Ceramic based coatings on steel for extreme erosive environment

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Thermal spray techniques offer flexibilities to tune the different properties of coatings desired for industrial applications. The main advantage of thermal spraying is that it is practically possible to deposit nearly any material which melts without decomposing. Ceramic-based coatings with specific reinforcements can serve to protect against wear, oxidation and corrosion even at high temperatures and pressures. High-Velocity Oxy-Fuel (HVOF) coating technique can develop ceramic coatings to enhance the surface properties of the parent material. HVOF process results in forming dense and strongly bonded coatings. There are many applications where components/machines are subjected to extreme environmental conditions. Some of these are petrochemical industries, turbomachinery, thermal powerplants, etc. The common problem associated with these areas is material degradation by hot erosion and hot corrosion. The scope of the present study involves high-temperature erosion evaluation of ASME SA387 steel coated with alumina-based coatings with ceria (CeO_2) and hexagonal Boron Nitride (hBN) as reinforcements, using the HVOF process. Optical microscopy, SEM, XRD and EDS were used for metallurgical characterization and Nano-indentation was used for mechanical characterization of the coated specimens. Hot erosion and fireside corrosion behavior of the coatings was evaluated by hot air jet erosion test rig with temperature up to 400ºC. Results indicate a significant reduction in erosion and fireside corrosion in case of ceria and hBN reinforced alumina coatings. Improved performance of coatings is attributed to the metallurgical aspects of the thermally sprayed ceramic-based materials which lead to newly formed phases within the coatings.

Keywords: Hot erosion, corrosion, coating, alumina based coatings, HVOF process.

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