

Alma Mater Studiorum - Università di Bologna

**DOTTORATO DI RICERCA IN MECCANICA E
SCIENZE AVANZATE DELL'INGEGNERIA**

Seminario specialistico

**STUDY OF HYSTERESIS CYCLES
PRODUCED DURING FALLING WEIGHT IMPACT TESTS
ON PLANT FIBRE COMPOSITES**

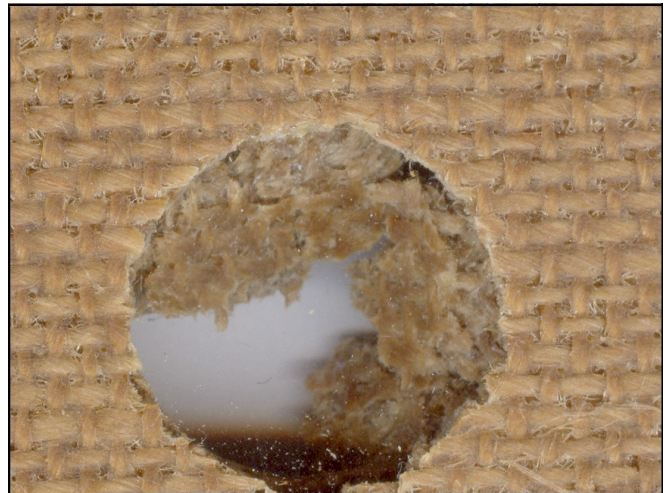
C. Santulli

One of the factors that currently restricts the application of plant fibre composites to large volume and cosmetic components is the limited knowledge about the mode of failure of these materials under bi-directional impact loading, which is a common damaging event due to striking of foreign objects on the laminate. In particular, the effect of plant fibre architecture on impact behaviour is still quite poorly understood. In practice, a considerable deal of literature is available already on uni-directional impact testing i.e., Charpy or Izod, of plant fibre composites. The significant scattering in work of fracture values raises concerns on impact performance, in particular on the marked influence of local defects, inherent to plant fibres structure, on it.

Typically, an impact event on sufficiently thick composite laminates consists of four phases: stress wave propagation during elastic loading, squashing, hinge rotation and elastic recovery before the striker rebounds. If the energy is sufficient to produce damage on the non-impacted face or even penetration, the final phase results in structural closure, resembling a severe forming process. The analysis of hysteresis curves obtained from falling weight impact tests, compared with indications given by impact damage characterisation, allows measuring the amount of energy actually absorbed by the laminates and comparing different laminates from the values of their real penetration energies, their linear stiffness and other variables obtainable from the cycles. In addition, these enable dividing real impact energy in different terms, namely elastic, plastic and rebound (or damping) energy.

In the specific case of plant fibre composites, hysteresis cycles are able to offer a sounder picture of the impact behaviour of the material, in particular through the measurement of the mode of absorption of energy, whether mainly in the elastic, plastic or damping phase. It is also possible to compare the performance of different laminates not only for the value of absorbed energy, but also from the different variables measured from the cycle.

In this presentation, hysteresis cycles are analysed and compared with impact damage characterisation from different plant fibre composites, including flax, hemp and phormium fibre reinforced laminates. The physical meaning of the different variables measured from the hysteresis cycles and their significance for the assessment of impact performance on these materials is also discussed.



Carlo Santulli got his MSc in chemical engineering from Università di Roma – La Sapienza in 1991 and his PhD in materials science and engineering from University of Liverpool in 2000. After a number of years working in different UK universities (Liverpool, Nottingham, Reading), he got a placement as an associate professor in Università di Roma – La Sapienza in 2006. For year 2008-09 he is also contract professor in Seconda Università di Napoli.

His principal research interests are on natural fibre composites, bio-inspired design and biomimetics. He has published over 100 papers, including journal and conference papers

**Mercoledì 8 luglio 2009 ore 11:15-13:00
Aula III piano Dipartimento DIEM
Viale del Risorgimento 2, Bologna**