MICROPARTICLES OF CORK AS REINFORCEMENT MATERIAL IN BRITTLE STRUCTURAL ADHESIVES


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ABSTRACT

Nowadays it is usual to include particles (nano or micro) to improve certain mechanical properties of structural adhesives (da Silva, 2011). Structural adhesives are known for their high strength and stiffness but also for their low ductility and toughness. In the present study, natural micro particles of cork are used with the objective to increase the mechanical properties of a brittle epoxy adhesive. The idea is for the cork particles to act like as a crack stopper leading to more energy absorption (Barbosa, 2012) (Barbosa, 2013). This fact occurs because cork presents a remarkable combination of properties (low density, low cost and sustainability of the raw material). The influence of the cork particle size, amount and surface treatment were studied. Particles of cork ranging from 125 -250 µm and 38-53 µm were mixed in the adhesive Araldite 2020 from Huntsman.

Keywords: Cork, structural adhesive, mechanical properties, reinforcement material.

INTRODUCTION

The epoxy resins are the most commonly structural adhesives used in industry. The molecular structure with high crosslink density gives epoxides their excellent mechanical properties, but is also responsible for its low resistance to crack propagation (Adams, 2005). The ability of an adhesive to absorb energy without a catastrophic failure can be enhanced by reinforcing the material through a second phase, resulting in improved toughness and impact, with minimal changes to the original properties of the polymeric matrix (da Silva, 2011). The inclusion of micro or nano particles is a method which promotes the improvement of mechanical properties such as toughness of the adhesive. One of the most common methods is the inclusion of rubber particles (Kinloch, 1997). However, natural materials are increasingly attract attention to their use as reinforcing materials, mainly due to its thermal properties, low density, low cost and its sustainability as raw material (Fortes, 2005). Cork has a honeycomb cellular structure without gaps between adjacent cells and hence a closed cell structure. The size of its cells varies according to the type of cork, even considering the same board. Moreover, there are variations between cells of spring and autumn, ranging between 10 and 40 microns (Fortes, 2003). These structural properties of cork may be useful for strengthening of brittle resins, especially toughness, since the closed cell made of cork can work in order to
absorb the impact. However, the properties of this composite resin/cork are not only dependent on the properties of the materials composing it, but also the interfacial adhesion properties between the cork and the resin, the size and the amount of cork particles, as well as the conditions that the mixing is carried out. In addition to being a viable technique, the application of cork as a reinforcing material allows a new application of cork powder, which until the date has not been properly enhanced in the cork industry, an industry that has a major impact on the Portuguese economy. The use of this material will give a new perspective of applications for the cork industry, with potential benefits.

RESULTS AND CONCLUSIONS
The presence of micro particles (125-250 microns) of cork influence the mechanical behavior of the composite resin / cork.
- The alveolar geometry of cork particles and the fact that exist a gaseous mixture of air and carbon dioxide inside the cells, enhances the absorption of impact.
- There is no penetration of resin into the interior of the cells, ensuring that the cell structure is intact. Without an intact cellular structure of the cork particles do not exhibit the impact absorbing capacity and does not promote the ductility of the material.
- It is noted that the composite with 1% cork has a higher ductility than the resin without any added particles, with a greater deformation capacity of the specimens when subjected to a force (compressive or tensile).

The cork may be used as promoter toughness in structural adhesives, promoting new uses for this by-product of the cork industry.

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REFERENCES