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STUDY OF CORROSION BEHAVIOUR OF MILD STEEL IN LONAR WATER LAKE MATEORITE IMPACT CRATER

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ABSTRACT:

Lonar Lake, Buldhana, Maharashtra is the only known basaltic meteorite impact crater lake with highly alkaline and hard water. This study investigates the corrosion rate of iron/mild steel coupons immersed in Lonar Lake water compared to distilled water and tap water. Weight loss method, pH, TDS, hardness, chloride and conductivity were measured over 30/60/90 days. Results show that high alkalinity and dissolved salts accelerate pitting corrosion despite high pH. The findings are useful for local infrastructure, agriculture equipment and conservation.

KEYWORDS: Meteorite, Saline water, Alkalinity, Hard water, Corrosion, Mild Steel

INTRODUCTION

Lonar Lake is the only known hyper-velocity meteorite impact crater in basaltic rock in the world. It is about 1.8 km in diameter and about 137 m deep. The lake water is characterized by high pH, high salinity and extreme hardness due to dissolution of basalt and soda deposits over thousands of years. Corrosion is a natural process of degradation of metals due to reaction with the environment. Water is one of the most common corrosion media. The rate of corrosion of iron depends on dissolved oxygen, pH, temperature, and presence of ions like Cl^-, SO_4^{2-}, HCO_3^-. Generally high pH forms a protective layer, but in presence of aggressive ions this layer breaks and causes localized corrosion. There is very limited systematic data on the effect of Lonar Lake water on metallic structures. Agricultural pumps, fencing, and temple structures near the lake show visible rusting. Hence this study was undertaken to:

Objectives:

1. To analyse the physico-chemical parameters of Lonar Lake water
2. To determine the corrosion rate of mild steel in Lonar water using weight loss method
3. To compare corrosion in Lonar water with distilled and tap water

MATERIALS AND METHODS

Materials:

Metal Specimens: Mild steel coupons of size 5cm×2.5cm×0.2cm.
Composition: C = 0.15%, Mn = 0.6%, Fe balance
Water Samples: Lonar Lake water collected in clean plastic bottles.
Control: Distilled water & Tap water
Chemicals: Acetone, emery paper, distilled water

Water Analysis

The collected water samples were analysed for:

Parameter	Method	Instrument
pH	Electrometric	pH meter
TDS	Gravimetric	TDS meter
Total Hardness	EDTA Titration	
Alkalinity	Acid Titration	

Corrosion Test - Weight Loss Method

1. Mild steel coupons were polished with emery paper, degreased with acetone, washed, dried and weighed W1.
2. 3 sets of coupons were fully immersed in 500ml beakers containing Lonar water, Tap water, and Distilled water.
3. Beakers were kept at room temperature 30±2◦C.
4. After 30, 60, 90 days coupons were taken out, cleaned with brush to remove corrosion products, washed, dried and re-weighed W2.
5. Weight loss W=W1−W2 in mg

Corrosion Rate Calculation:

$$CR = 87.6 \times W / D \times A \times T$$

Where,
CR = Corrosion rate in mm/year
W = Weight loss in mg
D = Density of mild steel = 7.85g/cm3
A = Area of specimen in cm2
T = Exposure time in hours

RESULTS AND DISCUSSION

Table 1: Physico-chemical analysis of water samples

Parameter	Lonar Lake Water	Tap Water	Distilled Water
pH	10.0	7.5	7
TDS (ppm)	30000	500	5
Total Hardness (ppm)	4000	300	0
Alkalinity (ppm)	15000	150	0

Table 2: Weight loss and Corrosion rate of Mild Steel

Exposure Time	Medium	Weight Loss (mg)	Corrosion Rate (mm/year)
30 Days	Lonar Water	100	0.124
30 Days	Tap Water	42	0.052
30 Days	Distilled Water	10	0.012
60 Days	Lonar Water	300	0.186
90 Days	Lonar Water	464	0.192

Discussion Points:

1. **High TDS + Chlorides**: Even though pH is alkaline, Cl^- ions destroy the passive Fe_2O_3 layer and cause pitting.
2. **Scaling vs Corrosion**: High hardness causes $CaCO_3$ scaling which may reduce corrosion initially but leads to under-deposit corrosion later.
3. **Comparison:** $CR_{Lonar} > CR_{Tap} > CR_{Distilled}$

4. CONCLUSION:

Lonar Lake water is highly alkaline, hard and saline in nature. The corrosion rate of mild steel in Lonar water is significantly higher than in distilled water due to aggressive ions.

REFERENCES:

1. NACE. (2016). Corrosion Basics: An Introduction. NACE International.
2. Jones, D.A. (1996). Principles and Prevention of Corrosion. Prentice Hall.
3. ISI 9137:1979. Method of measurement of corrosion rate by weight loss method.
4. Fredstone, J. et al. (1999). Geochemistry of Lonar Lake, India. Hydrogeology Journal.
5. Rao, N.V. (2005). Water chemistry of Lonar Crater Lake. Current Science.