Mechanical properties of aged bamboo fiber-reinforced composites under quasi-static loading

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Composites are widely used in different industries due to their ultra-high specific strength and specific modulus. Natural fibers can be considered

as adequate alternatives to synthetic fibers due to advantages such as a light weight, biodegradability, low cost, low energy consumption and abundant availability. The connection between mechanical properties and age factors guides the application of bamboo fiber-reinforced composites (BFRC) in outdoor engineering.

In a study published in the *Journal of the Mechanical Behavior of Biomedical Materials*, Prof. Lu Yubin's group from the Fujian Institute of Research on the Structure of Matter at the Chinese Academy of Sciences designed two different aging tests and explored the interaction between them.

The researchers first created bamboo columns by cutting raw bamboo, making bamboo strips by splitting the bamboo columns with a special knife, and then defibering the bamboo strips into coarser bamboo fiber bundles. They focused on extracting bamboo fiber from natural bamboo as a reinforced phase in BFRC and making BFRC sheets by dipping, drying and hot pressing the coarse bamboo fiber bundles.

Then the researchers processed the samples into specific specimens for subsequent aging tests and quasi-static mechanical tests. They chose the cold-hot test and the ultraviolet (UV) dry-wet test as representatives of the aging test to account for the natural weathering of raw materials in the open air, and carried out quasi-static experiments to study the mechanical properties of aged BFRC.

The researchers also performed mechanical tests on untreated BFRCS, revealing that the BFRC has significant anisotropy. The tensile strength of BFRC paralleled with the axis of the reinforcing fiber is as high as 148.53 MPa, which is 26.47 times greater than the tensile strength of BFRC perpendicular to the axis of the reinforcing fiber. This anisotropy was found to be closely related to the material preparation process.

After understanding the basic properties of the material, the researchers performed aging tests and quasi-static mechanical tests on the samples. They found that the aging tests had different effects on the mechanical properties of BFRC in different directions. The scanning electron microscopy (SEM) images showed that the effect of the UV dry-wet test on BFRC is more significant than that of the cold-hot test. The SEM images indicated that cracks occurred on the surface of BFRC samples under the UV dry-wet test. The two aging tests had an interactive effect on BFRC, which can reduce the sensitivity of BFRC to a UV dry-wet environment.

This study provides a good reference for predicting the lifetime of BFRC for use in outdoor construction.

More information: Yubo Hou et al, Experimental investigation on mechanical properties of aged bamboo fiber-reinforced composites under quasi-static loading, *Journal of the Mechanical Behavior of Biomedical Materials* (2023). DOI: 10.1016/j.jmbbm.2023.105869

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