THE EFFECT OF DISSOLVED OXYGEN ON CORROSION BEHAVIOUR OF MILD STEEL

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Corrosion of mild steel is a function of Dissolve Oxygen (DO) and microbial life activities. The present work indicates the corrosion behavior of mild steel which were dipped in different water sample of different amount of Dissolved oxygen. It was found, initially corrosion of mild steel is directly proportional to Dissolved Oxygen concentration then this rate diminished over a period of days because of formation of oxide film on the samples. It was generally observed that corrosion rate decreases with exposure times in all periods of environments. In our work observed results were due to the formation of an impermeable protective oxide film on the surface of the steel, after this, the steel is said to be passive and does not corrode easily.

KEY WOEDS- Mild steel, Corrosion loss, Dissolved Oxygen (DO), Corrosion Rate.

1.**INTRODUCTION**- Dissolved Oxygen (DO) refers to volume of oxygen that is contained in water. The amount of Oxygen that can be held by water depends on the water temperature, salinity and pressure. Dissolved Oxygen may change depending upon depth, distance, temperature and period of sampling. DO may also change drastically due to waste produced by many process industries.

A water body produces oxygen by gaining it from the atmosphere and from plants as a result of photosynthesis. Running water dissolves more oxygen than still water, because of its churning. DO consume by aquatic animals during respiration, by bacteria during decomposition and various chemical reactions. Wastewater from sewage treatment plants often contains organic materials that are decomposed by microorganisms, which use oxygen in the process. (The amount of oxygen consumed by these organisms in breaking down the waste is known as the biochemical oxygen demand or BOD). Other sources of oxygen-consuming waste include storm water runoff from farmland or urban streets, feedlots, and failing septic systems.

Mild steel also known as plain-carbon steel, is now the most common form of steel because its price is relatively low while it provides material properties that are acceptable for many applications like automobile components, structural shapes and sheets that are used in pipelines, buildings, plants and bridges. Low-carbon steel contains approximately 0.05–0.25% carbon[1] making it malleable and ductile. Mild steel has a relatively low tensile strength but high ductility, weldability and machinability. It is cheap and easy to form; surface hardness can be increased through carburizing.

Mild steel was not produced for corrosion resistive purposes but often use of this alloy in corrosive atmosphere has raised many issues. Mild steel is used in railways where this alloy is in contact of water. The bottom pillars of railway bridges and road bridges constructed over rivers, lakes and sea always remain in water.[2] In 1967, Silver Bridge build over Ohio river crumpled because of the failure of material due to immersion corrosion and the material was mild steel.[3]

The immersion corrosion is a function of Dissolved Oxygen and Microbial Life Activities[4]. If the water contains high oxygen concentration, initially corrosion rate may reach a high value. But this rate diminishes over a period of days due to formation of iron oxide layer (or corrosion products) on the iron, which causes barrier in diffusion of oxygen along the oxide layer. So initially corrosion of iron is directly proportional to oxygen concentration[5,6]. The relationship between dissolved oxygen and corrosion loss is represented in figure 1.

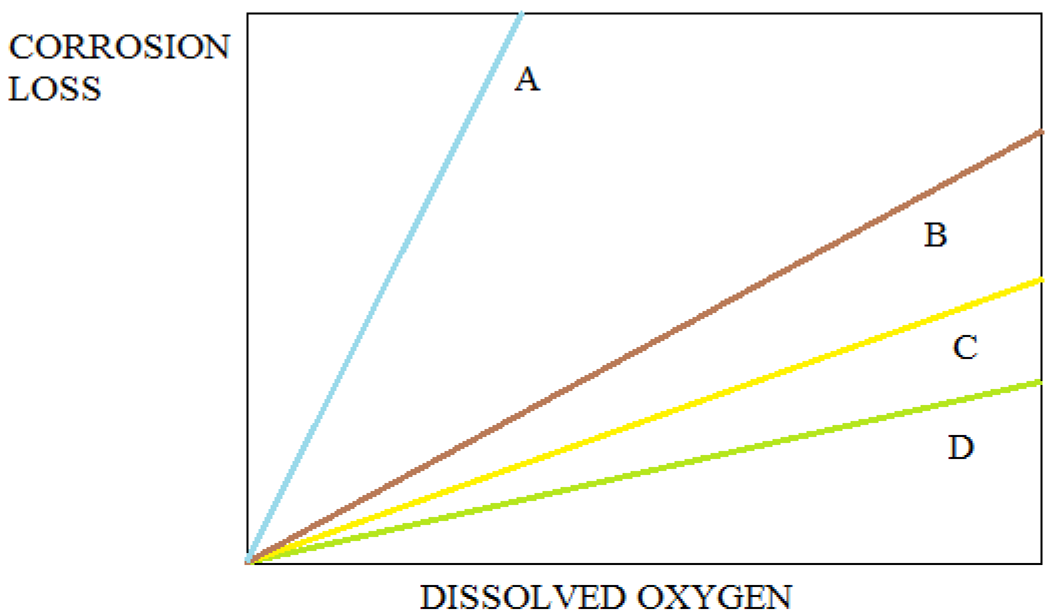


Figure 1- Dissolved Oxygen Vs Corrosion Loss

The value of DO is as follows A> B> C> D. So line A has highest corrosion loss due to high dissolved oxygen.

2.EXPERIMENTAL PROCEDURE

MATERIAL AND METHOD Mild steel samples were in the forms of cuboids, all of which have same exposed area. Water samples which have different dissolved oxygen values (ranged from 1.4 mg/L to 5.7 mg/L) were collected.

Experimental procedure can be divided into two steps:

(1). Determination of dissolved oxygen

The dissolved oxygen test procedure was in accordance to IS: 3025 (Part 38) - Reaffirmed 2003.

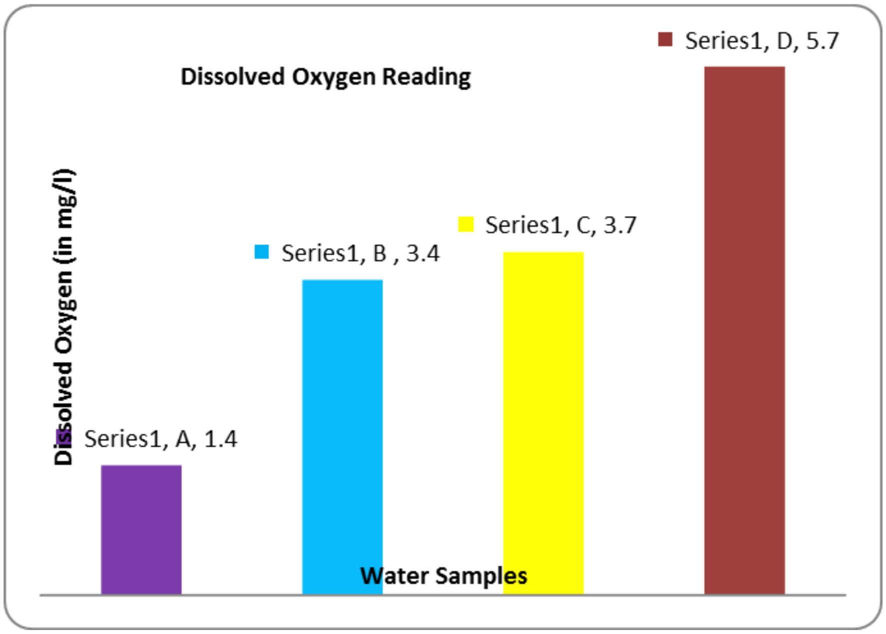
The procedure chart for DO determination is given figure 2 and DO values for different water sample are given in table 1.

(2). Determination of corrosion loss:

To determine the corrosion loss four steps were involved. The mild steel samples were dipped in water samples which have different dissolved oxygen values. Mild steel was dipped under normal room temperature conditions. After this, mild steel samples were periodically removed from the water, after drying and removing rust were weighted. The procedure chart for Corrosion Loss determination is given in figure 3.

Table 1: Dissolved Oxygen Reading

Water Sample	Dissolved Oxygen (in mg/L)
A	**1.4**
B	**3.4**
C	**3.7**
D	**5.7**



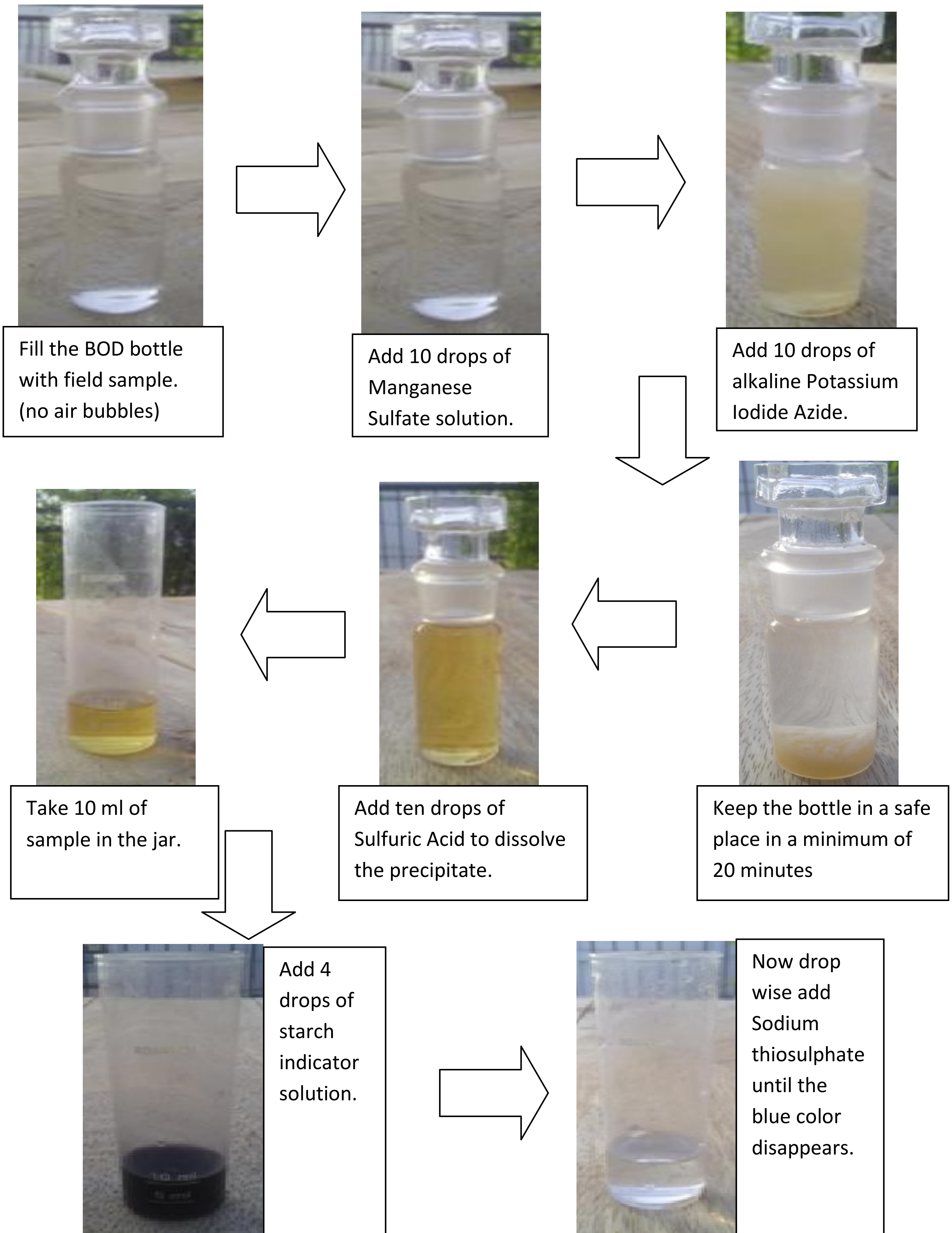


FIGURE 2: PROCEDURE CHART FOR DO

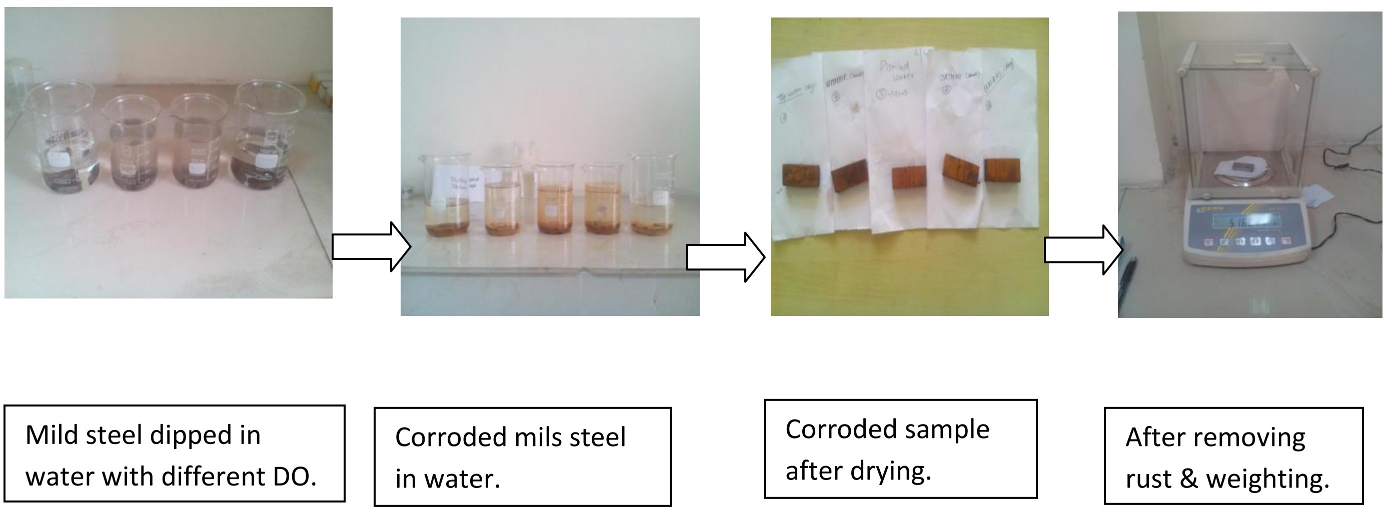
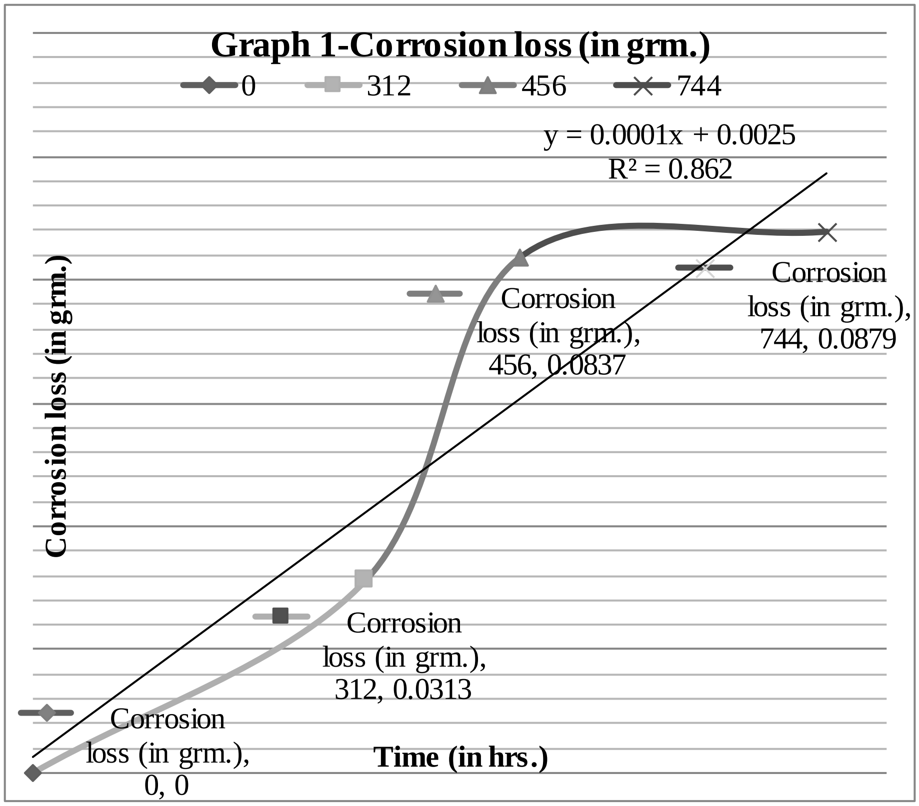


FIGURE 3: PROCEDURE CHART FOR CPR

RESULT AND DISCUSSION-

Table 1: Corrosion loss for mild steel dipped in water sample A

Time (in hrs.)	Corrosion loss (in gram.)
0	0
312	0.0313
456	0.0837
744	0.0879



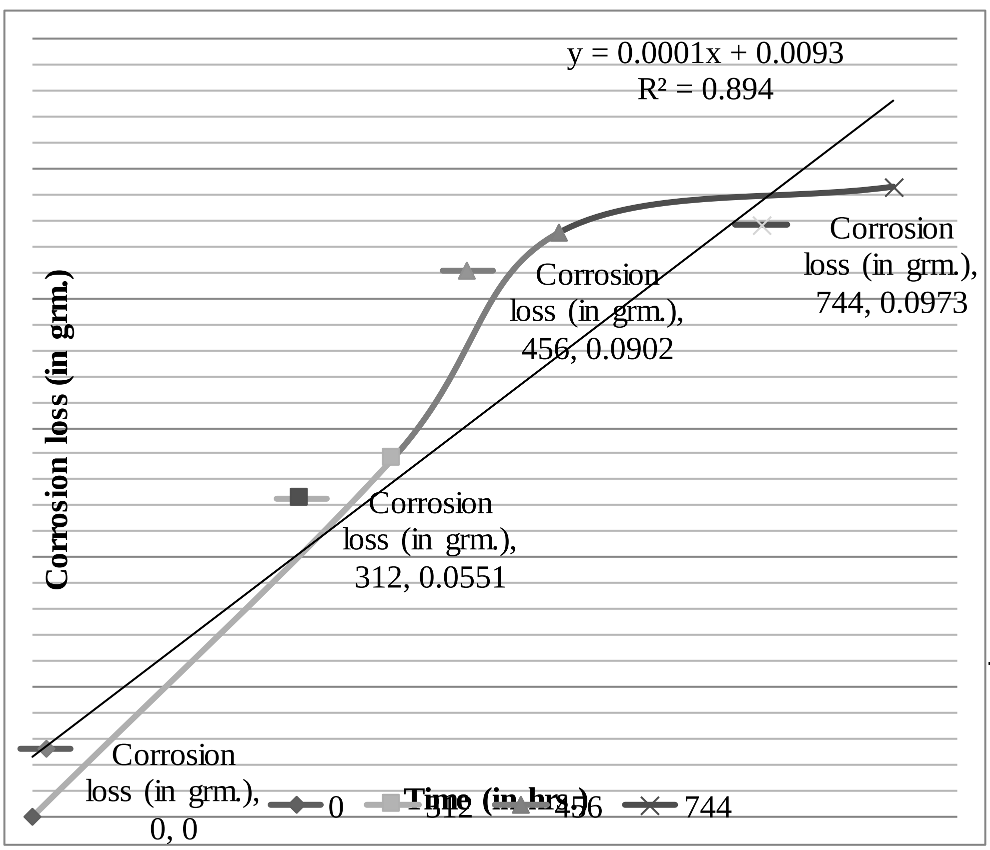
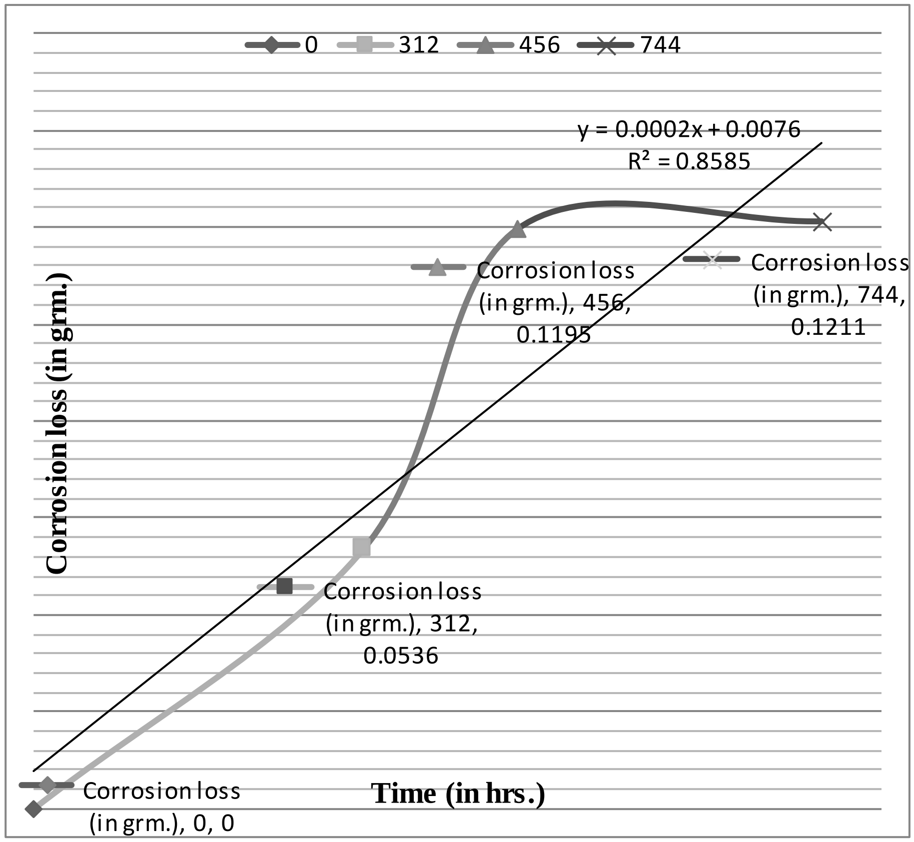


Table 2: Corrosion loss for mild steel dipped in water sample B

Time (in hrs.)	Corrosion loss (in gram.)
0	0
312	0.0551
456	0.0902

Table 3: Corrosion loss for mild steel dipped in water sample C

Time (in hrs.)	Corrosion loss (in grm.)
0	0
312	0.0536
456	0.1195
744	0.1211



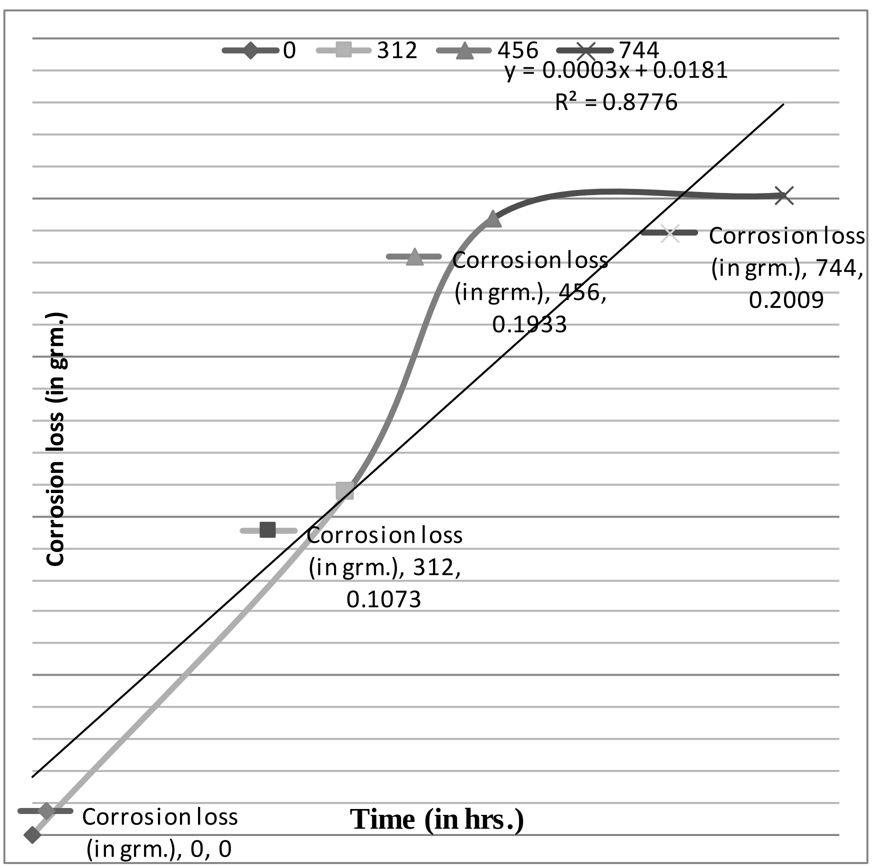
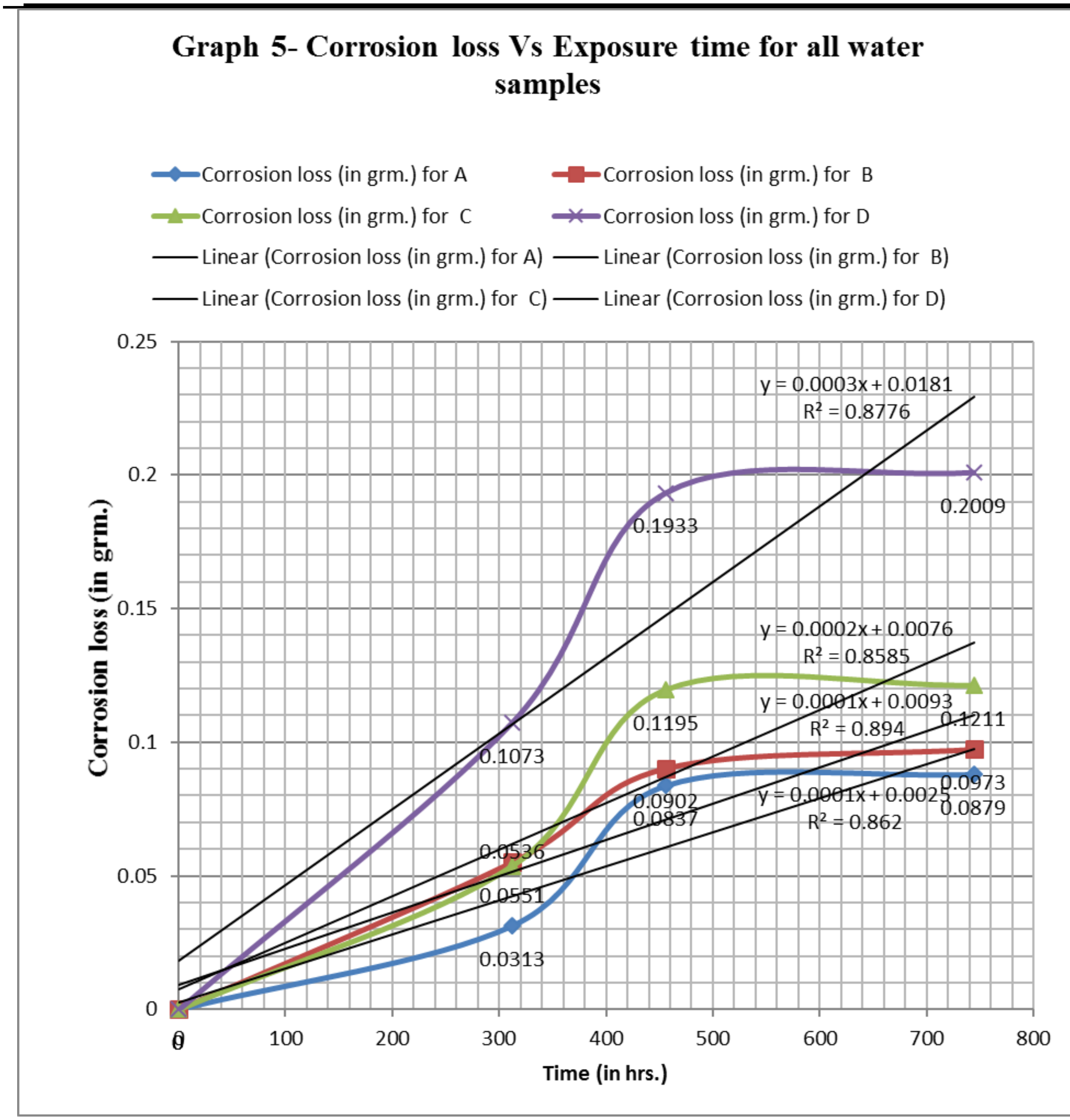


Table 4: Corrosion loss for mild steel dipped in water sample D

Time (in hrs.)	Corrosion loss (in grm.)
0	0
312	0.1073
456	0.1933
744	0.2009

Table 5: Corrosion loss Vs Exposure time for all water samples

Time (hrs.)	Corrosion loss (gram) for A	Corrosion loss (gram) for B	Corrosion loss (gram) for C	Corrosion loss (gram) for D
0	0	0	0	0
312	0.0313	0.0551	0.0536	0.1073
456	0.0837	0.0902	0.1195	0.1933
744	0.0879	0.0973	0.1211	0.2009



In all the above graphs initially slope of corrosion loss with respect to time graph increases but due to formation of corrosion products. If this product is not removed from the surface of the steel the corrosion rate is reduced that is indicated by nearly horizontal slope in all the above graphs.

CONCLUSION-

In this present work, the DO values of water samples were calculated by using mentioned method. The observed values of DO in different water samples were found to have wide range (from 1.4 mg/L to 5.7mg/L). Corrosion loss values were maintaining the direct proportional rate with DO values. Mild steel dipped in water which have high dissolved oxygen value, also have high corrosion loss. Initially corrosion loss increases with exposure time but due to formation of corrosive products this corrosion rate is reduced.

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