IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 3 Issue 1, January 2016.
www.ijiset.com
ISSN 2348 – 7968

Corrosion Behavior of Iron Sample Exposed To Local River Water

Modi Musalaiah[1] modimusalaiah@gmail.com

Asst.Prof. Indira Institute of Technology and Sciences

Bharat Gorantla[2] barat.gorantla@gmail.com

Engineer, Teamec Chlorates

Katuri Peddintaiah[3] peddintaiahkaturi@gmail.com

Asst.Prof. JNTUA College of Engineering, Pulivendula

Abstract:

The effect of formation of oxides of metal creates lot of problems in domestic level as well as in industry also. Corrosion creates huge loss to the economy by loss of valuable material, contamination of products from industry. Not only the severe environments but also the local natural river water environment causes corrosion of metal. In this study such a local river water environment was selected to study the effect on iron sample through weight loss method. Weight loss data was noted at each interval and used for calculation of corrosion rate. It was observed that as the time increases from 0 to 240 hr, the corrosion rate is increasing monotonically.

Key Words: River Water, Corrosion, Coupons, Weight Loss Method and Corrosion Rate

1. Introduction:

1.1.The Gundlakamma River:

The Gundlakamma is a seasonal river that flows through the east central part of the state of Andhra Pradesh, India. It arises in the Nallamalla Hills, an offshoot of the Eastern Ghats. Its main headwaters lie some 6 kilometers from the village of Ardhaveedu, Prakasam District at an altitude of 425 m. above main sea level [1]. Numerous mountain streams join it as it descends down the thickly forested hills through a series of curves and tight bends. It follows a north-easterly direction and enters the plains near Cumbum, after flowing through a town named after it. Gundlakamma is the largest of all the rivers that originate from the Nallamalla Hills [2]. The river then flows past the town of Markapur and towards the Coromandel Coast through addanki. It finally enters the Bay of Bengal, some 19 km east of Ongole after having covered a distance of 225 km [3].

1.2. Corrosion & Its impact:

Corrosion is a natural process, which converts refined metal to their more stable oxide. The corrosion process is an oxidation/reduction reaction that returns refined or processed metal to their more stable ore state. It is the gradual destruction of materials (usually metals) by chemical reaction with their environment. In the most common use of the word, this means electrochemical oxidation of metal in reaction with an oxidant such as oxygen. Rusting, the formation of iron oxides is a well-known example of electrochemical corrosion. This type of damage typically produces oxide(s) or salt(s) of the original metal, and results in a distinctive

ISSN 2348 – 7968

orange coloration. Corrosion can also occur in materials other than metals, such as ceramics or polymers, although in this context, the term degradation is more common. Corrosion degrades the useful properties of materials and structures including strength, appearance and permeability to liquids and gases. Many structural alloys corrode merely from exposure to moisture in air, but the process can be strongly affected by exposure to certain substances. Corrosion can be concentrated locally to form a pit or crack, or it can extend across a wide area more or less uniformly corroding the surface. Because corrosion is a diffusion-controlled process, it occurs on exposed surfaces. As a result, methods to reduce the activity of the exposed surface, such as passivation and chromate conversion, can increase a material's corrosion resistance. However, some corrosion mechanisms are less visible and less predictable [4]. With respect to the corrosion potential of drinking water, the primary concerns include the potential presence of toxic Metals, such as lead and copper deterioration and damage to the household plumbing, and aesthetic problems. The primary health concern is the potential for the presence of elevated levels of lead and copper in the water. In some cases, the water is so corrosive that the interior plumbing system needs to be changed and completely replaced with PVC piping, or other materials. They did not test the water and install a neutralizing system before the piping corroded and caused leaks throughout the home [5]. Corrosion can also be accelerated by: 1) low pH (acidic water) and high pH (alkaline water)- For high alkalinity water - it is possible that a chemical scale may form that would help to protect against corrosion, but if a bacteria becomes established the scale, such as SRB (sulfur reducing bacteria), it is related to Microbiologically Induced Corrosion, 2) high flow rate within the piping can cause physical corrosion, 3) high water temperature can increase biological rate of growth and chemical corrosion, 4) oxygen and dissolved CO_2 or other gasses can induce corrosion, 5) high dissolved solids, such as salts and sulfates, can induce chemical or bio-chemical corrosion, 6) corrosion related bacteria, high standard plate counts, and electrochemical corrosion can result in pinhole leaks and isolated corrosion and aesthetic water quality problems, and 7) presence of suspended solids, such as sand, sediment, corrosion by-products, and rust can aid in physical corrosion and damage and facilitate chemical and biochemical corrosion. If it is necessary to flush or run your cold water in the morning for a few minutes before you drink because the water has a bitter taste, Water is probably corrosive. If we see blue-green stains in your basins or some staining along the joints of your copper piping, Water is probably corrosive. As corrosive water stands or seats in pipes or tanks, it leaches metals from the piping, tanks, well casing, or other metal surfaces that water is in contact. If we see pink standing on the water's edge - this may not be corrosion, but pink bacteria. Pink bacteria are airborne bacteria. The impacts of corrosion are 1) decreases the efficiency of hot water heaters and may cause premature failure to the heater, 2) corrodes and causes premature failure of household plumbing and plumbing fixtures, 3) imparts a bitter taste to water because of elevated levels of metals, which causes you to purchase bottled water, 4) results in the formation of red water or greenish-blue stains on drains, and 5) consumption of water with elevated levels of toxic metals, such as lead and copper, have been shown to cause both acute and chronic health problem [6-8].

2. Materials and Methods:

The simplest, and longest-established, method of estimating corrosion losses in plant and equipment is by Weight Loss Analysis. A weighed sample/coupon (iron plate having initial weight of 16.5gm with an exposed area of 32cm^2 is used here) of the metal or alloy under consideration is introduced into the process (Gundlakamma river water), and later removed after

ISSN 2348 – 7968

a reasonable time interval (24hrs). The coupon is then cleaned of all corrosion products and is reweighed. This is carried up to 10 days. The layer of corrosion formation was showed in Figure.1. The weight loss is converted to a corrosion rate (CR) as follows, [9]

$$\text{Corrosion Rate (CR)} = W * K / \rho_A * A * T$$

Where,

W = Weight loss (gm)

K = Corrosion factor = $8.75*10^4$

ρ_A = Alloy Density (gm/cm^3)

A = Exposed Area (cm^2)

T = Exposure Time (hr)

Fig.1. Formation of Corrosion

3. Results and Discussions:

Initially ten iron samples were inserted in the process water, after completion of 24hrs, one sample was taken and the weight was measured, that data was noted. It was carried for every 24hrs up to completion of all the samples. The rates of corrosion are calculated by using the formula given in materials and methods, which are tabulated in the Table.1. The rate of corrosion is showed in plot, plotted against time showed in Fig.2.

Sample No.	Exposed Time, hrs	Weight of sample after expose, gm	Rate of Corrosion %
1	24	16.485	0.0250
2	48	16.410	0.0252

ISSN 2348 – 7968

3	72	16.300	0.0255
4	96	16.150	0.0260
5	120	16.005	0.0275
6	144	15.950	0.0293
7	168	15.500	0.0305
8	192	15.150	0.0325
9	216	15.003	0.0350
10	240	14.915	0.0375

Table.1. Experimental data

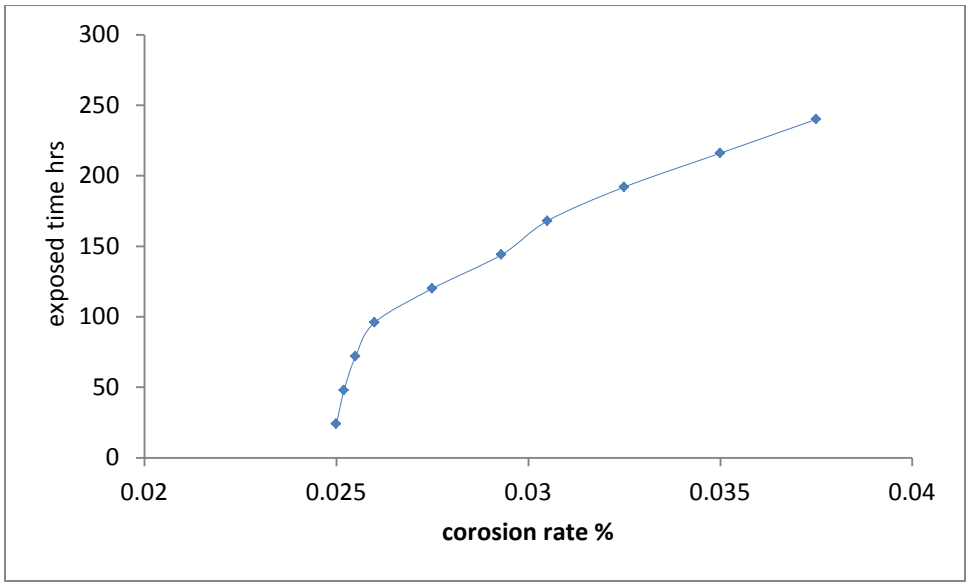

Fig.2. Rate of Corrosion with respect to Time

4. Conclusion:

Natural river water comprises of all the ions such as chlorides, sulfates, nitrates etc. From the results it is clear that as the time is increasing the rate of corrosion is also increasing. This may be due to the loss of passivity of metal or passive layer on the metal surface and continuous formation of oxides (iron oxides) on the iron sample behaving as anode when it is exposed to river water environment. Researchers also reported that as the time progress there is an increase in corrosion rate may be because of loss of passive oxide layer. This study will be continued for some more days till the pits of certain depth were clearly observed with the naked eye.

References:

ISSN 2348 – 7968

[1] Google Earth
[2] http://www.bl.uk/onlinegallery/onlineex/apac/other/019wdz000000600u00000000.html
[3] http://www.hindu.com/2007/02/05/stories/2007020513940400.htm

[4] Galvanic Corrosion. Retrieved on 2012-07-15.

[5] Methods of Protecting Against Corrosion Piping Technology & Products, (retrieved January 2012)
[6] Mr. Brian Oram, Professional Geologist (PG), Water Research Center B.F. Environmental Consultants Inc.

[7] Intergranular Corrosion. Retrieved on 2012-07-15.
[8] Crevice Corrosion. Retrieved on 2012-07-15.

[9] Metal Samples Corrosion Monitoring Systems, A Division of Alabama Specialty Products, Inc.