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Development of Protective Adhesive for Gloves

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Abstract: *This paper presents a study on the development of an adhesive with specific characteristics such as: the shear strength, flexibility and the practicality of being adhered to the glove according to the need of its user. In view of this, the project has the problem of making a protective coat for gloves that is resistant to cutting, flexible, so as not to disturb the movement, and that can be applied in any region of the hand, according to the need of its user. Consequently, its objectives are: to study the materials to complete this task, as well as to validate its operation through tests and to use materials from other operations. The methodology was based on the collection of waste from the grinding operation and, at first, its pressing with a plastic bag. As this operation failed, it was attempted to dissolve the bag and separately impregnate the iron powder and the residue in that solution to obtain a homogeneous film, thereby making it one of the layers of the adhesive. The results obtained in the first test were unsatisfactory because the pressed layers did not unite and the second test is being performed; therefore, the study is not yet complete.*

Keywords: *Adhesive, Cut resistance, Grinding powder.*

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I. INTRODUCTION

Operations in laboratories or workshops that involve the handling of cutting parts and instruments, such as razors and other sharp objects, represent risks for the worker who is carrying out an activity of this nature [1]. The parts of the body that suffer most from cuts and injuries are the hands [2]. Carpentry workers, 78.6% of respondents have already suffered cuts on their hands; of these, 9.0% had deeper cuts, and 7.1% witnessed accidents that caused the mutilation of fingers and palms of colleagues who were unable to return to work [3-4].

Around 92.5% of the accidents with biological material involving sharps [5] and many of the accidents that occurred in a professional setting occurs by sharps [6].

Workers' hands are directly exposed to the risks of cutting in the workplace and injury to the upper limbs [7]. One method to prevent hand injuries is the use of suitable gloves to protect against cuts. According to the literature, hand protection gloves can considerably decrease the risk of injuries [8].

Due to the lack of consolidated and official statistics on the subject in Brazil, the Network for the Prevention of Work Accidents with Biological Material in Brazilian Hospitals created, whose goals are the control and prevention of work accidents with exposure to Biological material.

Currently, there are gloves on the market that have anti-cutting properties, but none for the purpose of delicate work and secure handling by the operator.

In view of this, the present study is justified by the need to create personal protective equipment that prevents this type of injury and provides more safety to those who are handling material that offers such a risk; because in accordance with the Anexo III of Portaria [Ordinance] MTE 1.748: 2011 of NR 32 [9].

The employer must establish a multidisciplinary management commission, which aims to reduce the risks of accidents with sharps, with the likelihood of exposure to biological agents, through the elaboration, implementation, and updating of a plan to prevent the risks of collisions with sharps [9]. Thus, the theme of the project is based on the development of an adhesive protector that, among its characteristics, is resistant to cutting and has flexibility so that the user can use it in the way that best suits his activity.

II. LITERATURE REVIEW

Several accidents are caused by piercing gloves with sharp objects. In the surgical area, for example, these accidents can be fatal for the patient since his open body exposed to the surgeon or nurse's unprotected hands, which may be contaminated. Of the total surgical 1,525, procedures, 292 accidents with surgical gloves were observed (19.1 %). A significant number of surgical gloves were damaged, putting the patient's life at risk

[10]. High-density polyethylene (HDPE) is a polymer that is characterized by having long branched molecules, thus presenting excellent impact resistance, high flexibility, low density, and excellent processability, in addition to being partially crystalline between 50 and 60 %), its melting temperature is in the region of 110 to 115 °C [11].

Metal powders are the appropriate configuration tooling with subsequent heating under controlled conditions at temperatures below the melting point of the base metal to promote metallurgical bonding between the particles. There are several processes for obtaining it, and this depends on the set of properties and characteristics that desired to be achieved for such a function to be used [12-13].

Xylene (C8H10), also called xylol, is a colorless and liquid aromatic hydrocarbon used to solubilize, paints, varnishes, dye and dye industry, pharmaceutical preparations, plastics production industry, petroleum industry and as a solvent in laboratory analysis [14].

III. MATERIALS AND METHODS

Bibliographic research took place to study the properties of materials that could be used for this purpose and information about accidents involving sharps. With the knowledge acquired from research in scientific articles, the materials to be used in the manufacture of the anti-glue adhesive for gloves were defined, namely: the residue from the grinding process of SAE 1045 steel together with SAE 1010 steel, iron powder, and plastic bags, composed of high-density polyethylene. The two metallic powders were selected so that it was possible to draw a comparison between the results obtained with the use of each of them separately.

HDPE samples of bags and the powder were alternately placed in the mold for the press, forming three layers, as shown in Figure 1. This set was inserted in the press, at a heating temperature of 200 º C, with a closing force of 40 kN for 5 minutes. It was placed in water for approximately one minute to cool to a temperature in which it could be handled. At the end of this process, the product was obtained (Fig 1).

Figure 1. Materials preparing.

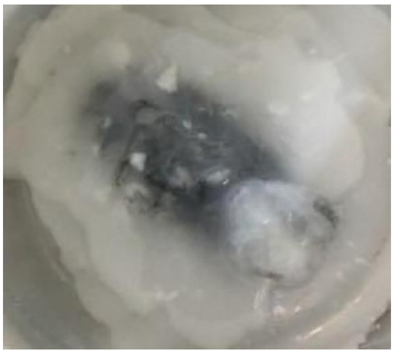
The second practice began; for the first sample, two plastic supermarket bags (HDPE) and 150 ml of Xylene were mixed in a beaker. When leaving these items four days in the chapel to solubilize and not get a response from the mixture, these two materials were solubilized at a temperature of 130 ºC. After having a homogeneous mixture, 3 g of iron powder was put in an attempt to unite the three elements; this material was reserved in the chapel for the evaporation of the solvent for five days (Fig. 2).

Figure 2. Second practice product (first sample).

For the second sample, a little differently occurs with the same temperature mentioned above. A bag solubilized in 100 ml of Xylene with 1 g of the iron powder was placed. This time, the mixture was divided into two different containers, one with a percentage more than the other and also reserved for five days.

Finally, unlike the other two samples made, a cut of a plastic bag (0.251 g) and 10 ml of Xylene was mixed at a temperature of 130 ºC; after the mixture became homogeneous, it was transferred to another container, and 0.5 g of iron powder was placed on top of it, as shown in Figure 3. To finish this step, another 0.064 g of the bag with 4 ml of Xylene was solubilized, which was placed on the two layers already mentioned, to form a film on them, and reserved.

Figure 3. Second practice product (second sample).



IV. RESULTS AND DISCUSSION

A single layer obtained with the pressing of some sample layers (HDPE) intercalating them with the metallic powder. The powder and HDPE form a resistant undercoat, but not enough sweat. When pressed, the regions that had the grains of dust did not adhere to the main layer for reasons of the wrong temperature, a large amount of dust, and a large amount of HDPE, among other aspects invalidating the practice and disagreeing with the project's objectives.

Regarding the second stage of the project, there were three samples: the first, after four days of rest, became a thick and brittle film due to the excessive amount of HDPE and Xylene used. It was also due to the short period resting, with traces of the solvent for not wholly evaporating.

The second stage stopped for four days, has already obtained more satisfactory results. When it was divided into two different containers, a smaller percentage of solvent and HDPE was placed in one of them, generating a firmer film aspect. However, the liquid was still not completely evaporated. The critical point of these two steps was the problem that occurred with the samples. The powder used in the containers was not mixing with the solvent and high-density polyethylene. To reverse this point, a third sample was made, which is not yet ready, as the solvent must evaporate completely, which is a time-consuming process. This one has the same mixture layer (HDPE + Xylene) as the other samples, although thinner to better meet the proposed objective; however, now, above it will have the iron powder, followed by another layer of mixture, to find a film with the pre-defined characteristics.

V. CONCLUSION

After analyzing the results, it is concluded that it was not yet possible to manufacture the proposed product; however, as more attempts were made, the results were more satisfactory and close to what was desired. The research has not yet been concluded. Therefore, the authors have as prospects the realization of tests with other materials, such as metallic powders in the nanometric scale. If it is possible to prepare the adhesive, it is also intended to perform a cut resistance test on it to validate its suitability for the purpose for which it was designed.

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