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Corrosion characteristics of plasma spray, arc spray, high velocity oxygen fuel, and diamond jet coated 30MnB5 boron alloyed steel in 3.5 wt.% NaCl solution

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Abstract

30MnB5 boron alloyed steel surface is coated using different coating techniques, namely 60(Ni-15Cr-4.4Si-3.5Fe-3.2B 0.7C)-40(WC 12Co) metallic powder plasma spray, Fe-28Cr-5C-1Mn alloy wire arc spray, WC-10Co-4Cr (thick) powder high velocity oxy-fuel (HVOF), and WC-10Co-4Cr (fine) diamond jet HVOF. The microstructure of the crude steel sample consists of ferrite and pearlite matrices and iron carbide structures. The intermediate binders are well bonded to the substrate for all coated surfaces. The arc spray coated surface shows the formation of lamellae. The cross-section of HVOF and diamond jet HVOF coated surfaces indicates the formation of WC, W2C Cr, and W parent matrix carbide structures. The corrosion characteristic of the coated steel has been investigated in 3.5 wt.% NaCl solution using electrochemical impedance spectroscopy (EIS), scanning electron microscope (SEM), and energy dispersive X-ray spectroscopy (EDAX) techniques. The results reveal that the steel corroded in the medium despite the coatings. However, the extent of corrosion varies. HVOF coated sample demonstrated the highest corrosion resistance while arc spray coated sample exhibited the least. EDAX mapping reveals that the elements in the coatings corroded in the order of their standard electrode potential (SEP). Higher corrosion resistance of HVOF coated sample is linked to the low SEP of tungsten.

Keywords: boron alloyed steel; coatings; coating techniques; corrosion; corrosion resistance

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