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Performance of HVOF Sprayed Ni-20CR and Cr3C2-NiCr Coatings on Fe-Based Superalloy in an Actual Industrial Environment of a Coal Fired Boiler

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Abstract : Hot corrosion has been recognized as a severe problem in steam-powered electricity generation plants and industrial waste incinerators as it consumes the material at an unpredictably rapid rate. Consequently, the load-carrying ability of the components reduces quickly, eventually leading to catastrophic failure. The inability to either totally prevent hot corrosion or at least detect it at an early stage has resulted in several accidents, leading to loss of life and/or destruction of infrastructures. A number of countermeasures are currently in use or under investigation to combat hot corrosion, such as using inhibitors, controlling the process parameters, designing a suitable industrial alloy, and depositing protective coatings. However, the protection system to be selected for a particular application must be practical, reliable, and economically viable. Due to the continuously rising cost of the materials as well as increased material requirements, the coating techniques have been given much more importance in recent times. Coatings can add value to products up to 10 times the cost of the coating. Among the different coating techniques, thermal spraying has grown into a well-accepted industrial technology for applying overlay coatings onto the surfaces of engineering components to allow them to function under extreme conditions of wear, erosion-corrosion, high-temperature oxidation, and hot corrosion. In this study, the hot corrosion performances of Ni-20Cr and Cr_3C_2-NiCr coatings developed by High Velocity Oxy-Fuel (HVOF) process have been studied. The coatings were developed on a Fe-based superalloy, and experiments were performed in an actual industrial environment of a coal-fired boiler. The cyclic study was carried out around the platen superheater zone where the temperature was around 1000°C. The study was conducted for 10 cycles, and one cycle was consisting of 100 hours of heating followed by 1 hour of cooling at ambient temperature. Both the coatings deposited on Fe-based superalloy imparted better hot corrosion resistance than the uncoated one. The Ni-20Cr coated superalloy performed better than the Cr_3C_2-NiCr coated in the actual working conditions of the coal fired boiler. It is found that the formation of chromium oxide at the boundaries of Ni-rich splats of the coating blocks the inward permeation of oxygen and other corrosive species to the substrate.

Keywords : hot corrosion, coating, HVOF, oxidation
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