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Behavior and Damage of Biocomposites Membranes under Large Deformations.

Farid Hicham, Mohamed Elghorba, Fouad Erchiqui.
National High School of Electricity and Mechanics, Casablanca
E-mail : farid.hicham@hotmail.com

Abstract:

The sustainable development of our industrial activities will be one of the great challenges of the 21st century. We will have to face simultaneously a rarefaction of the fossil resources and ecological risks, in particular the greenhouse effect. The use of the biomass for chemistry, energy and materials is one of the answers. The use of natural fibers for the reinforcement of polymers is increasingly developing, because it allows decreasing the environmental impacts. The research tasks in this field relate to mainly vegetable fibers (wood, flax, jute, to coir…) and allow the realization of the organic-composites. Indeed, the mechanical properties reported to the densities of these fibers are comparable, even higher, with those of glass fibers for example. Besides their good specific properties (due to their low density), the main advantages of natural fibers are their price, their sanitary harmlessness, and their biodegradability.

For the last few years, the emergence of new preoccupations in the field of green materials and structures is remarkable. In order to compete with the profitability and the performance of usual materials, and to enhance their place on the market of materials, the biocomposites must meet new requirements such a notable evolution of their mechanical characteristics, an optimization of their performances.

The objective of our research is to determine the behavior of composite materials with natural reinforcement (wood flour or sawdust), in order to have a good control of the processes of working of these materials such thermoforming, injection blow molding, or extrusion blow molding…

We are interested, on the one hand, in the characterization of circular polymeric PP and HDPE membrane charged with natural reinforcement, under biaxial deformation, using the bubble inflation technique, and on the other hand, in modeling and numerical simulation of the thermoforming of PP and HDPE materials using the dynamic finite elements method. Hyperelastic models (Mooney-Rivlin, Ogden) are considered. For numerical simulation, the Lagrangian formulation together with the assumption of the membrane theory is used. Moreover, the influence of the hyperalastic model on the thickness and on the stress distribution in the thermoforming sheet are analyzed for ABS and HIPS materials.