11th International Conference
on Advanced Materials
Rio de Janeiro Brazil
September 20 - 25
ICAM 2009

Influence of temperature on erosive wear of Cr_3C_2 plasma-sprayed coating

J. Vicenzi[(1)*], C. M. Marques[(1)] and C. P. Bergmann[(1)]

(1) Federal University of Rio Grande do Sul. Engineering School. Materials Department Osvaldo Aranha, 99/705. 90035-190 Porto Alegre – RS – Brazil. jvicenzi@ufrgs.br

* Corresponding author.

Abstract - This work presents the influence of the temperature and attack angle on erosive wear in Cr_3C_2 plasma-sprayed coatings. The erosion test was carried-out in a high temperature erosion rig developed based in ASTM G76. The results have shown the increase of rate erosion wear with attack angle in all temperatures. The microstructures after wear were similar at 25ºC and 800ºC.

Erosive wear affects numerous industries, such as power generation, mining, and the pneumatic transportation of solids. Based on structural features and material properties, fracture may have a different nature: in the case of brittle solids, the direct fracture is dominant; in the case of ductile ones, the mechanism of microcutting and/or low-cyclic fatigue prevails[1]. The worst case scenario normally occurs where there is a combination of both erosion and oxidation, especially at high temperatures[2]. In order to minimize damage caused by erosive wear, many authors propose the use of surface coatings[2,3]. This work investigates the erosive wear in Cr_3C_2 plasma-sprayed coatings at temperatures up to 800ºC.

The erosion test was carried out in a high temperature erosion rig developed based in ASTM G76[4], at different temperatures and particle impact angles, while the other parameters – particle velocity, erodent mass flux and erodent particle (fused alumina) – were kept constant. The results have been evaluated through weight loss after erosion considering the weight gain.

The results have shown the increase of rate erosion wear with attack angle in all temperatures (similar at literature[5] - detach in Figure 1). The highest rate erosion wear observed for the Cr_3C_2 coating at 800ºC for an attack angle of 90° may be caused by one or more of these phenomena, combined or not, and are dependent of temperature: i) modification of the properties mechanical (hardness and modulus of elasticity); ii) relief of residual stresses with or without the propagation of cracks in the coating or in the interface/substrate; iii) oxygen reaction (formation of oxides/release of CO/CO_2). The microstructure of the Cr_3C_2 coating after wear at 30° and 90° at 25 and 800°C, shown similarity (Figure 2). At low temperatures it was observed more significantly sharp corners, small cracks (indicated by arrows) and pits (surrounded), similar in dense aluminas[4] and in according to the literature for elastic-plastic mechanisms[6]. At high temperatures, can be observed the rounding of the edges after the erosion (indicated by circles) and there are less cracks (indicated by arrows) in the eroded surface.

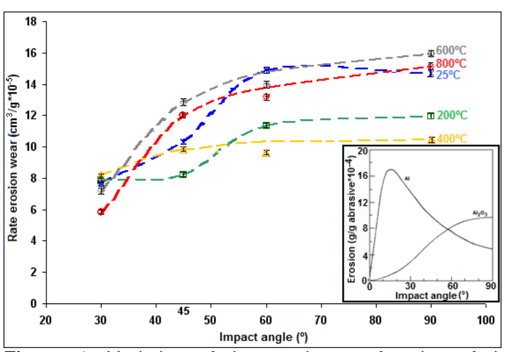

Figure 1: Variation of the erosion as function of the erodent attack angle, normalized by temperature. Literature dates in detach[(5)].

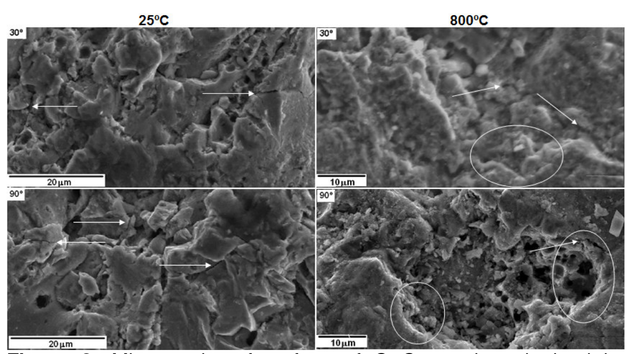

Figure 2: Micrographs of surface of Cr_3C_2 coating obtained by plasma *spray* after erosion at 25ºC and 800ºC at attack angles of 30º and 90º.

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