

인공해양환경에서 Arc Thermal and Plasma Arc Spray 공법이 적용된 Zn 코팅 강재의 내식성능 평가에 관한 연구

Study on Corrosion Resistance Performance of Zn Coating Applied by Arc Thermal and Plasma Arc Spray Process in Artificial Ocean Water

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Abstract

In present study, we have deposited the Zinc coating using arc thermal spray and plasma arc spray processes onto the steel substrate and durability of the deposited coating was evaluated. The bond adhesion result shows that plasma arc sprayed Zn coating exhibited higher in its value compared to arc thermal spray. SEM shows that Zn coating deposited by plasma arc process is more compact, less porous and adherent compare to arc spray process. The corrosion resistance properties are evaluated in artificial ocean water solution with exposure periods. EIS results show that total impedance at 0.01 Hz of plasma arc sprayed coating is higher than arc thermal spray owing to the compact and less porous morphology. It is concluded that plasma arc sprayed Zn coating is better than arc thermal spray process.

키 워 드 : 징크, 강재, 부식, 부착 강도

Keywords : zinc, steel, corrosion, bond adhesion

1. Introduction

Steel is being used in many sectors such as construction, medical, airline, car industries etc. due to strength, shape, availability, low cost, ductility, recyclability, workability etc. But corrosion is a great concern in the steel construction. Corrosion costs almost 4% of global GDP which is \$1.4 trillion worldwide.¹⁾ Therefore, it is utmost important to protect the steel structure from corrosion using different methods such as galvanizing, thermal spray coating, inhibitors, barrier type coating etc.²⁾ Among these methods, thermal spray coating process is most popular due to its easy to application. Therefore, in the present study, we have deposited the Zn coating as sacrificial coating using arc thermal and plasma arc processes and compared the bond adhesion, morphology and corrosion resistance properties in artificial ocean water with exposure periods.

2. Materials and Method

The Zn (99.95% purity) coating was deposited on sand blasted steel plate. 1.6 mm diameter twin wires were used in both coating processes i.e. arc thermal and plasma spray coating to deposit the Zn coating.

The bond adhesion measurement was carried out according to KS F4716. The morphology of deposited Zn coating was performed by scanning electron microscopy(SEM). The corrosion resistance properties of deposited coating were carried out in artificial ocean water i.e. ASTM D1141 solution at longer duration of exposure.

3. Results and Discussion

The average bond adhesion value of deposited Zn coating using arc thermal and plasma arc is found to be 4.27

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and 4.84 MPa, respectively. Plasma arc spray exhibited around 12% higher bond adhesion value compared to arc thermal spray process. This result suggests that Zn coating deposited by plasma arc is more compact and adherent compared to arc thermal spray process.

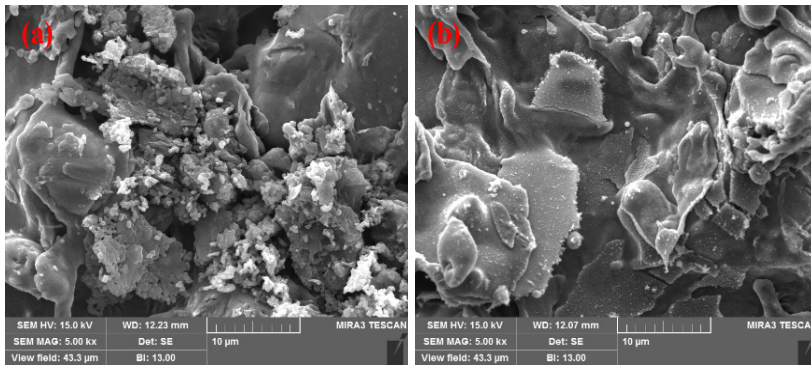


Figure 1. SEM image of Zn coating deposited by (a) arc thermal, and (b) plasma arc

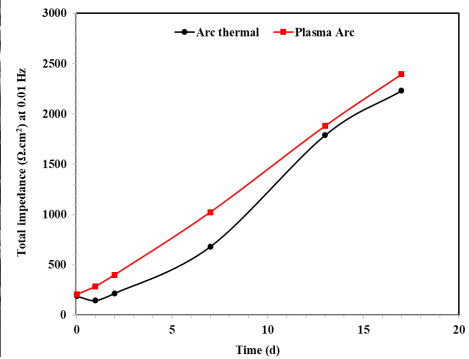


Figure 2. Total impedance of Zn coating in artificial ocean water with exposure periods

SEM results of Zn coating deposited by arc thermals and plasma arc spray is shown in Figure 1 (a) and (b), respectively. It can be seen that arc thermal spray process deposited coating possess heavy defects and porosity (Figure 1a) whereas plasma arc sprayed coating shows compact, uniform and adherent morphology (Figure 1b). Thus, plasma arc spray coating shows higher in bond adhesion value. On the basis of SEM results, it is utmost requirement to study the corrosion resistance of both processes deposited Zn coating. The total impedance of deposited Zn coating at lowest studied frequency i.e. 0.01 Hz is shown in Figure 2. It can be seen from this figure that plasma arc process exhibited higher in total impedance at 0.01Hz with exposure periods in artificial ocean water solution owing to the regular, adherent and less porous morphology.

4. Conclusion

From the above results and discussion, it is concluded that plasma arc spray process is better than arc thermal spray process in regards of bond adhesion, morphology and corrosion resistance. The bond adhesion value of Zn coating deposited by plasma arc spray process is 12% higher than arc thermal spray. Plasma arc spray process form uniform, compact and less defective Zn coating whereas arc thermal spray process exhibited heavy defects, pores and irregular morphology observed by SEM. The total impedance at 0.01 Hz of plasma arc sprayed coating is higher than arc thermal spray process exposed in artificial ocean water solution with exposure periods.

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