HYGRO-EXPANSION OF 3D-PRINTED BIOCOMPOSITES : STRUCTURAL WEAKNESSES AND OPPORTUNITY FOR ACTUATION

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The problem of depletion of biotic resources in coastal areas and littoral zones is now accepted by the scientific community. To remedy this, artificial reefs supposed to promote the dynamics of repopulation have been developed in coastal areas. However, the latter are often made of concrete blocks, ship hulls or used tires. These are by no means sustainable solutions. Previous work has underlined the potential of natural fibre to be used as actuation agent in hygromorph biocomposites due to their hygroscopic behavior. Indeed, morphing ability of hygromorph biocomposite is controlled by the hygroscopic stress state induced bu the fibre swelling within the polymer matrix.

The Morph-Reef project aims to develop a new concept of artificial 4D printed reef with hygromorph biocomposites while having a controlled lifespan and positive effect on marine microorganism colonization. This first work focuses on the understanding of the effect of various biopolymer having different stiffness (PLA, PBS and PBAT) on flax fiber swelling and consequently on morphing potential. Thus, hygroscopic (sorption and hygro-expansion), tensile hygromechanical properties and colonization properties of continuous flax biocomposites will be investigated.

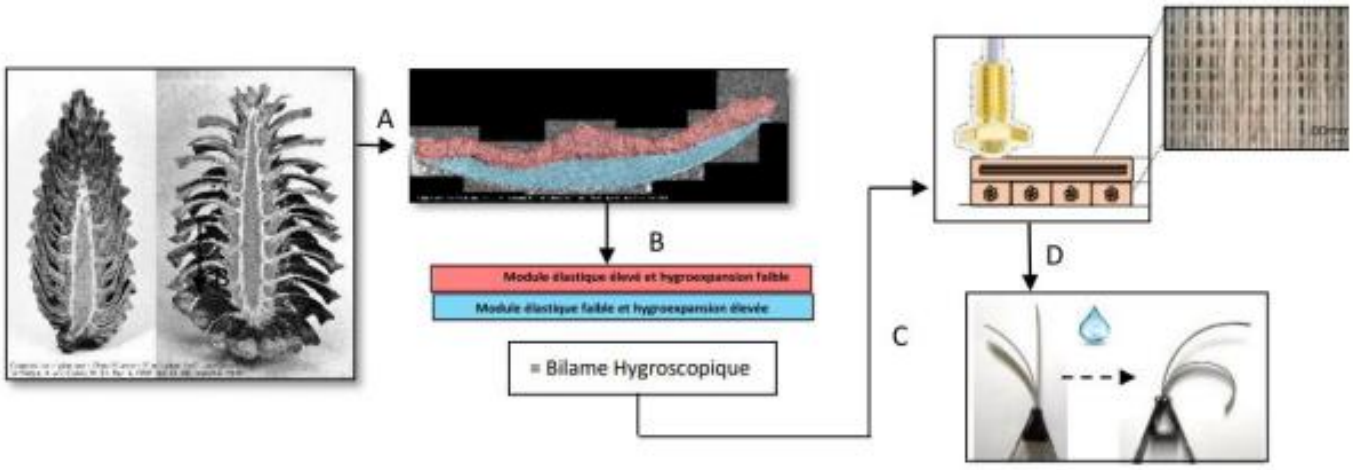

Fig. 1 – A Microstructure of pine cone scale, B Actuation principle with a bilayer microstructure, C Architectured hygromorph biocomposite made with 4D printing, D Moisture induced bending deployment of hygromorph biocomposite [1]

References

[1] A. Le Duigou, J. Merotte, A. Bourmaud, P. Davies, K. Belhouli et C. Baley, « Hygroscopic expansion : A key point to describe natural fibre/polymer matrix interface bond strength.”, Compos. Sci. Technol., vol. 151, p. 228-233, oct. 2017, doi: 10.1016/j.compscitech.2017.08.028.