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Performance of electrodeposited zinc on steel in biologically active environment

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Electrodeposited zinc on steel performs considerably well in natural seawater. The present study investigates the role of biologically produced hydrogen sulphide on the performance of zinc plated steel. The putrefaction of a green marine algae was used as the means of sulphide production. The levels of thiosulphate, sulphide and sulphate are monitored periodically to give an insight into the biological activity. To study the corrosion behaviour of zinc plated steel,pH and potential were monitored. The effects of initial exposure conditions after allowing sufficient time for considerable extent of putrefaction to take place has also been dealth with. The results are discussed in the light of changes in sea water chemistry and the effects of initial exposure conditions.

Key words: Marine macroorganism, electroplated zinc, green marine alga ulva Lactuca

INTRODUCTION

Protective property of zinc on steel is well documented in natural seawater [1]. The present study deals with the role of biologically active environment, effected by the marine macro organism, on the performance of electrodeposited zinc on steel. The effects of initial exposure conditions and the changes in seawater chemistry are highlighted.

EXPERIMENTAL

Rolled steel specimens of 60mm × 25mm × 1mm size were cut, pickled, polished and 5μ thickness of zinc was electroplated using zinc cyanide bath [2]. The decay of the green marine alga *Ulva Lactuca* was used to create a biologically active environment [3]. The plant was introduced at different compositions namely 20 g/l, 50 g/l and 100 g/l in seawater. For each composition quarterplicate panels were used. Two sets of experiments were conducted, one being plant and panels exposed together (P) and the other being panels exposed after 10 days of putrefaction AP). To monitor pH, potential and levels of sulphide and sulphate, separate set of tanks were used. For AP studies,10 days aged seawater was used as the control. Dissolution rate from weight-loss of the zinc is taken as a measure of performance of coating.

RESULTS AND DISCUSSION

The most significant initial event is the change in pH of experimental sets, while that of control remains unaffected. Figure 1 shows the change in pH in presence of decaying

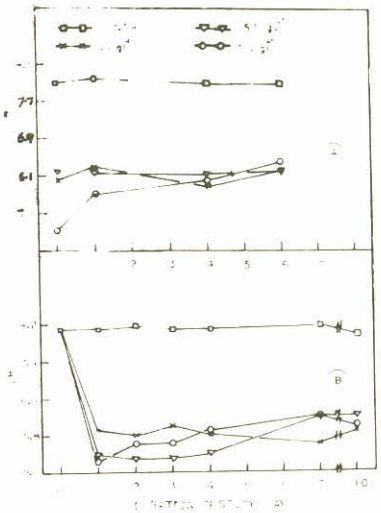

Fig. 1: pH of the environment

matter. Figure 2 represents the level of sulphide and sulphate in the experimental sets of 'P' and 'AP'. The biological activity of the environment is correlated to the levels of sulphate and sulphide. The toxicity of the zinc has a direct bearing in the activity of self-regulated bacteria and thereby decrease in sulphide levels [4] better than it is for the bare steel. Figure 3 shows the shift in open circuit potential values of 20P, 50P and 100P towards negative direction, indicating higher dissolution rate of zinc. This could be due to the presence of oxygen in trace amounts in combination with the commencement of sulphide production. The shift in potential towards that

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of steel after third day, indicates the sacrificial protection behaviour of zinc. The OCP of steel is achieved on the 11th day, in the experimental sets of 'P' indicating the failure of the coating.

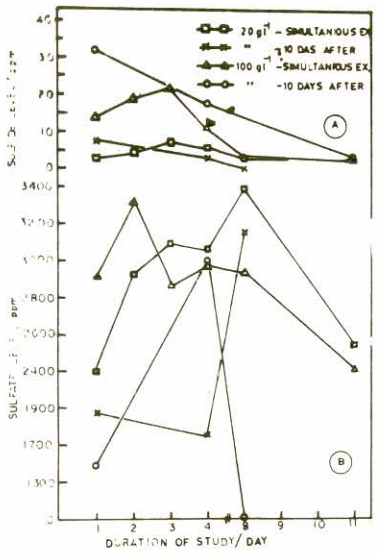

Fig. 2: Levels of sulphate and sulphide of the environment

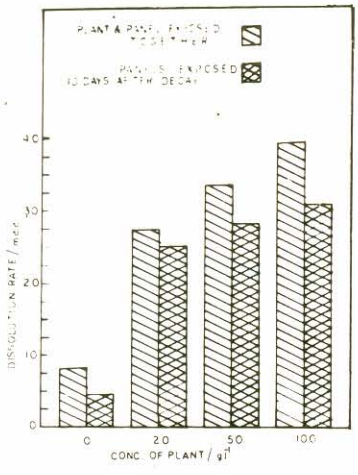

Fig. 3: Open circuit potential values of the panels in the environment

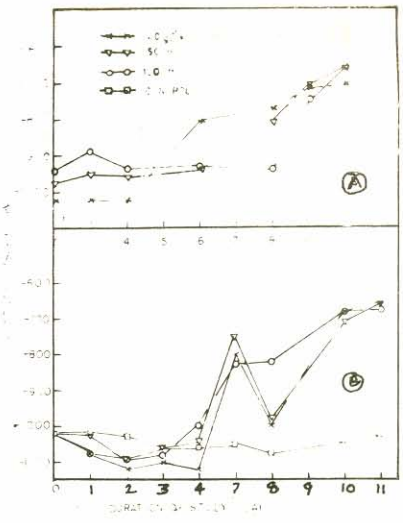

Fig. 4: Dissolution rate of zinc in the environment

The lower pH values in the sets of 'AP' enhanced the dissolution rate of zinc during initial period of exposure, which could also be observed from the OCP values. The higher levels of sulphide present forms a protective film over the exposed steel surface and inhibits the sacrificial dissolution of zinc resulting in the prolongation of time of failure of the coating to 13 days. The aggressiveness of the biologically active environment can be judged by comparing the higher dissolution rates of zinc in the experimental sets of 'P'and 'AP' which could be attributed to the levels of dissolved oxygen in seawater.

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