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EVALUATION AND CHARATERIZATION OF WEAR BEHAVIOUR OF ROLLED STEELS FOR THE PRODUCTION OF A SCREW

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ABSTRACT

A conveyor screw from the solid waste treatment industry, used to move organic waste and therefore subjected to a corrosive environment, was studied. The interaction of the mechanical component with the waste tends to speed up the wear process, resulting in a low equipment life/durability. This study compares the wear behaviour of three rolled steels for the production of a screw. AISI 1024, AISI P20 and AISI 304 steels were tested on a pin-on-disk apparatus, under the influence of three different waste types which act as corrosive environments during the pin-on-disk wear test. Two of the waste types were organic with different compositions, while the third was organic-based with addition of glass particles.

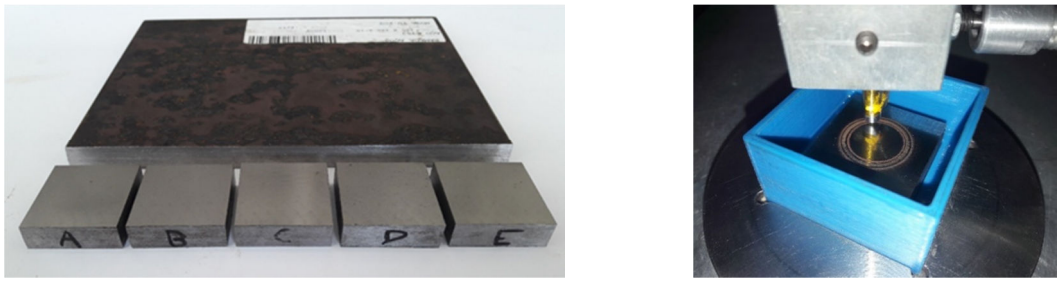
Keywords: hot rolled steel, wear, tribocorrosion, screw, ecodesign.

INTRODUCTION

The interaction between the solid waste and the rotating screw gives rise to damage caused by simultaneous corrosion and wear (tribocorrosion) of the component. The wear is mainly identified as adhesive, abrasive and corrosive wear. The environment where the tests are performed is of great influence to the wear rate. Usually, for atmospheric conditions, the non-corrosive wear rate is lower than that observed under tribocorrosion conditions (Li *et al*., 2016). Small particles originated by the corrosion process can influence the wear as such particles work as an abrasive (Lyu, Zhu and Olofsson, 2015).

RESULTS AND CONCLUSIONS

In this work, a total of 27 wear tests were performed, with 3 alternative materials used for screw manufacture. To insure the samples' roughness did not exceed 0.8 μm, the original steel plates (AISI 1024, AISI P20 and AISI 304) were divided into 30mm×30mm squares and were then mechanically grinded as shown in Figure 1(a). As shown in Figure 1(b), this wear tests were performed on a pin-on-disk tribometer, subjecting the samples to the influence of three different corrosive environments (organic waste, organic waste with added glass particles, and organic waste with added egg shell). A speed of 0.1 m/s and a load of 41.14 N were used to perform each wear test, which lasted for 30 minutes. The wear tests were performed at room temperature (≈25º C), notwithstanding the fact that the contact temperature between the disk and the pin tends to rise, a factor which was not controlled in this study.



(a) (b)

Fig. 1 - (a) Samples prepared for wear test; (b) and sample with wear track result from pin-on-disk test.

The results from the wear tests are shown in Figure 2. The presence of small particles such as glass particles influences the wear rates. The original steel (AISI 1024) is the most wear resistant when tested with waste 2.

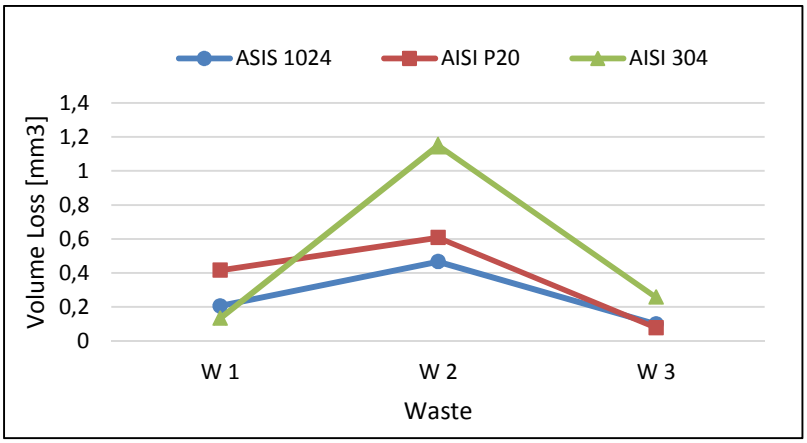


Fig. 2 - Materials volume loss [mm^3]

This study shows that, under ideal circumstances, that is, a completely organic solid waste, the most efficient solution would be to produce the screw from AISI 304 stainless steel, due to a higher corrosion resistance. Nevertheless, AISI 1024 presented the best behaviour when the organic waste with added glass (waste 2) was used.

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