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SIMPOSIO INTERNACIONAL SOBRE MATERIALES LIGNOCELULOSICOS

WATTABILITY OF NATURAL FIBERS FOR COMPOSITE MATERIALS MANUFACTURE

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ABSTRACT:

Natural fibers such as flax, jute, sisal and hemp have been used as reinforcement in polymer composites during the last decades. They are available in large amounts, at low cost, have low energy utilization and are renewable and biodegradable. In most cases the specific properties of the natural fiber composites were found to be competitive with those of glass fiber composite. But one of the keys of the expansion of this type of materials is the possibility of using the well-studied glass fiber composites processing techniques, like RTM, VARTM or SCRIMP. Therefore, it is crucial to understand how the main processing variables are affected when glass fibers are replaced by natural fibers, which have different structure, different fabric architecture and different chemical interactions with the resins.

Wettability of the fibers is a very important variable that strongly affect the processing conditions in liquid composite molding techniques. It is determinant for void formation mechanisms and affects injection times. Wettability has shown to be dependent on surface characteristics and fluid velocity during infiltration. In this work, dynamic contact angles have being measured as a function of fluid velocity (Capillary number, Ca) for single fibers with different surface treatments. The main goal is to determine if surface treatments like alkalization and PHB coating can improve wettability of jute and flax fibers. Dynamic contact angles were measured in a tensiometer (Kruss K100SF) that uses the Wilhelmy technique for obtaining angle values. The technique consists in a measurement of the liquid weight lifted in the meniscus by the spreading of the liquid upwards on a fiber. The alkali treatment was conducted with a constant NaOH concentration but during different times. Chemical composition of the fibers and SEM images were obtained in order to have more information for interpreting the contact angle results.

Results shows that natural fibers have a wetting behavior with the test fluid use in the experiments, but the contact angle increases as the fluid velocity (related to Ca) is increased. This behavior has a good correlation to Tanner law, which proposes a linear relation between contact angle and $Ca^{1/3}$. When comparing treated and untreated fibers, it was found that alkalized jute and flax have higher wettability than untreated ones, which is explained by the lignin and hemicellulose extraction during the mercerization process. This process leads to an increase in the hydrophilic components of the fibers (cellulose).