FRICTION COEFFICIENT OF CARDBOARD PACKING SAMPLES

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ABSTRACT
Many companies use cardboard for packing and shipping their products due to its benefits such as low cost, adaptability, and recyclability (Talbi et al., 2009; Hung et al., 2010; Li et al., 2023). The volume of cardboard packaging used has extensively risen since the electronic commerce industry started operations. Considering the amount of waste generated and the associated environmental impacts, governments have established regulatory requirements to prevent pollution risks (Li et al., 2023). Recycling of packaging materials can help move towards the Circular Economy model; however, there are other strategies considered more sustainable and effective in reducing the depletion of resources (Bocken et al., 2016). Although cardboard recycling is widely studied and methods to increase efficiency have been developed, significant environmental impacts still exist. For example, it is known that 18 m3 of water are contaminated per ton of recycled cardboard (Gholami et al., 2022).

It is recognized that factors other than friction influence the resistance of packages to slip during handling, warehousing and transit. High friction coefficient on the paper cardboard surface tends to resist the sliding in load units. But, high friction coefficient can potentially damage prematurely the contact surfaces of cardboard packing boxes. In this context, it is proposed to re-use cardboard boxes that preserve their high friction coefficient and little wear damage.

This work aims to identify the static friction coefficient between paper cardboard packing sections on some surfaces by using the inclined plane. Additionally, a series of pin disk tests were performed to compare the static friction results and relate dynamic friction coefficient behavior with the deterioration of the cardboard surfaces from their surface in contact with some typical surfaces. The results show how after complete some sliding distance, the friction coefficient tends to scatter the values depending closely on the counter-face. Additionally, only one low load was tested to avoid any cardboard deformation. The results also show that the cardboard in contact with some surfaces gave premature wear damage reducing its life and the potential of re-use the cardboard boxes. Figure 1a shows the cardboard material and Figure 1b the inclined plane.

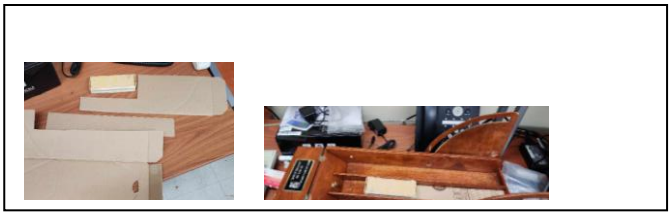

Fig a)cardboard packing, b)inclined plane.

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