EROSION BY IMPACT OF SOLID PARTICLES IN DUPLEX STAINLESS STEEL UNS S32205

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1 Introduction

Due to economic losses related to the deterioration of engineering materials in-service, the study of Tribology has been receiving increasing attention from researchers in the field of mechanics and materials. In the case of wear by erosion, that caused by the impact of hard particles on surfaces of ductile metallic materials still offers opportunities for research, especially on the mechanisms that can explain the phenomena related to the loss of mass that characterizes erosion[1,2,3]. This work aims to study the morphological and topographical effects of erosion on a flat UNS S32205 duplex stainless steel, by means of individual and successive impacts of alumina particles. For these purposes, surfaces were examined by SEM and the roughness was measured by a digital profilometer.

2 MATERIALS AND METHODS

2.1 Target material

Figure 1: Blasting chamber and compressor.

In view of the objective of the work a planning was made to obtain results in the more economic and fast mode possible. It was designed and mounted an installation aimed to promote erosive wear in metallic surface, by the impact of hard particles. The most of the experiments described in literature [3, 4] uses spherical particles of hard material, impacting the surfaces examined. Here, a particles beam embedded in air flow, typical of industrial sand blasting procedures was used. The installation, specially designed and constructed for this project (Figure 1), consisted of a compact blasting chamber, coupled to a compatible air compressor.

Samples of stainless steel duplex UNS S32205 were removed from 1/2” thickness commercial plates manufactured by North American Stainless and provide by Expander. Mechanical properties of the material are: Yield stress (0,2 %): 586 MPa; Ultimate tensile stress: 784 MPa; Elongation in 50 mm: 34 % and Hardness: 20 HRC [4].

2.2 Impacting Particles

Alumina particles (Al2O3) produced by ALCOA and provided by ESSENCE with 100 Mesh average granulometry and variable morphology are shown in Figure 2:

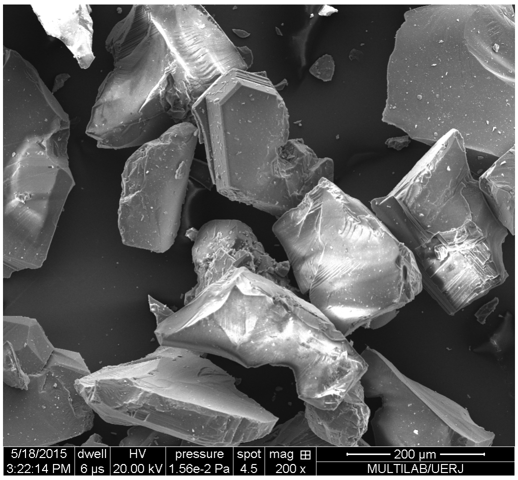

Figure 2: General aspect of Alumina particles.

3 RESULTS

The results with brief analyses are shown in tables of Figures 3 and 4. Each table includes a SEM micrography and a rugosimetric profile of the surface examined. Statistical curves from profiles are also included, as the ADC - Amplitude Distribution Curve and Abbott-Firestone (BAC - Bearing Area Curve).

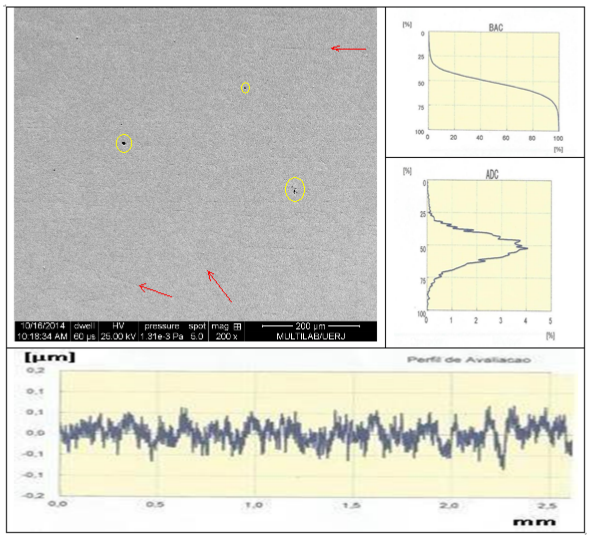

Figure 3: Polished sample. Micrography by SEM.

Morphological analysis: SEM image typical of polished surfaces. Scratches from grinding (red arrows). Voids revealed by polishing process (yellow circles). Topographical analysis: Roughness profile typical of polished surfaces. Gaussian distribution of ADC curve characterizes uniformity of surface finishing. Tips of the sigmoid BAC curve indicate equivalence between peaks and valleys in the profile [5].

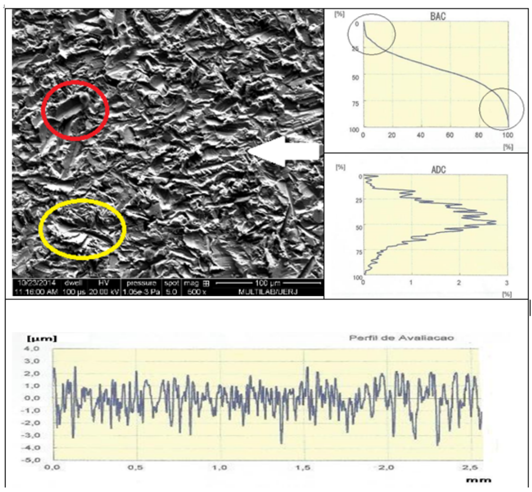

Figure 4: Sample after 3 s of erosive attack. Micrography by SEM.

Morphological analysis: SEM image showing craters. The crater pointed by white arrow (flux orientation) is elongated and oriented accordingly. The yellow and red circles show craters with borders due to plastic deformation [3, 4]. Different orientations were attributed to the turbulent nature of the flux. Topographical analysis: Roughness profile shows up to 3,7 micrometers of crater's depth and borders of 3 micrometers medium height. ADC curve was shifted to the left indicating more valleys than peaks. This is confirmed by the tips areas of BAC curve [5].

4 CONCLUSION

On the basis of the experiments carried out on samples of stainless steel UNS S32205 under the conditions established, it was possible to conclude:

The morphological study by SEM images of the surfaces of the material impacted by alumina particles conducted in turbulent air flow can be done in this way and not only with the use ballistic tests with a single particle.

This method allows obtaining simultaneously different shapes, sizes and orientations of surface craters, reducing the time and cost of the experiments.

The morphology of the craters formed on the surface of the material is compatible with models of erosion by cutting and plastic deformation, as well as experimental results of the literature consulted.

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