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PII: S0143-7496(18)30048-4
DOI: https://doi.org/10.1016/j.ijadhadh.2018.02.015
Reference: JAAD2140

To appear in: *International Journal of Adhesion and Adhesives*

Cite this article as: J.C.P. Figueiredo, R.D.S.G. Campilho, E.A.S. Marques, J.J.M. Machado and L.F.M. da Silva, Adhesive thickness influence on the shear fracture toughness measurements of adhesive joints, *International Journal of Adhesion and Adhesives,* https://doi.org/10.1016/j.ijadhadh.2018.02.015

Adhesive thickness influence on the shear fracture toughness measurements of adhesive joints

J.C.P. Figueiredo[a], R.D.S.G. Campilho[a,b*], E.A.S. Marques[b], J.J.M. Machado[b], L.F.M. da Silva[c]

[a]Departamento de Engenharia Mecânica, Instituto Superior de Engenharia do Porto, Instituto Politécnico do Porto, Rua Dr. António Bernardino de Almeida, 431, 4200-072 Porto, Portugal

[b]INEGI – Pólo FEUP, Rua Dr. Roberto Frias, 400, 4200-465 Porto, Portugal

[c]Departamento de Engenharia Mecânica, Faculdade de Engenharia da Universidade do Porto, Rua Dr. Roberto Frias, s/n, 4200-465 Porto, Portugal

[*]Corresponding author. Tel.: +351939526892; fax: +351228321159. raulcampilho@gmail.com

Abstract

To increase the confidence in the design of bonded structures, it is important to accurately predict their mechanical strength. In this context, Fracture and Damage Mechanics approaches have significant advantages over Continuum Mechanics. The Fracture Mechanics approach is often applied by an energetic analysis, where the main parameter to predict the evolution of damage and failure is the critical strain energy release rate (G_C). This parameter can also be divided into the tensile (G_{IC}) and shear (G_{IIC}) components. Cohesive Zone Models (CZM) are a powerful strength prediction technique within the scope of Fracture Mechanics and take advantage of cohesive laws to induce crack growth in the numerical models. This work aims to estimate G_{IIC} of adhesive joints of composite structures by the End-Notched Flexure (ENF) test, considering different values of adhesive thickness (t_A). In this context, different data reduction methods to estimate G_{IIC} are compared. On the other hand, the shear cohesive laws of the adhesive layer are obtained by the Finite Element Method (FEM) and CZM using an inverse technique, enabling to understand the influence of t_A on the joints' shear behaviour. The numerical models accurately captured the observed experimental behaviour of the adhesive. A clear dependency was found regarding both G_{IIC} and the shear cohesive strength (t_s^0), depending on t_A.