Separating Bubbles by Superficial Capillary Flow

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ABSTRACT

Developments in the field of advanced composite materials over the past decades have significantly altered their current and future potential role in structural applications. Composites offer structural designers materials of higher strength, stiffness and lower distortion than previously available engineering materials. Epoxy resin composites are one example of such a material. These composite systems are finding widespread use in the transportation, marine, aerospace and even sporting goods industries. As these structures are becoming more optimised, in order to reduce weight and material cost, the requirement on mechanical properties are increasing in the terms of performance and consistency.

Vacuum infusion is one of the manufacturing techniques used to give increased performance and . It is suitable for large load carrying composite and sandwich structures. The vacuum infusion process virtually eliminates styrene emissions, making for a cleaner and healthier workplace. This process not only improves the air quality, but also reduces non-construction solid waste products significantly. Resin infusion under flexible tooling (RIFT) is a variant of vacuum driven resin transfer moulding in which one of the solid mould faces is replaced by a polymeric film. One variant of the process is known commercially as SCRIMP

During the manufacture of composite components by resin infusion bubbles may develop during mixing due to air entrapment, local pressure variation and out-gassing of volatile components and dissolved gases. Bubble problems during composite impregnation results in higher void content. The void content distribution in the final laminate leads to inhomogenous problems in impregnation. It is very difficult to eliminate bubbles in a viscous fluid. It is possible to bring a bubble closer to the surface to diffuse but viscosity governs the drainage on the bubble film, therefore smaller bubbles take a longer time to break up.

In an earlier analysis, it was found that bubble film is the best method for removal of volatile components and dissolved gases. The bubble film thickness may reduce to around 0.1 m before break up and this allows diffusion at molecular level, without nucleation. Formation of bubble film on the other hand, can provide a larger diffusion surface area. At one end, the bubble is playing an important role in removing the unwanted component and at another, the bubble itself is the problem and very difficult to eliminate. The separation of bubbles by means of capillary superficial flow process is found to provide a possible solution to get bubble free resin mixture prior to infusion. Therefore the process of mixing, degassing, bubble straining and infusion can be carried out concurrently to form a continuous supply system.

The paper would develop the above work being undertaken at the University of Strathclyde to seek to reduce the formation of bubbles in the resin infusion manufacture of composite structures.