Durability assessment of lightweight bio-composites for demanding applications

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Description

Ecological issues have recently encouraged researchers to focus on eco-friendly and lightweight materials. In this way, plant fiber composites offer numerous benefits compared to synthetic fiber ones, such as lower material cost, lower density as well as important specific mechanical properties. Despite their environmental and technical advantages, the application of plant fiber composites is limited because of their poor durability, particularly in outdoor and wet environments. Several applications such as aerospace, marine and automotive are always subjected to harsh and fluctuating environments. For instance, wind turbine blades operate in aggressive and extreme environments in which UV and cyclic moisture exposure is featured with a wide range of temperatures. However, the lack of informations on the long-term mechanical performances of bio-composites and the ability to predict their service life would limit their industrial integration. Thus, the possibility of using plant fiber composites in outdoor applications requires a deep understanding of their mechanical response and physico-chemical features under the influence of different weathering types.

The aim of this thesis is to develop a novel bio-composite and to explore the influence of various environmental factors on its performance, with a view to promoting its use in sustainable applications. Particular attention will be given to the evaluation of moisture barrier and mechanical properties under various environmental conditions, which will be correlated with physico-chemical and microstructural changes to better understand the underlying degradation mechanisms. Analytical models will then be used to predict the service life of these bio-composites. More importantly, numerical simulations will be performed to model the hygro-mechanical coupling of composites and predict the internal stresses induced by hygroscopic swelling.

Qualifications académiques et compétences requises

The position requires an outstanding PhD candidate with strong experimental and numerical skills in Materials Science, Mechanics of Materials or related fields. Skills in physico-chemical and mechanical characterization techniques (SEM, OM, DSC, FTIR, XRD, mechanical testing…) as well as in numerical simulation, are highly appreciated. The candidate must have a Master's degree (or equivalent) in Materials Science, Mechanics of Materials or a related research field. Excellent written and oral communication skills in English and French are highly required.