Selected papers from the 6th International Conference on Durability Analysis of Composite Material Systems

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Composites are everywhere today. They are present in nature from plants and trees to the different components of human and animal bodies. They are incorporated in an increasing way in many structural elements in aeronautical, space, water and land transport as well as in offshore, pipeline, bridge and general infrastructure applications. They are also widely used for renovation and repair of damaged and deteriorated infrastructure elements.

The composite concept is an old one, which made a comeback in the early years of the 20th century with concrete and reinforcing elements followed by a high technology evolution after the 2nd world war and the development of new synthetic resins. Although the polymers were very easy to process and very convenient for manufacturing of different geometrical shapes they did not fulfil the conditions of stiffness and strength necessary for applications in load- bearing structural elements. Different fibres were produced in order to reinforce those polymers and today we have a very large spectrum of fibers, matrices, manufacturing and processing methods used to build up composite material systems for a variety of applications.

In a composite, the interaction level between the basic components is a crucial factor in the behaviour and especially the durability of the structural component.

Today we become able to tailor the interaction level as needed for a specific application.

With the increasing use of composites in mechanical, civil, aerospace and biomedical engineering applications, reliability has become an essential concern.

For a complete reliability analysis, we need a good understanding of the behaviour of the composite system under different mechanical loading conditions and of its response to changes in environmental conditions. We have to consider simple loadings such as quasi-static and fatigue loading, temperature and moisture variations, but also the possible interactions between these basic loading components. We have also to consider the consequences of internal transformations occurring in the components of the composite, such as physical and chemical ageing of polymer matrices and degradation of the interaction and stress transfer capacity between the different components of the

composite system.

Our understanding of the hygrothermomechanical behaviour of the composite system has to be extended to cover long-term evolution, especially if a time-dependent material component, matrix or fibre, is present in the composite.

We define the aim of the durability analysis of a composite system as the prediction of the structural integrity of the system after a complex mechanical loading history in interaction with environmental variations for a given lifetime.

After the meeting on Durability Analysis of Polymer-Based Composite Systems (August 1990 – Brussels), the International conferences on Progress in Durability Analysis of Composite Systems (Duracosys 95, July 1995 - Brussels and Duracosys 97, September 1997 – Virginia Tech), the International Conferences on Recent Developments in Durability Analysis of Composite Systems (July 1999 – Brussels, November 2001 – Tokyo), we had the 6th International Conference on Durability Analysis of Composite Systems, hosted by the Institute of Polymer Mechanics of the University of Latvia in Riga on May 12-14, 2004.

Out of the 30 papers presented in Riga, we have selected a certain number of them for this special issue. The complete list of presentations at Duracosys 2004 can be obtained from the secretary office on simple request (mbourlau@vub.ac.be).