Abstract #1709, 224th ECS Meeting, © 2013 The Electrochemical Society

Corrosion resistance and mechanism of zinc rich paint in corrosive media

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1. Introduction

Zinc is widely used as sacrificial protecting coating in process industries, constructions and buildings. The use of zinc based coating articles is increasing because its sacrificial protection of steel from corrosion. Due to the fact that, zinc is less noble metal and cathodically protects the steel from corrosion [1]. In order to deposit a coating on a metal substrate, electroplating, hot dip galvanizing and spray can be employed. When applied by spray, the duration for the coating process can be reduce and consumed less energy compared to electroplating or hot dip galvanizing. Most literature evaluated zinc based coating using electroplating and hot dip galvanizing process. Therefore, further insight and study on zinc based coating using spray method is essential. In order to achieve effective zinc based coating, not only depends on deposition method, zinc contents also play an important roles. Kalendovà [2] and Jagtap et al. [3] studied the effects of size and shape of zinc particles on the anticorrosive coating. The performance of zinc rich coating has improved significantly due to their efforts [4].

2. Experimental

The metal substrate was a pure iron with purity of 99.5% (10mm x 20mm x 0.5mm), and abraded with #600, #800 and #1000 emery papers, respectively. Thereafter, the metal substrates were thoroughly rinsed in ethanol in an ultrasonic bath and dried at room temperature. The zinc rich paints were obtained from Atom Paint, Japan with zinc content of 74% and 96%. Zinc rich paints were applied onto the metal substrates by air spraying following the manufacturer's instructions. The metal substrates were sprayed with 1, 3 and 5 layers coating, respectively. Then, scribes were made onto the coated samples.We sprayed the paints continuously in order to cut the spraying process to meet the industrial needs. After the coatings were applied, the metal coated substrates were allowed to dry at ambient temperature.

The rears back of coated substrates were protected with an epoxy to leave a 2.0 cm^2 surface contact with the corrosive media. By using silver paste, the coated substrates were connected to copper wire. The corrosion tests were carried out at ambient temperature in corrosive media consisted of 0.5 and 1 M NaCl solution. The electrochemical experimental set-up was composed of a three electrode cell using a platinum grid as counter electrode and saturated silver-silver chloride electrode Ag/AgCl/KCl as reference, the coated samples connected to the working electrode. The measurements were carried out using a potentiostat/galvanostat HA-151 coupled to a frequency response analyzer (FRA) FRA-5022. The polarization curves were obtained between -1V ~ 1V whilst the impedance data obtained between 100kHz and 10mHz at 1mV as the applied sinusoidal perturbation. The coated samples were lifted out of the solution after the test and cross-section, made perpendicular to exposed surface were observed by SEM.

3. Results and discussion

Polarization tests were carried out for each concentration, 0.5 and 1M, respectively. Fig. 1 shows the polarization curve measurement result of ZRP coated specimens, 74% and 96% ZRP in 0.5 M NaCl solution.

Corrosion potential for pure zinc in NaCl solution is approximately -1.05V whilst pure iron is -0.65V. 96%-5 ZRP shows the less noble potential with value of -0.74V.As numbers of coatings were increased, the corrosion potential tend to shift to less noble potential and the anodic current shifted to lower current density compared to one layer coating, which indicates that numbers of coatings have significant effect on anodic current. This may be explained, as numbers of coating increased epoxy thickness also increased which formed a barrier coat. Therefore, the process of corrosion may be inhibited. Fig. 2 shows the polarization curves of 74% and 96% ZRP coated samples in 1M NaCl solution. It is found that polarization curves have the similar trends with samples measured in 0.5M NaCl. However, corrosion potential for samples coated with 96% ZRP show a value of -0.98V, regardless of their thickness. In contrast, for samples coated with 74% ZRP, as number of coating increased the corrosion potential tends to shift to less noble potential. This implied that the compactness and concentration of zinc particles in the coating enhanced the corrosion protection.

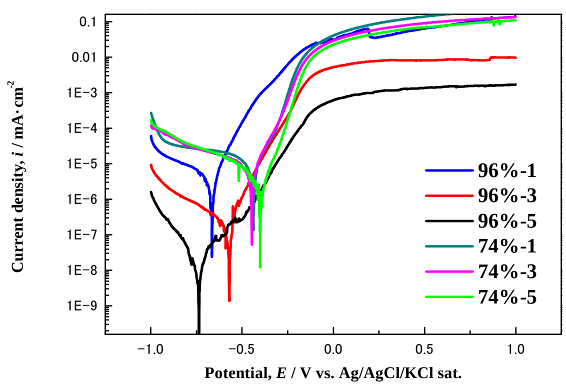

Fig. 1. Polarization cathodic curves in 0.5 M NaCl solution.

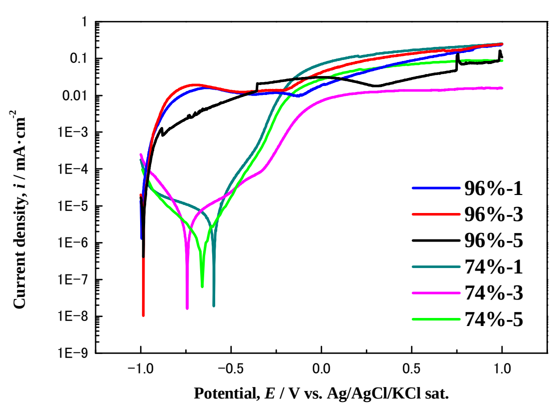

Fig. 2. Polarization cathodic curves in 1.0M NaCl solution

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