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► To cite this version:

Khalid Aoujdad, Elhadji Amadou Ba, Pierre Marechal, Damien Leduc, Alexandre Vivet, et al.. Mechanical and ultrasound characterizations of aging of blade materials in marine environment. 5th International Conference on Materials Science and Engineering Technology, Feb 2024, Singapour, Singapore. hal-04579253

HAL Id: hal-04579253

<https://hal.science/hal-04579253>

Submitted on 6 Jun 2024

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Mechanical and Ultrasound Characterizations of Aging of Blade Materials in Marine Environment.

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The blades of offshore wind turbines and tidal turbines are subject to severe operating conditions due to their environment: humidity, salinity, thermal variations, as well as inertial mechanical stresses due to wind and waves turbulences etc... This can greatly affect their performances, being the primary organ responsible for the energy conversion. It is therefore very important to ensure their state of health and predict maintenance or replacement [1]. This is the objective of the work presented here by two teams of researchers of 2 Normandy universities: a team of mechanicians (CIMAP UMR 6294, Caen University) for the development of representative samples of blades on a laboratory scale and their destructive mechanical characterization, and a team of acousticians (LOMC UMR 6294, Le Havre University) for the establishment of non-destructive ultrasonic indicators, with comparison between the 2 approaches. The comparison of the 2 methods should result in reliable ultrasonic indicators allowing, as a future of this work, to instrument a blade in situ environment in the aim of giving its state of health in real time. The samples developed are sandwich structures with a skin made of fiberglass composite materials on a Polyester matrix, and a core of polymer foam, as shown on Fig.1.

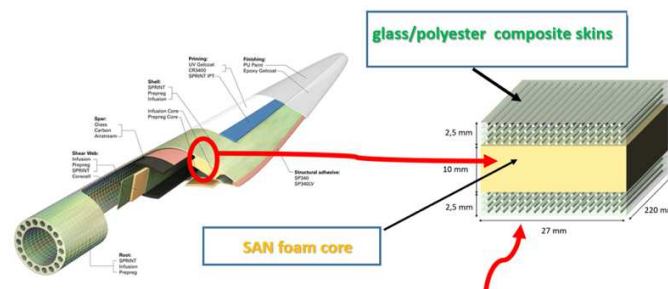


Fig.1: Sandwich structure representing a pale

The samples underwent accelerated aging in a seawater tank heated at 40°C or 60°C. These samples are tested according to their aging duration to monitor the evolution of damage propagation. Mechanical tests based on 3 or 4 points bending tests made it possible to identify 5 families of damage: matrix cracks, fiber/matrix decohesion, skins/core decohesion, delamination and fiber breakage. The ultrasound approach consists of measuring the speed and attenuation of ultrasounds in the structure, the transmission coefficient through the structure, as well as C-scan imaging reporting their internal state. Several samples of increasing aging durations were tested by the 2 methods and the first signs of aging are successfully compared mechanically and by ultrasound.

KEYWORDS:

Aging in marine environment, ultrasounds NDT, mechanical characterization.

ACKNOWLEDGEMENT:

The authors would like to warmly thank Labex EMC 3 for financing this work.

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