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STUDIES OF CORROSION AND ELECTROCHEMICAL BEHAVIOR OF SOME METALS AND BRASS ALLOY UNDER DIFFERENT MEDIA

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ABSTRACT
The phenomenon of corrosion is quit old and the need for the corrosion studies and corrosion treatment methods increases as a large amount of money is lost due to corrosion in Industrial establishments. The use of stainless steel in vessels, containers and suitable plating materials have reduced the corrosion loss to be considerable extent with this background the present study of corrosion of Iron, Copper Aluminium metals and Brass alloy in the form of 8 x 6 x 0.3 cm strips under different media is undertaken and study reveals that corrosion rate increases in the following order Al > Fe > Cu > Brass and for the media in which the corrosion takes place in the order of HNO_3 > H_3PO_4 > H_2SO_4 > HCl > CH_3COOH. With exception of Alumunium The rate of corrosion increases with increase in the concentration of acids. The rate of corrosion increases with increase in time
Keywords: Metal, Alloy strips, corrosion, Different media, EMF Studies, Weight loss in mg.

INTRODUCTION

Corrosion [1-3] is defined as the destruction or deterioration of materials because of the reaction with its environment. Some insist there the definition should be restricted to metals only, but corrosion engineer must consider the corrosion of metals, non metals, ceramics, Rubber and other non metallic materials deterioration of paints and rubber by sun light or chemicals, fluxing or lining of steel making furnace and attacks of solid metals by another molten metals (liquid metal corrosion) are all considered to be corrosion.

The process of corrosion may be fast, slow or moderate. The corrosion of metals can be considered as extractive metallurgy. Rusting is a term reversed for steel and Iron corrosion. During the process of corrosion most of metals form their metal oxide. Practically all environments are corrosive. Air, moisture,fresh distilled water, salt and mine water, rural and urban and industrial atmosphere, steam and other gases such as ammonia, chlorine, hydrogen sulphide and sulphur dioxide, fuel gases, inorganic and Organic acids, solvents, petroleum oils cause corrosion environment. Inorganic materials are more corrosive than the organic materials. High temperature and pressure produce more severe corrosion condition.

EXPERIMENTAL

Acids like HCl, H_2SO_4, H_3PO_4, HNO_3, and CH_3COOH of different concentrations viz, 0.1N, 0.5N, 1N, 4N, have been prepared from (A.R.) grade reagents and are standardized. Similarly bases like NaOH, KOH, NH_4OH have been used in different concentrations [4,5]. Small rectangular size metal-alloy plate of the size 8 x 6 x 0.3 cm. are used and the plates are dipped in different solutions in for different times viz. 1 to 5 hours. The weight losses are measured in different solutions. The EMF also measured for each metals by using respective the metal strip as an electrode and the calomel electrode are used as reference electrode in different solutions. The summary of results are given in Table-1 and 2.

Table-1: Comparative Corrosion study of Metals and Brass alloy in different media in terms of Weight loss (mg) parameter

S. NO.	Medium	Metals			Alloy
		Al (mg)	Fe (mg)	Cu (mg)	Brass (mg)
1.	4 N HCl	7234	214	13	08
2.	4N H_2SO_4	1292	586	38	33
3.	4N HNO_3	661	3229	7536	2975
4.	4N H_3PO_4	532	829	54	52
5.	4N CH_3COOH	218	84	08	14
6.	4N NaOH	10123	19	22	12
7.	4N KOH	9132	25	33	19
8.	NH_4OH	5523	33	20	10
9.	NaCl (saturated)	72	18	166	9.5
10.	KCl (saturated)	80	59	26	12
11.	Sea water	154	142	4	7
12.	Tap water	31	20	18	20

Table-2: Comparative Corrosion study of Metals and alloys in different media in terms of EMF (m V)

S. No.	Medium	Alloys	Metals	
		Brass (EMF)	Fe (EMF)	Cu (EMF)
1	4N HCl	376	370	354
2	4N H_2 SO4	102	438	52
3	4N HNO3	357	488	47
4	4N H_3 PO4	720	492	87
5	CH_3 COOH	132	501	101
6	NaOH	586	789	582
7	KOH	633	715	625
8	NH_4 OH	557	327	533
9	NaCl	370	648	345
10	KCl	304	623	325
11	Sea Water	261	599	245
12	Tap Water	39	315	37

Corrosion Rate Expression

The expression mils per year is the most desirable way of expressing corrosion rate . The expression is readily calculated from the weight loss of the metal specimen during the corrosion test by the formula given below:

$$M\ p\ y = 534\ W / DAT$$

Where, W = Weight loss in mg
D = Density of specimen (gram/cm^3)
A = Area of specimen (sq. inch)
T = Exposure time (hours)

In the present study, the corrosion rate is correlated to the weight losses in mg.

RESULTS AND DISCUSSION

Corrosion of Iron[6-8] , Copper, Aluminium and Brass alloy in form of small plates of size is studied under 8 x 6 x 0.3 cm. in different media by weight loss method . Four different concentration viz, 0.1N,0.5N, 1N and 4N Solutions are used in different timing viz,1 to5 hours from the study of the following conclusions have been reached

1. The rate of corrosion increases with increasing the concentrations of the acids
2. The rate of corrosion increases with increasing time
3. The order of corrosion activity on the acids has been found to be-

$$HNO_3 > H_3PO_4, > H_2SO_4, > HCl > CH_3COOH$$

The bases NaOH and KOH show comparatively less corrosion rate than the above acids The potential (EMF) studied have been carried out in the respective solution Iron metals as electrode and calomel electrode as reference electrode .The Inorganic acids which show more corrosion, The EMF is found to be less, and for the bases, The EMF is found to me more .The potential studied on Iron shows the following order Bases > Neutral > Organic acids > Inorganic acids. This is related to electrochemical behavior of metals under the different concentrations. Similarly weight loss and potential studies have been carried out for copper and Brass alloy The order of corrosion has been found out to be Al > Fe > Cu > Brass Since Brass is an alloy of Cu and Zn the coupling effect of metals do not occur and hence the corrosion rate is less. Solid solution alloys are usually more corrosion resistant than alloys with two or more phases.[9]

CONCLUSION

For inorganic acids which shows more corrosion, the EMF is found to be less, and for bases, the EMF is found to be more This is related to the electrochemical behavior of metal under different concentrations. Similar weight loss and potential, studies have also been carried out for copper and brass alloy. The order of reactivity has been found out to be iron>Copper> Brass. Since Brass in an alloy of Copper and Zinc, the coupling effect of metal does not occur and hence the corrosion rate is less. This is in relation to the observed literature. In the case of aluminum, it is more corroded in concentrated hydrochloric acid than other acids. It is passive towards concentrated nitric acid. Similarly, in the bases, the rate of corrosion increases due to its reactivity towards bases.

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