Overview

Quality assurance and process control often go hand-in-hand The information gathered by the quality control specialist is of great importance to the people monitoring and designing process control parameters On the other hand, each change of control parameters will influence the performance of the structure and should therefore be investigated by the quality assurance division. In the composites industry, this interaction is even more crucial since many processing issues are still new and not completely understood

The study of the "Effects of Processing Variables on the Quality of Co-cured Sandwich Panels" by Jouin, Pollock, and Rudisill is one such example A number of material systems are subject to a variety of processes The resulting sandwich quality is determined through a number of destructive test procedures such as leak, compression, and tension testing This study eventually leads to improved performance of the sandwich panels by optimizing the lay-up sequence, the cure cycle, and the choice of surfacing plies

"An Evaluation of the Current Status of Automated Process Control for Thermosetting Composites" by Holl and Rehfield focuses on another side of the issue In this case, in-process control is used to provide information about the physical state of the resin during the cure cycle Transducers based on dielectric, acoustic, and fluorescent signals are used as sensors in a feedback loop They can be interfaced with algorithms which adjust the temperature and pressure profiles during the cure cycle. In-process control is an important area of research since fluctuations during the cure cycle have a direct impact on the final performance of the composite structure Capabilities, cost, and size of available transducers are crucial parameters that have to be taken into account when selecting the proper in-process monitoring system

The "Analysis of Composite Materials Containing Defects" by Frankle, Jones, Roberts, and Shusto using nondestructive evaluation techniques highlights the advantages of quality control methods combined with advanced design tools This study shows a dramatic step forward in the interaction of design and analysis tools used to predict the performance of actual composite parts. A finite element structural analysis code is used to model the performance of carbon-carbon rings Digital ultrasonic NDE data are then superimposed to develop a mechanism for automatically including the effect of defects in the analysis of the actual composite structure Changes in matrix- and fiber-dependent properties based upon the ultrasonic data are taken into account in the analytical techniques Subsequent hoop-tension tests have shown good correlation between the finite-element code predictions and the actual performance of the rings

"Image Enhancement Techniques for Ultrasonic NDE Applications" by Steiner have proven to be a reliable method for the inspection of composite structures One of the barriers is the dissemination of information from the quality control department to the manufacturing and design department Image enhancement techniques allow the analyst to improve dramatically the detectability of defects and visibility of critical information gathered about the internal structure of the composite A variety of techniques such as contrast stretching, histogram equalization, Kernel enhancement, and fast Fourier transformations can be applied These techniques, combined with statistical histogram analysis and digitized full-volume waveform analysis, are powerful tools for the classification of flaws Classification of defects

into such categories as porosity, contamination, delaminations, and matrix-rich or matrix-starved regions and information about the flaw depth provide important information which can be used by both design and manufacturing to improve the quality of subsequent production runs.

This session covers the effects of process variables on co-cured sandwich panels, automated process control for thermosetting composites, the analysis of defects in composites using non-destructive evaluation techniques, and ultrasonic NDE techniques as a reliable way of inspecting composite structures