Impact of wood fibers on the mechanical performance of biocomposite materials

Popular Science Summary of Master's Thesis (TFHF-5244) in mechanics, Lund University, 2021
by José María Moreno Iváñez de Lara

This master thesis successfully investigates the influence of wood fibers when they are introduced in a polymeric matrix. Plastics are amazing materials with outstanding properties that make them very useful and cheap for a wide range of uses. However, their pollution to the environment has become one of the main problems to solve in this century.

Biofiber Tech. is a start-up based in Stockholm that is producing a new kind of biocomposite, a material composed of a polymeric (plastic) mayor part, called matrix, combined with wood fibers in a minor part (up to 40%), called filler. With this material it can be reduced the amount of plastic used in products with hard plastics such as plastic furniture, kitchenware… and increase its biodegradability. Even the plastic used in this material could be bioplastic or recycled plastic. The incorporation of wood into polymers increases the rigidity of the final product, properties that would be difficult to achieve by other materials.

The problem of this material comes when you try to incorporate the fibers into the matrix, because the adhesion between each other is very poor. Here Biofiber Tech. applies a surface treatment to the fibers so the adhesion between it and the polymer and the fibers. In this project, it has been analysed the internal structure of samples with different surface treatments via x-ray tomographies. The samples were also analysed with another x-ray tomography after broken in a tensile test, where they are elongated to see how much force can be withstood.

From the internal structure, three different phases were identified. The polymeric matrix, which composed the mayor part. The porosity, caused mainly because of the production method, and because of the evaporation of the humidity contained in the wood when the material is heated. The fibers, that could be presented distributed along the volume or in clumps that were called aggregations.

The porosity and fibers were mainly aligned with the longitudinal axis of the sample (due to the flow of the material when injected into the mould), which means that probably the material will withstand higher forces in the longitudinal direction than in the transversal direction. Aggregates were also found to have a planar shape usually oriented parallel to the nearest face of the sample (due to the friction of the material when flowing).

In the fracture analysis, a relation between the surface treatment that presented the highest adhesion for the fibers and the highest force withstood in the tensile test was found. Also it was found that the fracture tends to grow along the matrix avoiding the fibers, with an ease to be found in the border of fibers that are horizontally oriented, meaning that there is still work to do to increase this fiber/matrix interaction.