



MECHCOMP3

3RD INTERNATIONAL CONFERENCE ON MECHANICS OF COMPOSITES

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ESCALAPIO

73 | The nanotransformation products of hydrocarbons and natural compounds by the usage of the magnetic nanocatalyst

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A comparative study between the oxidation products of aromatic, natural and non-aromatic compounds was performed by the usage of the magnetic nanocatalyst. Obtained products were evaluated by GC-MS and IR. The magnetic nanocatalyst (Zn-acetanilide@amino functionalized silica supported magnetic nanocatalyst) has been synthesized previously and was used for the oxidation of aromatic compounds: 3-nitrobenzaldehyde, 3-hydroxybenzaldehyde and 4-methoxybenzaldehyde. Here it was used for the oxidation of monoterpenes such as geraniol and α -pinene, and also for the oxidation of non-aromatic compounds like 1-propanol and cyclohexanol. The catalyst bears no metal leaching and can be rapidly recovered by the usage of an external magnet and reused several times.

346 | Modelling and design procedure of prestressed composite materials

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The paper introduces the concept of eccentric prestressing of fiber reinforced polymer materials in order to improve their mechanical properties and global mechanical behaviour. Prestressing is here understood as application of the initial tensile stress to the fibres embedded in selected external layers of the composite material. The objective of prestressing is to increase stiffness of the composite and to obtain desired response to applied external loading. The main objective of this research work is to develop a comprehensive approach to analysis of prestressed composites, which includes analytical and numerical modelling of the static behaviour, optimal composite design, as well as, simulation of dynamic response. Initially, we derive simple and effective analytical model of prestressed composite based on models of individual prestressed plies and their homogenization. The analytical model is used to reveal beneficial influence of prestress on strain and stress distribution in particular plies and resulting increase of the composite stiffness. Further, three options for the FEM-based numerical modelling of prestressed composites are proposed and thoroughly compared with each other. Developed analytical and numerical models are used to propose methods of prestressed composite design in which optimization of prestressing forces is used to minimize required composite thickness or fiber volume fraction. Eventually, FEM simulations are applied to assess the influence of prestress force magnitude on natural frequencies and modal shapes of eccentrically prestressed composite beams of various fibre volume fraction. The final part of the paper summarizes the potential advantages of the prestressed composites and unveils their superiority in comparison to the standard ones. Potential applications of prestressed composite materials in civil engineering and aerospace industry are briefly discussed. In addition, challenges related to design and manufacturing of structures made of prestressed composite materials are presented.

183 | Multistep forming of thermoplastic composite parts

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Press forming of thermoplastic composite (FRTP) parts is usually performed on laminates with constant thickness and predefined and limited fibre orientations to facilitate in-plane shearing. This limits the potential of FRTP materials for a number of structural applications. In this research, the focus is on the feasibility of press forming FRTP parts in multiple steps. In each step, another laminate or layer is added by forming and consolidation to the already formed layers. Using this principle FRTP parts with thickness variations and/or unrestricted fibre directions are made. The research used prefabricated PEI/Glass fibre laminates, made of fabric material. These laminates are preheated with Infrared and transferred to be press formed using a preheated metal die and a pre-shaped rubber die. This resulted in parts having three different thicknesses and a quasi-isotropic fibre orientation. Subsequent to the forming steps the laminates are consolidated. Testing of the parts, by retrieving Mode I and IISS test specimens from different sections of the part, show that the bonding between the different laminates is as good as for reference material, made of laminates consolidated in a flat platen press. Future developments, included in this paper, are focused on the reduction of the process time, which is current too high, use of UD prepregs, and on industrialisation of the concept.