

Through-Thickness Permeability Measurements of Fibre Reinforcements



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Introduction

The permeability of fibre reinforcements is an important parameter in Resin Transfer Moulding (RTM), a manufacturing process for near-netshape composites. Unlike the in-plane permeability, the through-thickness permeability has not been investigated extensively, since until recently only quasi two dimensional components were made by RTM.



Figure 1 : The carbon fibre braided trailing arm of the NH90.

A full three dimensional characterization of the permeability tensor becomes essential when composite materials are applied in thick structural components with high performance requirements. An excellent example of such a structural part is the trailing arm of the NH90 helicopter (Figure 1). The arm is manufacture with RTM, using a braided carbon fibre preform.

Objective

An experimental set-up is designed aiming to characterize the through-thickness permeability of a fibre reinforcement for different types of fibre architectures and different fibre contents.

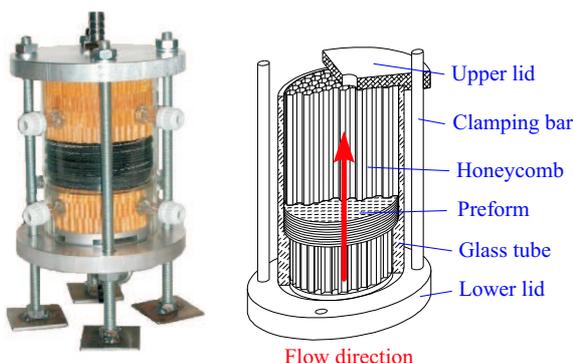


Figure 2 : The glass tube filled with honeycomb and a carbon fibre preform of approximately 50mm thick.

Methods

The experimental set-up consists of a glass tube (Figure 2) filled with honeycomb to position the preform and to distribute the resin flow leading to a flat flow front.

The wall thickness of the glass tube varies stepwise to minimize the effect of “racetracking”, as shown in Figure 3.

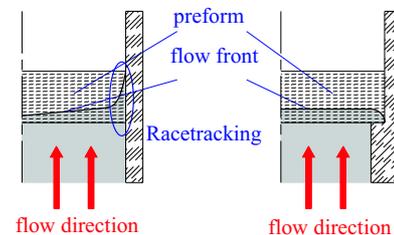


Figure 3 : The racetracking effect will be minimized by using a stepwise changing wall thickness of the glass tube.

The location of the resin during the experiment is monitored using a sensor which is based on the difference in electrical resistance between air and resin. As the resin reaches the contact points a change in voltage is measured over the reference resistance (see Figure 4).

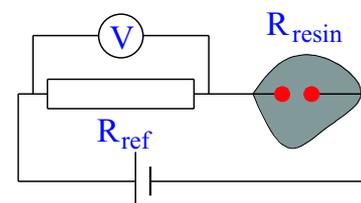


Figure 4 : The electrical scheme of the resin location sensor.

Further Research

The knowledge obtained by these experiments will be used for further development of a 3D-permeability measurement tool. The permeability data will be used to validate the currently available numerical models.