



Increasing Of The Corrosion Resistance By Preparing The Trivalent Nickel Complex



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Abstract

This paper is intended to investigate the preparation of a complex ion Ni chloride (II) and with ligand Schiff base (N, N) dimethyl of the amino Benzaldehyde and characterized ligand prepared and complexion Ni chloride(II). These metallic organic chemical compounds have been checked using Spectroscopic Techniques Spectrums of infrared and spectra of UV. The study included a Test of the Corrosion Rate of free matter and nickel complex in tap water solution in a linear polarization method By the linear polarization curves resulting from Tafel device readings. The results showed that the nickel complex has an effective inhibitory effect due to the low current value, which increases its corrosion resistance.

Keywords: Corrosion; Inhibitor material; Nickel Complex; Tafel exploration method.

1. Introduction

Strictly speaking, Schiff bases are applied to organic compounds that contain the amine group or what is known as the azomethine group what is known as the having a formula $-C=N-$. Moreover, the association of the carbon atom with a double atom with the nitrogen atom is merit to the preparation of compound to the world Schiff [1]. In 1964 AD, he attended a number of these rules

through a simple intensification reaction between aldehydes or ketones with aliphatic or aromatic primary amines With aliphatic or aromatic primary amines or with amino acids [2]. Often the amines have become called the principles of Schiff, a term used by chemists to denote organic compounds of formula $RR'C=NR''$ containing the group of amines [3]. Where R is an aryl group' R' is a hydrogen atom and R'' is either an alkyl or aryl group. However,' usually compounds where R'' is an alkyl or aryl group and R' is an alkyl or aromatic group is also counted as Schiff bases.82 The Schiff base class is very versatile

as compounds can have various substituents and can be unbridged or N, N bridged. Schiff bases commonly have NO or N₂O₂ -donor atoms, but the oxygen atoms can be replaced by sulfur, nitrogen or selenium atoms. The salphen and salen complexes were studied thoroughly as the essentials of the Schiff method.

Corrosion is the loss of metal as a result of chemical interaction with the environment. It is defined as a percentage of weight loss or the corrosion's penetration rate, measured inches per year[4]. Corrosion may occur when liquids or gases are present. It may happen at any temperature. However, the rate of corrosion usually increases as the temperature rises. Liquid corrosion is often caused by contaminants or trace elements within the liquid. For example, the presence of chlorine promotes the development of hydrochloric acid, whereas the presence of sulfur promotes the formation of sulfuric acid. It is crucial to remember that any alloy, stainless steel or not, might corrode under specific conditions. Corrosion may not always imply a damaged product; it might also suggest an incorrect use of that product, such as utilizing a material that is not the greatest match for a certain climate[5]. Metals, especially stainless steel, generate a thin coating of chromium oxide that shields the inner metal from oxygen. This is significant because rust/iron oxide requires oxygen to form. There will be no rust if there is no oxygen. The layer is self-healing and passive (the process is called passivation); if the surface is scratched, the oxide layer regenerates itself if oxygen is available.

Corrosion-resistant alloys include stainless steel, copper-based alloys, and nickel-based alloys, to name a few[6]. Stainless steels are the most prevalent corrosion-resistant alloys, with a minimum chromium content of 10.5 percent by definition. The chromium forms a self-healing oxide layer that protects against corrosion. Stainless steel is distinguished from other ferrous alloys by a variety of performance and aesthetic characteristics. Still, consider that even a minimal quantity of certain components might affect corrosion resistance[7].

Other desirable qualities of copper-based alloys combine with corrosion resistance to make copper-based alloys appealing. Its employment is aided by its excellent thermal and electrical conductivity, high mechanical qualities, and simplicity of handling. While certain compounds and acids destroy these

materials violently, they work well in the presence of numerous organic and inorganic substances in the air, water, and seawater.

Moreover, nickel-based alloys are crucial in industrial applications, although only partially due to their exceptional corrosion resistance. They are resistant to corrosion by non-oxidizing acids and caustic alkalis in freshwater, a normal environment, and a normal atmosphere. They also function well in harsh conditions with both low and high temperatures and tremendous stress. Nickel is resistant and ductile, but it is also more costly than other metals[8]–[12].

Ben-Saber, et al., [13] Examined the antibacterial activities of the Schiff base derived from the salicylaldehyde and histidine and its Mn(II) 'Co(II) 'Ni(II) ' Cu(II) and Cd(II) complexes on some pathogenic bacteria. The divalent metal ions of Co(II) ' Ni(II), or Zn(II) have the formulae of M₁2x₂ and M₂ in their complexes.

Within a di topic macrocyclic ligand platform, [14] uses a unique divergent method to create a range of bimetallic complexes selectively. Nickel is easily coupled to a Schiff base cavity in our technique, and a variety of redox-inactive cations (M=Na⁺, Ca²⁺, Nd³⁺, and Y³⁺) are subsequently installed in a pendant crown-ether-like site. This modular method enables complexes containing Lewis acidic trivalent cations strongly Nd³⁺ and Y³⁺, a hitherto inaccessible family of molecules. Spectroscopic and electrochemical analyses indicate a broad range of characteristics, most of which are regulated by trivalent cations. The loss of Nd³⁺ and Y³⁺ from the pendant crown-ether site, when exposed to dimethylformamide, suggests that solvent effects should be carefully examined in future applications involving Lewis acidic metals strongly.

2. Corrosion

The corrosion process is one of the main important problems facing the engineer in the field of work, as the equipment destroyed annually due to the corrosion process is estimated at billions of dollars. Therefore, it is necessary to study this phenomenon and explain the factors that cause it and the methods to control it [15]. Corrosion may be defined as damage to the surface of the metal due to a chemical or electrochemical reaction with the surrounding medium that is in direct contact with it, whether this

medium is the normal air or any other chemical environment and at any temperature [16]. It has become known that many minerals of technological importance are present in nature in the form of compounds because these minerals, in this case, are more stable. As its union is accompanied by a decrease in the system's energy, this explains the great tendency to exist in the form of compounds. It also explains the great difficulty in extracting these minerals from its ores, as we need to spend large energy in the extraction, but this energy is self-emitted when interacting. So one of the definitions of the corrosion or oxidation process was that it is the opposite process of extracting [17].

the next reaction represents the corrosion or oxidation:



Whereas:

M: the metal atom

Mn+: metal ion

nē: number of electrons involved in the reaction

It is possible to use the principles of thermodynamic (Thermodynamic Principles) to know if any chemical reaction occurs automatically (Spontaneous Reaction). In other words, the laws of this science show the tendency of the metal to corrosion in any medium. However, it cannot determine the rate of corrosion of this mineral in this Medium, and the metal's tendency to corrosion in any medium can be determined from the following relationship:

$$\Delta G = -nFE \quad (2)$$

Whereas:

G: change energy kibbs

n: number of electrons involved in the reaction

F: Faraday constant = 96500 coul (Amp.sec)

E: the electrode voltage of the metal

If the change in the kibbs energy associated with the chemical reaction is a negative amount, then this means that the reaction occurs automatically, and its occurrence is accompanied by energy release, as in magnesium. If the change in the CPS energy associated with the reaction is a positive amount, then this means that the reaction does not happen automatically, and for it to happen, it needs energy such as gold and platinum [18].

3. Calculation Of Corrosion Rate

The corrosion rate is the decreasing rate in the material thickness across a unit of time or the rate at which the mass moves from the metal body through the unit areas and unit of time [19].

The value of the corrosion rate is of great engineering significance, as this helps determine the effective life of the piece used in a medium under certain conditions. It is possible to know the tendency of the metal to corrosion in a medium with the help of the Electrochemical Series. However, these tables and data do not give numerical values for the corrosion rate.

If the corrosion rate is measured by the electrochemical method, the corrosion rate is expressed by the corrosion current density (Corrosion Current Density, I_{corr}), measured in units (Amp / cm²). In this case, we can convert the corrosion rate expressed by the density of the corrosion current to another expression in other units according to the following law[20]:

$$R(\text{mpy}) = 0.13 \cdot I_{corr} \cdot e \cdot \rho \quad (3)$$

Whereas:

I_{corr} : corrosion current density, measured in (Amp / cm²)

e: chemical weight equivalent of metal = atomic weight / valence.

4. Tafel Extrapolation Method

The Tafel completion method is used to measure the rate of corrosion by Wagner and Traud to prove their theory, the Mixed-potential Theory. This method is based on the readings obtained from the anodic polarization and the cathodic polarization, as shown in figure 1[21].

E M / M +: metal potential, H / H + E: hydrogen potential.

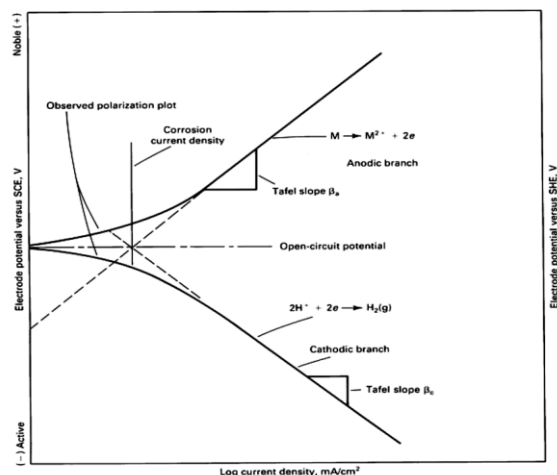


Fig.1 An outline of the Tafel curve completion method is shown to calculate M's metal corrosion rate.

5. Experimental Part

5.1. Synthesis of Schiff base ligand

The method of preparation was as follows:

The 4-amino antipyrine (5 gm, 0.014 mol) dissolved with 4-dimethylamino benzaldehyde (3.6 gm, 0.024 mol) in ethanol (40 ml). This solution added five drops from glacial acetic acid, and the mixture was refluxed for 1.5 hrs. The Schiff base ligand was isolated after the volume of the mixture was reduced to half by evaporation, and the obtained product was collected by filtration ' washed several times with ethanol and recrystallized by absolute ethanol. The melting point of the yellow crystals was found to be 219 degrees centigrade. The purity was 99.99%.

5.2. Preparation of Schiff base complex

The mixtures of the Schiff base under investigation (3.34 gm 0.01 mmol) in 30 ml ethanol and metal salts [1.29 gm NiCl₂ (0.01 mol)] in the same amount of the same solvent were refluxed for two hours 'The complex was collected by filtration and then washed several times with ethanol. The resulted product was dried in the air, and the stored characterization compound was understudy mediated by spectroscopic techniques available as infrared (IR) spectra and ultraviolet and visible (Uv-Vis) of the compound dissolved in ethyl alcohol.

5.3. Electrochemical Method

The Linear Polarization method is used to measure the corrosion current of coatings and base metal. In this method, we determine the mechanics of corrosion and the type of solution (acid, basic, saline) and determine the time and concentration of solutions where the device consists of the measuring cell and its poles, where the cell is made of non-corrosive materials such as glass and is spherically shaped with a capacity of one liter. It contains different nozzles to put the electrodes in. The cell includes three electrodes: the working electrode, which includes steel samples without coating, steel coated samples with (Ni), and the auxiliary electrode is the platinum electrode (Auxiliary Electrode), and the third electrode is of a reference type (Reference Electrode) The saturated calomel electrode is usually used. The anode or cathode current is passed through the auxiliary electrode, and the ammeter measures this current. In contrast, the working electrode voltage is measured relative to the comparison electrode by the voltage change circuit, and the measurement of the electrical voltage and the current value in the external circuit can be changed using a variable resistance; in this case, we record the value of the voltage Corresponding to the value of this current. Figure 2 shows the electrochemical cell that is used to draw the polarization curves.

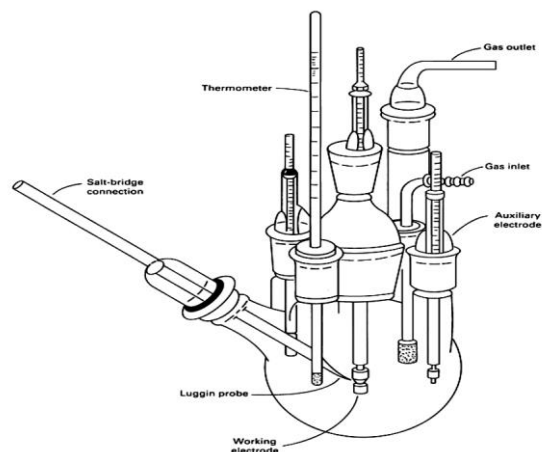


Fig 2. shows the measurement cell diagram

6. Results And Discussion

Linear polarization was used to find both E_{corr} . The corrosion current density is I_{corr} . This is by drawing tangents for both the anode polarization

curve and the cathode polarization curve, as the intersection point represents both the corrosion potential and the corrosion current density, as the results are given automatically on the side of the polarization curves as shown in Figure 3

If this method was used to find the corrosion rate in the middle of the regular tap water, as it includes testing the sample of bivalent nickel complex (II) (Z1), this sample was tested in the regular tap water at room temperature as (Figure 3). The tendency of the complex to corrode in regular tap water, testing the nickel complex sample in ordinary tap water. It was noted that the nickel complex tends to corrode at the value of the corrosion intensity and the corrosion effort mentioned in the results. The corrosion that occurs in the sample of the complex submerged in ordinary tap water is an expected phenomenon because ordinary water can be considered a harsh medium for many minerals and salts, and this is due to the presence of dissolved gases and dissolved salts in addition to the presence of solid components. As for it being considered a corrosion inhibitor, yes, it is considered as such because according to the apparent values we have concerning the value of the low corrosion current, which indicates the complex's high resistance to corrosion, which makes it used in the field of inhibition. So we can add it to the paint solution to reduce metal corrosion as it is noticed from figure 3, show that the nickel complex tends to corrode at the value of the corrosion current density and corrosion voltage as follows:

$$I_{\text{corr.}} = 809.66 \mu\text{A}$$

$$E_{\text{corr.}} = 1026 \text{ mv}$$

Figure (3) shows the polarization curve for the sample of bivalent nickel complex (Z1) immersed in the regular tap water, as the corrosion of the model of the complex immersed in the regular tap water is a predictable phenomenon, as the normal water can be counted as a rough medium for many minerals And salts due to the presence of dissolved gases (Dissolved gasses) and soluble salts (Dissolved salts) in addition to the presence of solid components, [22], [23], where we note the value of the corrosion current and low and this indicates its resistance to corrosion is high, which makes it used in the field of inhibition, and when conducting A comparison of a sample of carbon steel as this type Of the minerals, its resistance to corrosion is improved when painted with a substance, unlike our study of the complex mentioned above, as we can add the latter to the

coating solution to reduce the corrosion of metals

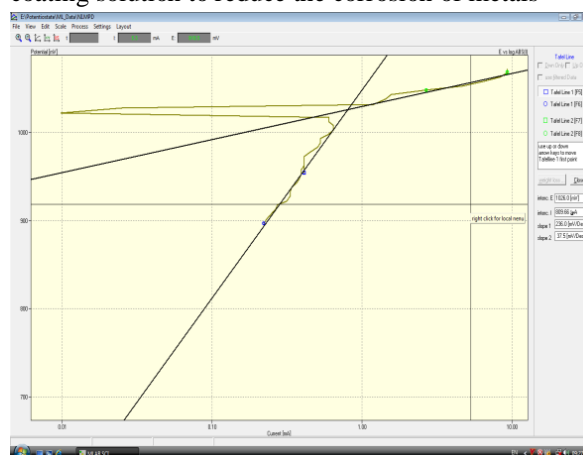


Fig 3. shows the measurement cell diagram.

7. Conclusion

1. Ease of preparation of this type of ligand accompanied by some of the difficulties in isolating and purifying prepared compounds.
2. Through the results of tests of the inductive Tafel apparatus, it was found that the prepared material has very little current, and this leads us to conclude that the bivalent nickel complex (II) is effective in using it as an inhibitor.
3. Through our study of the effect of corrosion on the free material and the nickel complex, we can study the inhibitory effect of the material on some alloys of metals by adding them to solutions causing corrosion or by depositing them as membranes on the surfaces of metals.

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9. References

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