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On a Determination of Residual Stresses and Wear Resistance of Thermally Sprayed Stainless Steel Coating

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Abstract : Thermal spraying processes are widely used to produce coatings on original constructions as well as in repair and maintenance of long standing structures. A lot of efforts forwarding to develop thermal spray coatings technology have been focused on improving mechanical characteristics, minimizing residual stress level and reducing porosity of the coatings. The specific aim of this paper is to determine either residual stresses distribution or wear resistance of stainless steel coating thermally sprayed on a carbon steel substrate. Internal stresses determination was performed using an extensometric method in combination with a simultaneous progressive electrolytic polishing. The procedure consists of measuring micro-deformations using a bi-directional extensometric gauges glued on the substrate side of the materials. Very thin layers of the deposits are removed by electrochemical polishing across the sample surface. Micro-deformations are instantaneously measured, leading to residual stresses calculation after each removal. Wear resistance of the coating has been determined using a ball-on-plate tribometer. Friction coefficient is instantaneously measured during the tribological test. Attention was particularly focused on the influence of a post-annealing at 850 °C for one hour in vacuum either on the residual stresses distribution or on the wear resistance behavior under specific wear and lubrication conditions. The obtained results showed that the microstructure of the obtained arc sprayed stainless steel coating is classical. It is homogeneous and contains un-melted particles, metallic oxides and also pores and micro-cracks. The internal stresses are in compression in the coating. They are more or less scattered between -50 and -270 MPa on the surface and decreased more at the interface. The value at the surface of the substrate is about –700 MPa, partially due to the molten particles impact with the substrate. The post annealing has reduced the residual stresses in both coating and surface of the steel substrate so that the hole material becomes more relaxed. Friction coefficient has an average value of 0.3 and 0.4 respectively for non annealed and annealed specimen. It is rather oil lubrication which is really benefit so that friction coefficient is decreased to about 0.06.

Keywords : residual stresses, wear resistance, stainless steel, coating, thermal spraying, annealing, lubrication
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