AN OVERVIEW OF METHODS TO INCREASE THE TOUGHNESS OF STRUCTURAL ADHESIVES WITH MICRO PARTICLES

A.Q. Barbosa\(^1\), L.F.M. da Silva\(^2\), M. D. Banea\(^3\), A. Öchsner\(^4\)

\(^1\)INEGI, Rua Dr. Roberto Frias 400, 4200-465, Porto, Portugal
\(^2\)Department of Mechanical Engineering, Faculty of Engineering, University of Porto, Porto, Portugal
\(^3\)Federal Center of Technological Education in Rio de Janeiro, Brazil
\(^4\)Griffith School of Engineering, Griffith University, Southport Queensland 4214, Australia

(*) Email: dem09031@fe.up.pt

ABSTRACT

Epoxy adhesives have the widest range of application of the various classes of adhesives arising principally from their extremely wide set of performance properties. They are known for their high stiffness and strength, as well for their low ductility and toughness. Currently, there is an increasing interest in developing methods of improving toughness. A toughened adhesive in general contains elastic or thermoplastic domains dispersed in discrete form throughout the resin matrix, in order to increase the resistance to crack-growth initiation. This paper provides an overview of the current developments in the use of reinforcement materials and introduces the reader to early findings on the use of micro particles for toughness enhancement of adhesives. The theme of the use of materials of natural origin as reinforcement materials, giving special emphasis to the use of cork particles as toughener material is also presented.

Keywords: Toughness, adhesive, epoxy, micro-particles, cork.

INTRODUCTION

One of the most used technique for joining materials is adhesive bonding, mainly due to its versatility [1]. Adhesives can be used to join a large range of materials (i.e. metal, ceramics and polymers) and combinations of any of these materials [2, 3]. Thus adhesive joints have been increasing their application in various branches of industry, from applications with high mechanical stress and requirements (i.e. aerospace, aeronautic, electronic and automotive), to more traditional applications (i.e. packaging sport and construction) [3-8].

Epoxies are the most common structural adhesives due to their good mechanical, thermal and chemical properties. They offer greater strength, rigidity, toughness, durability and chemical resistance than polyesters, but at a higher price and with more difficulties in processing [9]. When epoxies are in polymerized state, they are amorphous and highly reticulated due to their thermoset nature. Epoxy resins are monomeric or oligomeric compounds containing two or more epoxide rings that may be opened catalytically, or stoichiometrically, by reaction with multifunctional amines or carboxylic acids, to give a cross-linked network [9]. This microstructure results in very useful properties for applications of structural engineering, such as high modulus of elasticity and strength, low creep, and good thermal strength [1, 10]. However, the structure of these thermoset polymers also causes brittleness, with a low resistance to the initiation of cracks and their propagation [4, 5]. For this reason, their toughening has been extensively studied in the last decades [4, 11-13]. There are some
solutions available in literature to improve the toughness of brittle adhesives, such as: addition of a second polymer with a good toughness [14], use of woven or knitted reinforcement [8], inclusion of micro or nano inorganic (silicates, glass, alumina, etc.) [10] or organic particles[15].

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REFERENCES