Influences du vieillissement hydrique sur les évolutions du comportement mécanique des structures sandwich utilisées pour les pales d'éolienne en milieu marin (EMR)

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Abstract
In 2020, in France, the National Low Carbon Strategy was implemented to achieve a neutral carbon footprint by 2050. The COSPHI project, a collaboration between the CIMAP (Université Caen Normandie) and LOMC (Université du Havre) laboratories and financed by LabEX EMC3, aims to propose an in-situ measurement tool of the material health of an offshore wind turbine blade to optimize its lifespan. My thesis focuses on the influence of water aging and mechanical impacts on the damage and residual mechanical behavior of sandwich structures used for the manufacture of offshore wind turbine blades. Samples are immersed in seawater at 40°C with or without mechanical impact. Bending tests with damage monitoring by acoustic emission allow to measure the mechanical behavior according to the material history. The classification of acoustic waves confirmed the presence of 5 damage mechanisms : matrix cracking, fiber/matrix decohesion, internal skin and skin/core delamination, fiber breakage. The changes in acoustic signatures allow to distinguish 3 aging phases. The first, water absorption phase during the first 16 weeks, is marked by an increase in the acoustic wave descriptors, mainly the sound amplitude, probably because of water in the specimens. During the second phase extending from 16 to 60 weeks, with a stabilized water content, the progressive reduction in the values of the acoustic descriptors reflects an alteration of the interfaces. The degradation phase, from 60 weeks of immersion, with a sudden increase in the descriptors shows that the deterioration affects the volume of the structure in addition to the interfaces. On the macroscopic level, as the water ageing progresses, the mechanical resistance of the sandwich structure decreases continuously and non-linearly until reaching an failure for low loading levels. A mechanical impact at 13.2 Joules, sufficient to generate localized but non-critical damage, nevertheless significantly accelerates the propagation of damage by creating incipients around the impacted area. Combined with advanced water ageing, an impact in service can become a critical incident