DEVELOPMENT OF HYBRID NATURAL FIBRE REINFORCEMENTS FOR STRUCTURAL COMPOSITES – CONCEPTS AND OPPORTUNITIES

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The paper discusses the possibilities to use hybrid yarns and reinforcements made from natural fibres in structural reinforcements. The techniques to manufacture these reinforcements by co-wrapping, staple spinning and carding will be described. The possibilities to tailor the mechanical properties and processability as well as their use in composite applications will also be demonstrated.

Natural fiber composites have during the last 20 years been studied regarding their potential to replace glass fibres in composites. Due to the effort to find carbon dioxide neutral materials, the interest in these composites is even bigger. Annual plant fibers such as hemp and flax, are mechanically processed into yarns which then are used for the manufacture of textile reinforcements by conventional textile processing techniques. Although the mechanical properties related to the density of these plant fibres are rather good, and even competitive with the heavier glass fibers, their use is still minor, due to the lack of high quality fibre sources which can be converted into reinforcements. Regenerated cellulose fibers, such as viscose and Lyocell, are industrially produced in large quantities as continuous yarns. Their chemical purity is high, and they can be therefore easily modified to improve the compatibility with the matrix resin. The textile manufacturing techniques gives also opportunities to make technically and economically competitive natural fibre reinforcements, especially if different types of fibres are combined in the reinforcement.

This presentation will review the on-going research at University of Borås regarding development of novel textile reinforcements which can be used in structural composites. Non-wovens are rather low-cost reinforcements composed of mechanically bound staple fibres, and in the non-woven some degree of orientation can be induced in thecarding process. By combination of different types of staple fibers in the non-woven, it is possible to make tailored reinforcements with various properties, both for thermoset and thermoplastic composites. More advanced composite reinforcements can be made by weaving and warp-knitting of hybrid yarns, which are composed of different fibre types. These hybrid yarns can be made by co-spinning of staple fibres into yarns, or by using a co-wrapping technique. Novel reinforcements are then possible to make by different composition in the hybrid yarn.

In order to demonstrate the feasibility of these reinforcements we have made composites by compression moulding as well as by resin transfer moulding. Their mechanical and thermal properties have been evaluated and compared to conventional reinforcements. Both thermoset and thermoplastic composites have been evaluated.

The paper will give an overview of the technical potential to use these reinforcements in structural composite applications.