Bulletin of Electrochemistry 6 (5) May 1990, pp 494–496

Corrosion and surface modifications of zinc at Mandapam

G Subramanian, V Ananth, P Chandrasekaran, S Palraj
Corrosion Testing Centre, CECRI Unit, Mandapam Camp- 635 519, INDIA
and S Guruviah
Central Electrochemical Research Institute, Karaikudi-623 006, INDIA

Atmospheric exposure studies carried out on zinc specimens at Mandapam Camp, India, show that cumulative corrosion rate decreases with time. The rise in surface temperature and the appearance of corrosion spots are the reasons for recrystallisation which in turn results in grain refinement over longer duration of exposure.

Key words: Atmospheric corrosion, zinc, grain refinement, cumulative corrosion rate

INTRODUCTION

The present investigation deals with the corrosion of zinc and surface modification in presence of pollutants for a period of two years, in the aggressive tropical marine environment [1] prevailing at Mandapam Camp. The surface modification is highlighted using Scanning Electron Micrograph.

MATERIALS AND METHODS

2 mm thick rolled zinc sheets of commercial grade (Pb: 0.08%, Zn: balance) was used in the present study. Triplicate panels of 150 × 100 mm sizes were used for each withdrawal. Mechanically polished panels were weighed to an accuracy of 0.01 mg after degreasing. Exposed panels were chemically cleaned using chromic acid solution [2] and weighed accurately to determine the corrosion rates. The cleaned panels were etched with Palmerton etchant for Scanning Electron Micrograph analysis. The meteorological data as well as salinity and dust content of the atmosphere were regularly recorded.

RESULTS AND DISCUSSION

Figure 1 shows the level of salinity-the major pollutant-present at this tropical-marine atmosphere. Monthly (for one year), quarterly and cumulative corrosion rates of zinc are presented through Figs. 2 to 4. The corrosion rates for the third quarter as well as the monthly corrosion rates during this quarter were high. Higher salinity values combined with favourable meteorological conditions were the reasons for higher rates. Cumulative corrosion rates exponentially decrease due to the formation of tenacious corrosion product [3]. The 12 months data which deviate from this trend can be explained by considering the change occurring on the surface of the panel. The scanning electron micrographs (Figs. 5 to 8) represent the surface characteristics of the exposed zinc panels of 3, 9, 12 and 15 months respectively. The presence of elongated grains on the rolled surface of zinc panels advocate that recrystallisation temperature of the

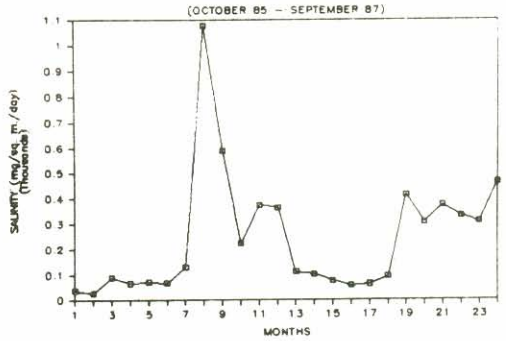

Fig. 1: Atmospheric salinity of the site (Oct. 85–Sep. 87)

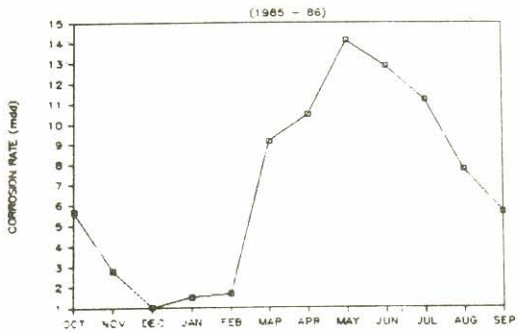

Fig. 2: Monthly corrosion rate of zinc (1985–86)

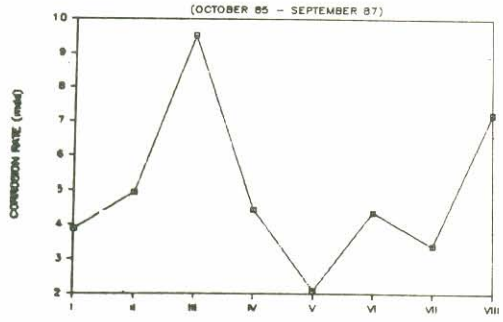

Fig. 3: Quarterly corrosion rate of zinc (Oct. 85–Sep. 87)

Fig. 6: SEM of 9 months exposed zinc

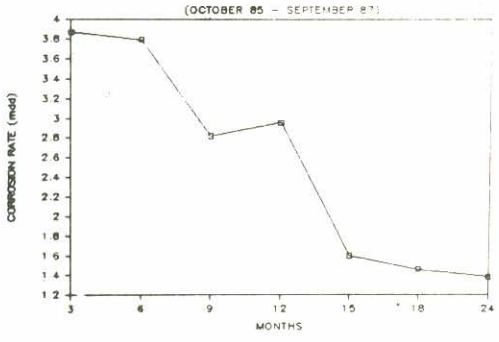

Fig. 4: Cumulative corrosion rate of zinc (Oct. 85–Sep. 87)

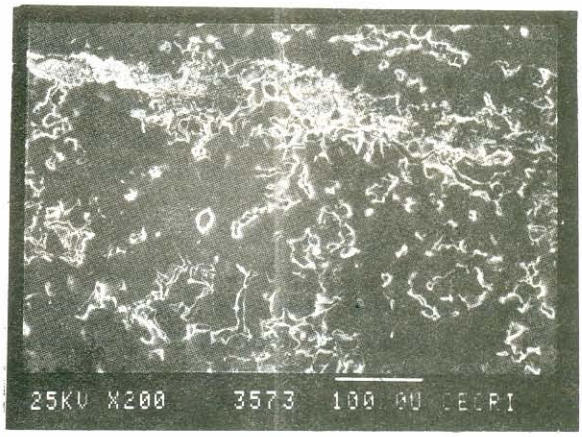

Fig. 7: SEM of 12 months exposed zinc

Fig. 5: SEM of 3 months exposed zinc

Fig. 8: SEM of 15 months exposed zinc

commercial zinc utilised in this study is greater than the room temperature [4].

The surface of the specimens exposed for 9 months had elongated grains and experienced uniform attack.

Recrystallisation occurred on the panels exposed for longer periods. The surface exposed for 12 months has distinct equiaxial grains with more attack on selective areas, which could have resulted in higher corrosion rate. Compared to the surface exposed for 12 months, the surface exposed for 15 months has finer grains.

CONCLUSION

Increase in the surface temperature above the recrystallisation temperature and nucleation of corrosion spots would have affected the pronouncement of recrystallisation on the exposed surface. The refinement of grains is pronounced with respect to period of exposure.

REFERENCES

1. K S Rajagopalan, PL Annamalai, M Sundaram, C Rajagopal and V Chandrasekaran, *Br Corros J,* **6** (1971) 175
2. Annual book of ASTM Standards, Part 10 (1980) p782
3. (Ed) Florian Mansfeld, *Corrosion Mechanisms*, Marcel Dekker, New York (1987) p 258
4. S N Avner, *Introduction to Physical Metallurgy*, (1984) p 532