

BAMBOO COMPOSITES MADE BY VACUUM INFUSION TECHNIQUE

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1 Introduction

Since mankind began to build, bamboo has been known for its unique qualities. Bamboo is a fast growing plant that gives us a lightweight and strong wood. The uncut bamboo pole is optimally designed to bear loads and withstand Euler buckling at a minimum of weight, while bamboo strips, sticks and stock are used for almost every kind of utensil.

More recently, laminated composite panels made of glue and veneer or woven strips resulted in many products such as panel boards and plywood. Bamboo composite pioneer Gary Young showed the potential of laminated bamboo veneer in surf boards during the eighties. Still, such typical composite moulding techniques with bamboo are not common practice yet.

Little is known about the use of bamboo as a fibrous material. Whereas thinner stems from plants such as flax and hemp can be processed into yarns, bamboo fibre extraction is more difficult. Nevertheless, fine bamboo yarns were recently developed that resulted in many textile products. These materials could boost the use of bamboo composites.

Moreover, it has shown that also bamboo strips and veneer can be processed into composite structures by using the vacuum infusion technique. Complete structures built up from bamboo veneer layers allow proper infusion as long as the injection strategy and permeability of materials are well chosen.

2 The Vacuum Infusion Technique

The resin infusion process is a technique that enables the manufacture of large composite structures with high mechanical properties. It is a closed mould technique in which fibrous or porous material is impregnated by a resin flow. The resin flow is created by applying vacuum on the bagged material. In comparison to the traditional hand-lay up method the vacuum infusion results in:

- Increased mechanical properties, high fibre volumes up to 60% are possible while the composite material can be made void free.
- Decrease of labour cost (no hand lay-up)
- Less harm to environment and health. The closed mould technique prevents hazardous styrene emission.

The process is as follows; dry reinforcement is placed in a mould, the mould is closed by a film or upper mould, then vacuum is applied and resin flows into the mould and impregnates the reinforcement. The driving force for the flow of the resin is a pressure difference. The impregnation speed is then determined by porosity and permeability of the reinforcement and the viscosity of the resin.

3 Bamboo Composite Processed by Vacuum Infusion

To obtain a strong wood composite, one would need to fully impregnate the wood with a polymeric resin. Wood veneer is hard to impregnate, it requires thin veneer. Bamboo veneer however is far more permeable. This was the background for bamboo composite experiments at the Delft University. The vacuum infusion technique proved to be the right process. Strong, void-free laminates can be made in a closed mould. With recently developed techniques to speed up impregnation, typical shell structures, such as the surf board, were manufactured.



Bamboo composite surf board