ORIGINAL RESEARCH PAPER

Chemistry

KEY WORDS: Amino acids, corrosion, inhibitors, Brass, Glutamic acid.

EFFECT OF GLUTAMIC ACID AS CORROSION INHIBITOR ON BRASS IN ALKALINE MEDIUM

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ABSTRACT

In the last two decades, research in the field of corrosion inhibitors had been directed towards the goal of using cheap effective molecules of low or non- negative environmental impact to replace the environmental hazardous compounds one of the encourager compounds which can be used as safe corrosion inhibitors are amino acids. They are environmentally friendly, non-toxic, biodegradable and relatively cheap. On other hands, the development of computational modeling helps to understand the inhibitions mechanism of those compounds and to develop the newly designed inhibitors. In review, most of contribution made in paper on the use of amino acids as corrosion inhibitors for brass was presented and discussed.

INTRODUCTION:

Due to their importance in industry and wide range of application, Copper and its alloys have been the subject of numerous investigations since the 1920 s. These studies aimed at preventing or reducing the corrosion process in aggressive media. As corrosion inhibitors, various substances, both inorganic and organic, can be used. While inorganic inhibitors reduce the corrosion through film formation, organic compounds act mostly via adsorption process on the metal surface and complex formation. As most efficient organic corrosion inhibitors could be toxic and thus unacceptable for the environment, contemporary studies are directed towards the search for alternative inhibitors that would be ecologically acceptable, stable , non-toxic and available at relatively low cost. These compounds referred to as green, ecofriendly or environmentally-friendly comprise both organic and inorganic inhibitors. Among the organic inhibitors, natural plant extract are used from aloae vera to radish leaves, most of them contain hetero atoms such as N, S, P and O can thus form protective films. Among green inhibitors, studies on lanthanide salts, natural polymers, such as guar gum and starch and bio mimicking green inhibitors, such as amino acids were conducted. Amino acids are completely soluble in aqueous media and can be produced with high purity at low cost.

Among various amino acids, cysteine is the most extensively studied. This is related to the fact that it contains sulphur, which is expected to beneficially affect the inhibition mechanism, as reported for various organic inhibitors.

Amino acids generally act as cathodic inhibitors , i. e, they inhibit the cathodic partial reaction to a larger extent than the anodic partial reaction . With increasing concentration of amino acids , the inhibition efficiency generally increased so that corrosion decreased.

The value of IE was noticed to increase with time of immersion . The aim of the present work was to study glutamic acid as corrosion inhibitors of brass corrosion in NaOH solution.

EXPERIMENTAL:

Rectangular specimens of brass of approximate composition 60% Cu , 40% Zn of dimension 2.5cm x 2.0cm x 0.05cm containing a small hole of about 2mm diameter near the upper edge were taken. Specimens were cut from the centre of brass sheet and were thoroughly cleaned, buffed , rubbed with emery paper to obtain mirror like spotless surface. The specimens were finally degreased by using acetone . All chemicals used for the synthesis of amino acids were of analytical reagent grade and solution of sodium hydroxide were prepared in double distilled water.

Each specimen was suspended by a V- shaped glass hook made by fine capillary glass tube and immersed in a glass beaker containing 50ml of test solution at room temperature. After the exposure of sufficient time the test specimen was taken out, cleaned under running water and finally dried firstly with filter paper and secondly desicator.

The percentage corrosion inhibition efficiency was calculated as-

$$IE/\ \% = \frac{(\Delta M_u - \Delta M_i)}{\Delta M_u} \times 100$$

Where , ΔM_u = Mass loss of metal in uninhibited solution.
ΔM_i = Mass loss of metal in inhibited solution.

The degree of surface coverage (θ) of metal was calculated as;

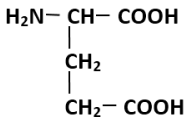
$$= \frac{(\Delta M_u - \Delta M_i)}{\Delta M_u}$$

The corrosion rate in mmpy (milli mils penetration per year) can be obtained by following equation.

Corrosion Rate (mmpy) = 87.6 ΔM/A T d

Where , ΔM= Mass loss in mg.

A = Exposed area of metal surface in cm^2.
T = Time of exoposure in hours
d = metal density in gm cm^{-3} .



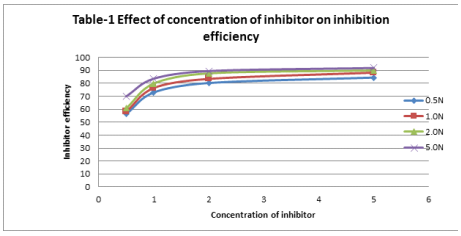
Glutamic acid

RESULT AND DISCUSSION:

Mass loss and corresponding inhibition efficiency in different strength of NaOH in different concentrations of inhibitors are depicted in table 1. It is observed from the table that percentage inhibition efficiency increases with the increase in the concentration of inhibitors. It is also clear from the table 1 that inhibitor has higher efficiency at higher concentration of NaOH. Maximum efficiency is shown at the highest concentration of base (5N). Organic molecules having hetero atoms like N, P and S adsorb on the metallic surface. In the present case Amino acids adsorb on the surface of brass, thus reduce the exposed surface area for electrochemical reaction , Nitrogen atom present in Amino acid acts as the reactive centre because of high density which results in a monolayer of amino acid on the metallic surface.

Table 1. Mass loss (ΔM) and inhibition efficiency ( ) for Brass in NaOH solution with given inhibitor addition. . (time exposure = 4 hr)

Glutamic acid addition	0.5N NaOH			1.0 N NaOH			2.0 N NaOH			5.0 N NaOH		
	ΔM (mg)	η %	θ	ΔM (mg)	η%	θ	ΔM (mg)	η %	θ	ΔM (mg)	η%	θ
Unhibitied Glutamic acid	9.6			9.3			8.9			8.5		
0.5	4.2	56.25	0.56	3.9	58.06	0.58	3.5	60.67	0.60	2.9	65.88	0.65
1.0	2.6	72.91	0.72	2.2	76.34	0.76	1.8	79.77	0.79	1.4	83.52	0.83
2.0	1.9	80.20	0.80	1.5	83.87	0.83	1.1	87.64	0.87	0.9	89.41	0.89
5.0	1.5	84.37	0.84	1.1	88.17	0.88	0.9	89.88	0.89	0.7	91.76	0.91



ANALYSIS OF IR SPECTRA:-

A chemical substance shows marked selective absorption in the infrared region. After absorption of IR radiation, the molecules vibrate at different rates of vibration, giving rise to close packed absorption bands called an IR absorption spectrum.

A characterstic feature of IR spectra of glutamic acid in the presence of a relatively large number of sharp band and particularly diagnostic are these near 2966 cm⁻ą (O-H stretching), 2855 cm⁻ą for (C-H stretching), 1690 cm⁻ą (c=o group) 1523 cm⁻ą (N-H stretching of the amino group).

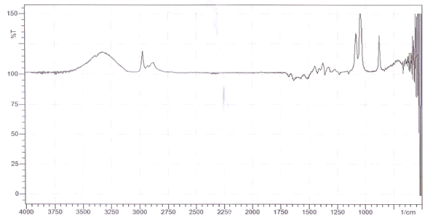


Figure:-Infrared spectra of Glutamic acid

Analysis of SEM Image:-

The SEM image of the brass metal surface immersed in 0.5N NaOH solution in the presence of glutamic acid. It can be seen that brass metal surface is covered with a layer of corrosion products . Images show that with increasing base concentration, corrosive surface area decreases and inhibition efficiency increases.

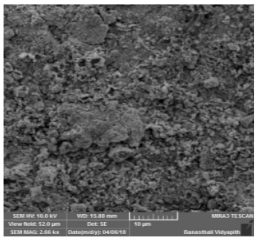


Figure:-SEM-Brass surface

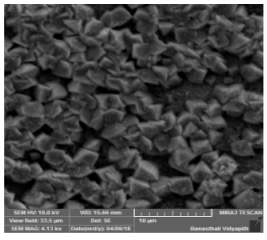


Figure:-AFM image in the presence of 0.5 N NaOH

CONCLUSION:

A study of one synthesized amino acid, glutamic acid has shown them to be effective corrosion inhibitor for brass in NaOH. Mass loss method have indicated that the inhibition efficiencies increase with decreasing strength of NaOH from 5N NaOH to 0.5N NaOH and with increasing concentration of inhibitors in the range from .5 to 5ppm.

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