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Chemical Modification of Cellulosic Fibres to Improve their Adhesion with Polymeric Matrices

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The aim of this investigation is to optimise the performance of composite materials based on cellulosic fibres embedded into a non-polar macromolecular matrix, e.g. a polyolefin. This type of material has gained renewed interest in recent years because natural fibres are renewable, cheap, strong and recyclable. However, their high surface energy and hydrophilic character can conspire against the establishment of a strongly adhesive interface when they are married to polymers bearing predominant aliphatic or aromatic moieties, i.e. an exclusively dispersive surface energy contribution.

The chemical modification on the surface of the cellulosic fibres is one of the ways to improve the quality of such interfaces and constitutes our general strategy in this context.

The reactions described here are all based on the condensation of the OH groups present at the surface of the fibres with complementary groups such as isocyanates, carboxylic anhydrides, siloxanes and organomettallic moieties. These modifications were conducted in media which did not induce any swelling of the cellulose substrate, e.g. toluene, methylene chloride or THF. The appended structures resulting from this heterogeneous surface grafting ranged from small hydrophobic chains to macromolecules with numerous reactive groups and included bifunctional reagents. With the latter molecules it was possible to induce a more pronounced macromolecular grafting which enhanced the quality of the fibre/matrix interface thanks to the additional effect of chain entanglement.

Various specific examples will be provided to show the different approaches adopted and the corresponding ensuing consequences in terms of possible applications.

The extrapolation of these concepts to the chemical modification of wood, albeit for a different purpose, will also be briefly discussed.