Caractérisations ultrasonores du vieillissement de pales d'hydroliennes et d'éoliennes en milieu marin. Confrontation aux essais mécaniques

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Abstract
This thesis discusses the ultrasonic non-destructive characterization of representative samples of offshore wind turbine blades. The samples are made of composite materials based on Unidirectional Glass Fibers Reinforced Polyester (UD GFRP). Samples are subjected to accelerated aging in heated seawater at 40°C and 60°C, in order to simulate the marine environment and reduce study times. The aim is to find acoustic parameters sensitive to aging, enabling the effect of aging to be assessed or quantified. Lamb's guided wave analysis showed a decrease in mode phase velocities and Rayleigh velocity, as well as an increase in attenuation in the material, indicating that the mechanical properties of the material are degrading due to aging. C-scan imaging shows degradation of the resin, leading to reorganization of the fibers and changes in their alignment. Finite element numerical modelling of guided wave propagation in these materials has shown that the structural and geometric properties of the materials degrade with age. The parameters most affected are the elasticity constants, as well as the density for stronger and longer aging. Finally, the number of reinforcement plies in a sample plays an important role in its resistance to aging.