3.5 중량% NaCl 용액에서 쌍선 아크 용사 공정으로 증착된 Al-Zn 코팅의 부식 성능에 대한 기공 밀봉제로서의 헥사메타인산나트륨의 영향

Effect of sodium hexa-meta phosphate as pore-sealing agent on the corrosion performance of Al-Zn coating deposited by twin-wire arc thermal spray process in 3.5 wt.% NaCl solution

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Abstract : Al and Zn are used to protect the steel structures from corrosion. In the present studies, 15Al-85Zn alloy wires has been used for the deposition of coating by arc thermal spray process. Moreover, this process of coating exhibited severe defects formation, therefore, this coating was post-treated with different concentrations i.e. 0.05, 0.1 and 0.5M sodium hexa meta phosphate (Na6[(PO3)6]: SHMP) to fill to defects of deposited coatings and assessed their corrosion resistance in 3.5 wt.% NaCl solution with exposure periods. After the treatment, the porosity of the coating reduced significantly by formation of composite oxide films onto the coating surface. Initially, 0.5 M SHMP treated coating exhibited highest in total impedance due to significant reduction of porosity but once the exposure periods are extended, the composite oxides are dissolved, thus, total impedance is decreased.

키워드 : 강재, 부식, 코팅, SEM, EIS.
Keywords : steel, corrosion, coating, SEM, EIS

1. Introduction

Corrosion is the versatile issues of the world. Therefore, different protective techniques are being used to protect the steel from corrosion. One of the best and convenient method is thermal spray process[1]. Therefore, different pore sealing agents have been used by present authors to enhance the corrosion resistance properties of Al coating. Therefore, in the present studies, we have deposited 15Al-85Zn alloy coating onto the steel surface and post treated it with different amount of sodium hexa meta phosphate (Na6[(PO3)6]: SHMP) and accessed their corrosion resistance properties in 3.5 wt.% NaCl solution with exposure periods.

2. Materials and Method

The plain carbon steel was coated with twin wire of 15Al-85Zn alloy with 1.6 mm diameter. The treatment of the deposited coating was carried out with nylon brush by dissolving 0.05, 0.1 and 0.5 M sodium hexa meta phosphate (Na6[(PO3)6]: SHMP) in distilled water to reduce the porosity and enhance the corrosion resistance properties of coatings in aggressive environment. The treatment of Al coating was carried out for 24 hours at every 8 hours of interval thereafter kept in humidity chamber at 50 ^{o}C and 95% RH (relative humidity) for 7 days.

The morphological characterization of coatings was performed by Scanning Electron Microscopy (SEM). The electrochemical studies of treated as well as 15Al-85Zn coatings was performed in 3.5 wt.% NaCl with exposure periods.

3. Results and Discussion

The morphology of the coatings is shown in Figure 1. The as coated sample i.e. 15Al-85Zn coating exhibited splat and coarse particles

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(Figure 1a) of molten metals along with defects. The 15Al-85Zn coating treated with 0.05 M SHMP, the surface is covered with needle like crystals as shown in Fig. 1b. There is some space observed on the treated coating. The 0.1 M SHMP treated coating densely cover the coating, reduced the porosity and fill the defects as observed in Fig. 1c. Alternatively, once the concentration of SHMP increased greater than 0.1 M, the coating surface exhibits crack formation in oxide film as shown in Fig. 1d but the oxide film is very dense. The crack formation in 0.5 M SHMP treated coating is attributed to the brittleness of composite oxides films[2,3].

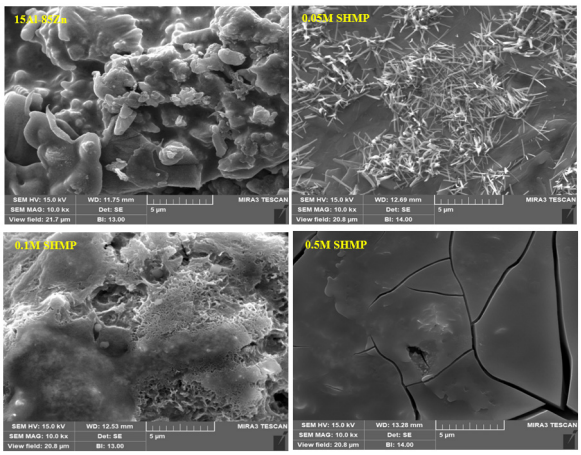

Figure 1. SEM of 15Al–85Zn coating and treated samples

4. Conclusions

The 15Al-85Zn deposited coating exhibited defects and pores formation. Therefore, it was treated with different concentrations of SHMP which fill the defects and porosity of the deposited coatings. 0.05 M SHMP treated forms very thin layer of needle like crystal which cannot significantly fill the defects, therefore, it shows lowest in total impedance. The defects in coating make the surface active where corrosion reaction has started but once the exposure periods are increased, corrosion products fill them and enhances the corrosion protection. However, 0.5 M SHMP treated coating completely fill the defects, therefore, it shows highest impedance after 1 h of exposure but at the meantime, it forms cracks in coating which enhances the corrosion reaction at longer duration of exposure. Thus, it shows lower in total impedance after 41 d of exposure compared to 15Al-85Zn coatings. Moreover, 0.1 M SHMP treated coating fill the defects and improve the corrosion resistance once exposed to 3.5 wt.% NaCl solution due to formation of stable and protective corrosion products which fill the remaining defects in the coating.

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