

Pilot plant for alkali treatment of chopped banana fibre

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The preservation of natural resources and the strict environmental regulations have forced the composite industry to find alternative fibre reinforcements and resin systems that are environmentally-safe. Natural fibres composites are a good alternative because of their eco-friendly nature and recyclability, which make them attractive materials for their application in different fields. Natural fibres have the advantages of low density, low cost and biodegradability. However, they present poor compatibility between fibre and matrix, and a high moisture sorption. In numerous researches it has been observed that the quality of the composite depends on the adhesion, for this reason the application of treatments to the fibre would improve the properties of the composite.

The LIFE BAQUA project “Solutions through the new use for a waste of banana crop to develop products in aquaculture and plastics sector” (LIFE15 ENV/ES/000157) is included in the Environment and Climate Action LIFE Programme. The main objective is to establish a new circular economy approach to take advantage of wastes from banana plantations. From the pseudostem and using mechanical processing, two different raw materials are obtained: high quality natural fibres from one side and the residual pulp on the other side. In this work, we are focused in the use of the banana fibre.

As previously mentioned, it is necessary to apply different chemical treatments to enhance the interfacial interaction between the fibre and the polymer matrix. Therefore, a system to treat the fibre after extraction is implemented in the pilot-scale plant. Before the reactor design, different treatments are carried out to select the optimal procedure. Thanks to these tests, it is established that the reactor to be used is a bubbling fluidized bed reactor, where the gas used is compressed air to favour the agitation. The reactor is formed by two baskets, the first with the air distribution disc and the second with a filter to extract the fibre. The treatment used is alkaline or mercerization with a sodium hydroxide solution 1 N for one hour and the fibre/liquid volume ratio is 2 kg/200 l. After the treatment, four rinses with water are performed, 30 minutes each. In order to make this process cleaner and environmentally friendly, the NaOH dissolution is reused 9-10 times, adding the amount of sodium hydroxide and water consumed in each treatment. The image I shows the pilot treatment plants, which consist in two tanks, the first where the dissolution is prepared and the second for the rinsing water. Then the feeding pumps, the turbo blower and the reactor.

Finally, a recovery system for treatment wastes is designed for the pilot-scale plant. Due to the resulting dissolution typology, three different options have been studied. One of the methods is based on the Kraft process used in the paper industry, the second method studied is the recovery of lignin by precipitation and lastly, managing the solution as a waste.