SAND2000-1425
Unlimited Release
Printed June 2000

Evaluation Of Hand Lay-Up And Resin Transfer Molding In Composite Wind Turbine Blade Manufacturing

Douglas S. Cairns and Jon D. Skramstad
Department of Mechanical and Industrial Engineering
Montana State University-Composites Technology Team
Bozeman, MT 59717

Sandia Contract: BC-3536

Abstract

The majority of the wind turbine blade industry currently uses low cost hand lay-up manufacturing techniques to process composite blades. While there are benefits to the hand lay-up process, drawbacks inherent to this process along with advantages of other techniques suggest that better manufacturing alternatives may be available.

Resin Transfer Molding (RTM) was identified as a processing alternative and shows promise in addressing the shortcomings of hand lay-up. This report details a comparison of the RTM process to hand lay-up of composite wind turbine blade structures.

Several lay-up schedules and critical turbine blade structures were chosen for comparison of their properties resulting from RTM and hand lay-up processing. The geometries investigated were flat plate, thin and thick flanged T-stiffener, I-beam, and root connection joint.

It was found that the manufacturing process played an important role in laminate thickness, fiber volume, and weight for the geometries investigated. RTM was found to reduce thickness and weight and increase fiber volumes for all substructures. RTM resulted in tighter material transition radii and eliminated the need for most secondary bonding operations. These results would significantly reduce the weight of wind turbine blades. Hand lay-up was consistently slower in fabrication times for the structures investigated. A comparison of mechanical properties showed no significant differences after employing fiber volume normalization techniques to account for geometry differences resulting from varying fiber volumes. The current root specimen design does not show significant mechanical property differences according to process and exceeds all static and fatigue requirements.