ABSTRACT

The objective of this study was to quantify pore type defects and cracks in coatings obtained by thermal spray by electric arc through techniques of quantitative analysis and stereology and digital imaging. Coating porosity was determined by quantitative image analysis based on scanning electron microscopy (SEM) micrographs taken from cross sections. The presence of porosity, cracks and fissures in the coating, are considered failures that will generate a permeability deleterious corrosion resistance and their presence is a function of parameters of the process.

Keywords: Ni and Co coatings, thermal sprayed, digital image.

INTRODUCTION

Thermal spraying is a deposition technique that directs a spray of molten particles to the substrate to form the coating. It is used for the protection of parts against wear, corrosion and high temperatures, thus improving the properties of engineered surfaces. Moreover, thermal spraying processes are also applied to repair damaged and worn parts (Knight, 1990, Schorr, 1999, Šimunović, 2010, and Azizpour, 2012). The coatings were prepared by electric arc thermal spray process on carbon steel plates with 20 grit Al2O3 grit-blasted surfaces. The steel samples were cut to form approximately 100 mm x 150 mm x 4.5 mm sized specimens. Initially, was applied an intermediate bond that increases the adhesion of coating. Argon gas was used as the powder carrying and the shielding atmosphere. All the process parameters, including the spray distance, were kept constant throughout the coating process. The main parameters were the electric voltage and the distance of pistol (circa 100 mm). From the possible combinations of wires and intermediate bonds, two combinations were chosen. The condition 1 will be hereafter labeled as FeCoCr; and condition 2 as FeCrNi, considering the main alloy elements present in the deposits.

During the thermal sprayed deposition process the following average parameters values were used: a voltage of 40 V, a current intensity of 100 A and a deposition rate of 2.34 kg hr⁻¹. The used equipment has two entrances for 2.6 mm diameter wire reels. The microstructures of the coatings were examined by SEM and surface chemistry was studied by X-ray energy dispersive spectroscopy (EDX) microanalysis and the spectral mapping and point of elements. The samples for microscopic examination were prepared by standard metallographic techniques. Twenty 300x magnification images for each coating condition were subjected to

RESULTS AND CONCLUSIONS
The morphology of coatings exhibit characteristics of lamellar microstructures with the long axis of impacted splats oriented along the substrate surface. Incompletely melted particles together with a distribution of similarly oriented oxides were observed for the two coating types. The coating condition 1 showed 3.31 ± 1.42% of defects and the coating condition 2 showed 3.81% ± 0.9. Both coatings showed more cracks than pores, i.e., the empty type defects, with very elongated morphology and shape factor less than 0.70. These results are in agreement with those obtained by other techniques porosity measurements (Azizpour, 2012), showing values around 4% for these coatings, however, without further information about the morphology and distribution of defects. Other factors that affect the analyses of defects are orientation, morphology, distribution throughout the coating thickness, shape of pores and thermal insulation effects. The amount and distribution of these defects depend on selected thermal spray parameters.

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