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Investigation on the Corrosion and Cavitation Erosion Behaviors of the Cast and Friction Stir Processed Ni-Al Bronze in Sulfide-Containing Chloride Solution

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Corrosion and cavitation erosion behaviors of the cast and friction stir processed (FSP) Ni-Al bronze (NAB) in sulfide-containing (polluted) 3.5% NaCl solution were investigated in the present study. The electrochemical impedance spectroscopy (EIS) results demonstrated that the corrosion product film formed in the polluted solution was of poor protectiveness, and the gravimetric measurements results indicated that the sulfide ions increased the corrosion rate by a factor of 1.13 for the cast and 2.12 for the FSP NAB, compared with the results in clean 3.5% NaCl solution. The sulfide ions promoted the formation of a thick and porous corrosion product film, which consisted of sulfides and oxides. Deep pits were found propagated along the eutectoid microstructure for the cast and the β' phases for the FSP NAB. The cavitation erosion mass loss with the addition of sulfide was 0.92 times and 2.52 times more than that in the clean solution for the cast and FSP, respectively. The increased corrosion damage induced by the sulfide ions deteriorated the mechanical properties and consequently accelerated the cavitation erosion degradation. The corrosion-cavitation erosion synergy/total mass loss (i.e. S/T) value in the polluted solution reached 73.48% for the cast and 76.94% for the FSP. It can be seen that the FSP NAB exhibited no obvious superiority in the corrosion and cavitation erosion resistance, compared with the cast one in the sulfide-containing chloride solution.

Keywords: Friction stir processing; Ni-Al bronze; Sulfide; Corrosion; Cavitation erosion

FULL TEXT

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