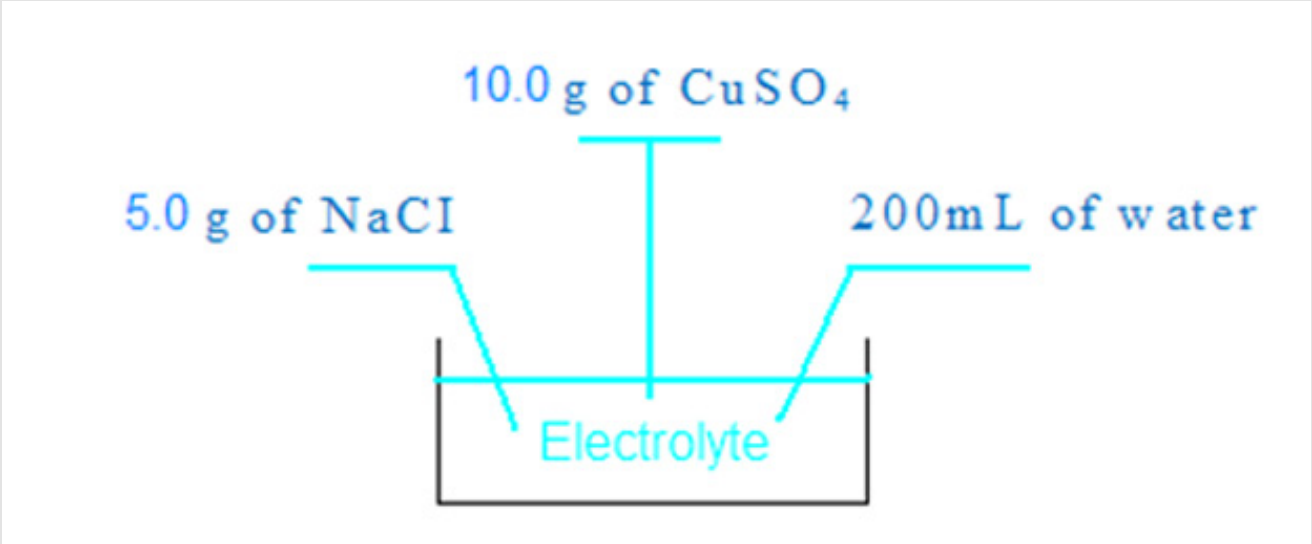

Figure 1: What substances and in what proportions were mixed in the used electrolyte (not counting the inhibitor).

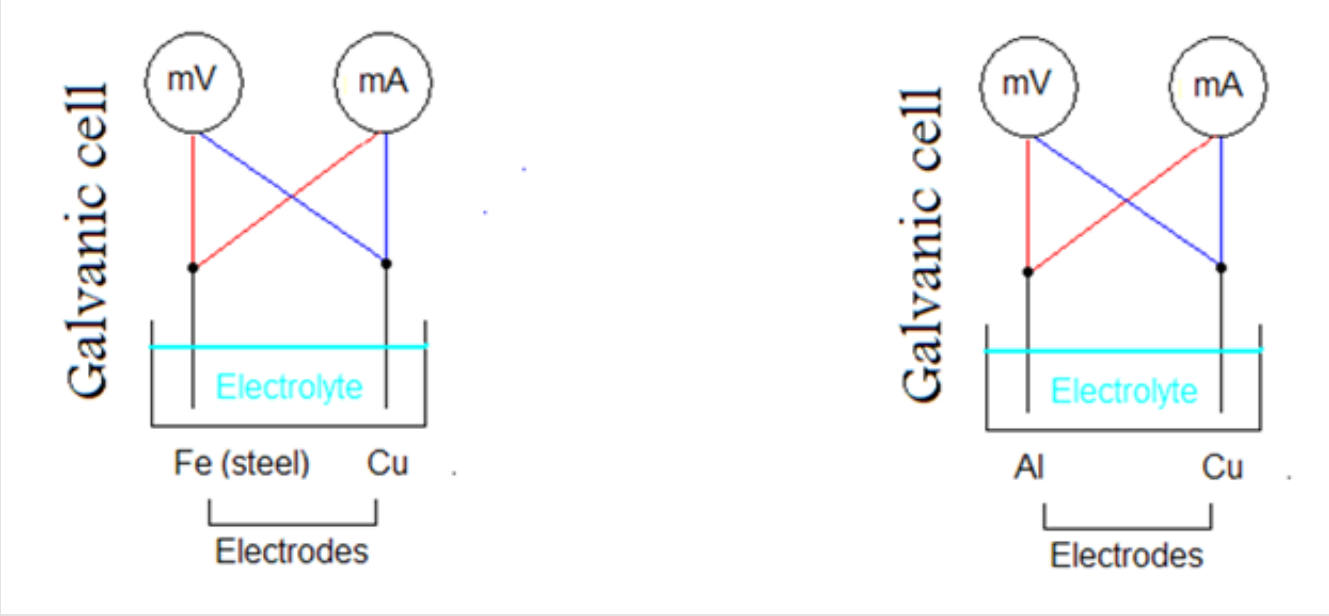

Figure 2: General type of installations with the same and unchanged distance between fixed electrodes.

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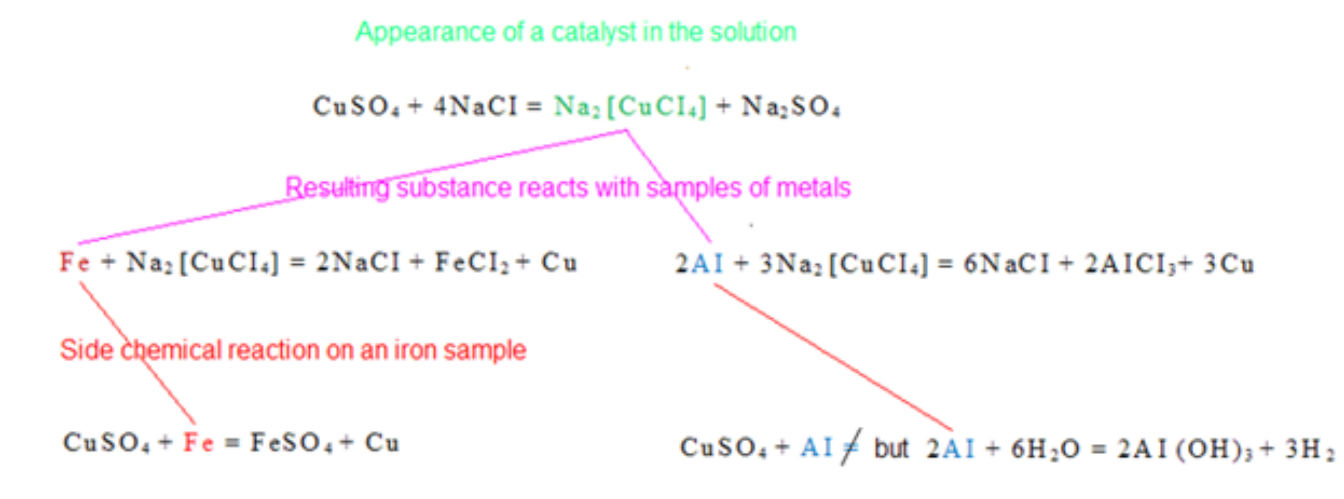

Figure 3: The first line is the birth of a reagent from a catalyst and the original substance, the second line is the main reactions, the third line is adverse reactions.

Results and Discussion:

The value μ will be used - this is mA/mV. In all episodes of the experiment, there was a decrease in the value μ.

Galvanic Cell with a Steel Sample

The amperage dependence on the voltage on a steel sample is the nature of the changes is the same - a linear character (the angle with the axis of the abscissa is the same). On a steel sample, a uniform decrease in μ with an increase in the amount of inhibitor is observed - obviously, this is due to the average activity of steel iron in a series of stresses. It is approximately noticeable that the developed current strength by a steel model is 6 times less than the developed current strength by an aluminum sample, and the developed voltage by a steel sample is 2 times less than the developed voltage with an aluminum sample. In addition, changes in time occur faster, which is expressed in a small distance between individual points (the distance between two points is 1 minute) (Figure 4).

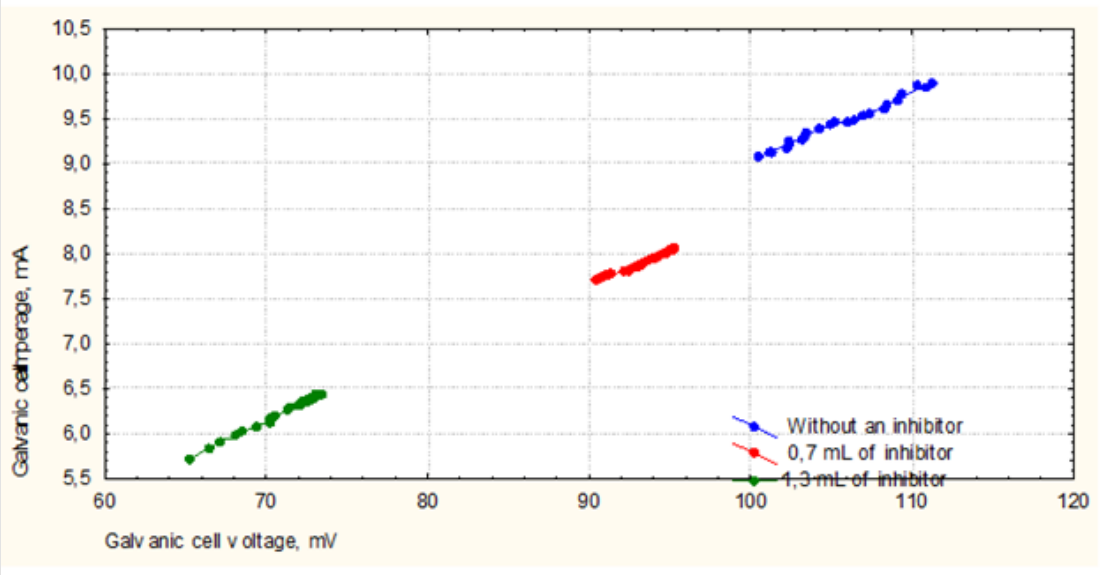

Figure 4: Different doses of the inhibitor reduce the current strength and voltage (steel sample) developed by the galvanic cell.

Galvanic Cell with an Aluminum Sample

The amperage dependence on the voltage on the aluminum is the nature of the changes is the same - a linear character (the angle with the axis of the abscissa is different). The aluminum sample shows its electrical properties extremely interestingly: with a small amount of inhibitor, an increase of μ is observed, at 1.3 ml it almost merges with control, as if they could coincide with any not very different concentration. The current strength varies weakly, unlike voltage (practically does not weaken the current strength, but the voltage increases). (Figure 5) The aluminum sample increases the current strength and voltage of the galvanic element, in which it participates compared to the steel sample. This is especially true for current strength, which is explained by the higher activity of aluminum metal and the constant presence of Al_2O_3. The lack of adhesion of copper to the surface of the aluminum sample is noteworthy. Such observation may be associated with the formation of Al_2O_3. The control curve and the 1.3 ml curve come together, which is associated with the presence of negative charges in the components of the inhibitor and its molecules cannot be adopted on the aluminum rich in electrons, so the large amount of inhibitor no longer protects the metal (and, perhaps, catalyzes the formation of Al2O3 with possible adsorption on it). Of course, an adverse reaction of aluminum with water also makes a contribution, since CuSO4 creates an acidic environment due to hydrolysis, at the same time the $Al2O_3$ oxide film is also removed.

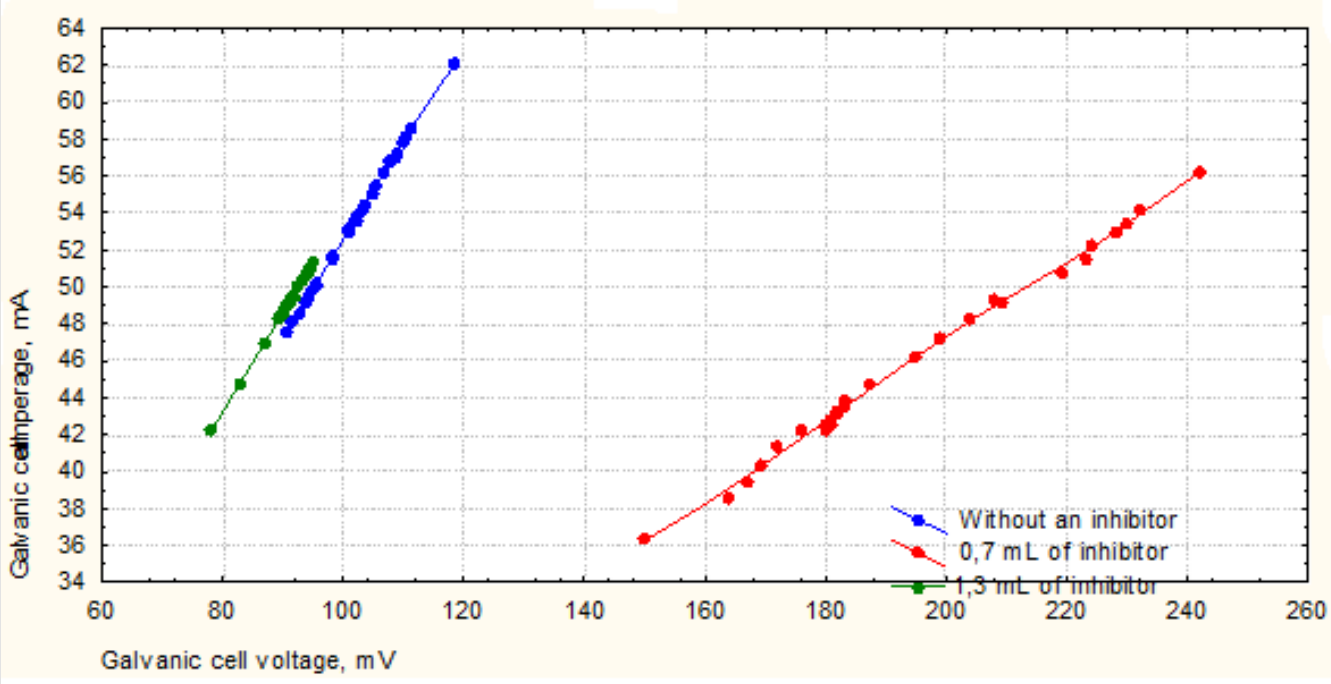

Figure 5: Different doses of the inhibitor mainly reduce the tension developed by the galvanic cell (aluminum sample).

About Copper Released on Cathodes

Extracted from the galvanic cell (from steel and aluminum samples-electrodes) copper had the next mass (Table 1). The mass of copper, which is observed, is due to 2 processes: the main and side (Figure 1). Both are implemented on a steel sample to a large extent, but copper on a steel sample is distinguished by a stichiometrically less than on an aluminum sample. On the contrary, on an aluminum sample, the main reaction gives 3 times more copper, judging by stichiometry, but the side reaction does not occur at all. Competition of a pair of chemical reactions gives rise to the real mass of the released copper. The zero adhesion of copper on the surface of the steel is realized when the galvanic cell is added to the electrolyte of 1.3 ml of the inhibitor, which is explained by the adsorption filling of the surface of the steel molecules of the inhibitor. There is a different situation in the case of an aluminum sample: zero adhesion is realized there in all cases, which is explained by the obvious impossibility of adsorption of the inhibitor molecules on the surface of an constantly regenerated film Al_2O_3.

Table 1: The result of competition of the main and side chemical reactions that give rise to the precipitation of copper.

Inhibitor volume, ml	Copper mass, g	Degree of adhesion, yes/no - level
STEEL		
0	2.7	Average
0,7	2.2	Average
1.3	1,7	No
ALUMINUM		
0	3.1	No
0.7	1.4	No
1.3	2	No

Conclusion

The stereotypical effect of the inhibitor was noticed in the case of the use of a steel model. In the case of the use of an aluminum sample, a strong effect on inhibitory properties (changing spasmodic) exert negative charges of the inhibitor components, removal and constant updating of the oxide film. All these factors cause a sharp increase in the power of the galvanic cell with aluminum, so aluminum in the aquatic environment is extremely prone to corrosion and the methods of inhibitory protection have become difficult for him.

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