

Oral Presentations

Determination of ageing indicators on glass-fibre polyester composite skins using Lamb guided waves

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Structural adhesive bonding based on GFRP (glass-fibre reinforced polyester) composite is used in industries such as aeronautics, automotive, renewable energy (tidal turbines blades, offshore wind turbines blades...). These structures, and especially their skins, are exposed to severe environmental conditions (high variations in temperature, humidity, pressure, wind turbulence...) that induce structural ageing. Industrials are interested in non-destructive evaluation methods to control the structural health status during the life cycle. This work focuses on GFRP composite skins representative of offshore wind or tidal turbine blades. Samples of two different thicknesses (4-ply and 6-ply) were subjected to accelerated ageing in a thermostated tank (40°C or 60°C) of seawater, while the others (the reference samples) had not undergone any particular ageing. The aim is to evaluate the properties changing using ultrasonic Lamb waves and to identify indicators of ageing [1]. An experimental setup consisting of a contact transducer for emission and a laser velocimeter for reception is used to generate guided Lamb waves. The normal displacement of the propagating waves is measured for several positions in the propagation direction. Time and space double FFT is performed to obtain the experimental dispersion curves. The study is conducted on unaged 4 and 6 ply samples of GFRP and aged ones for 15 and 28 weeks respectively. Results show that for a given frequency the wavenumber in the aged sample is increasing compared to the unaged. This induces a decreasing of the phase velocity in accordance with previous results showing the decreasing of the mechanical properties of the material with ageing [2]. The difference between wavenumbers in aged and unaged is more significant on the 6 ply samples compared to 4 ply ones, which can be explained by the difference ageing period.

References

- [1] Y. Gélébart, H. Duflo, J. Duclos, « Air coupled Lamb waves evaluation of the long-term thermo-oxidative ageing of carbon-epoxy plates », *NDT & E Int.*, vol. 40, n°1, p. 29-34, 2007 (DOI: 10.1016/j.ndteint.2006.07.010).
- [2] P. Davies, F. Pomiès, et L. A. Carlsson, « Influence of water and accelerated aging on the shear fracture properties of glass/epoxy composite », *Appl Compos Mater*, vol. 3, n°2, p. 71-87, 1996, (DOI: 10.1007/BF00158994).