Conference Report

Summary of ASTM Symposium on Producibility and Quality Assurance of Composite Materials

An ASTM Symposium on Producibility and Quality Assurance of Composite Materials was held in St. Louis, MO, on 20 Oct. 1981. The objectives of the symposium, sponsored by Committee D-30 on High Modulus Fibers and Their Composites, were to bring together workers in composite technology and provide a forum to present and discuss the latest developments in composites processing and quality assurance, including applications to the aerospace, automotive, and marine industries.

The symposium consisted of two sessions: Session I—Quality Assurance Methodology, was chaired by J. F. Carpenter of McDonnell Douglas, St. Louis, MO, and Session II—Processing and Materials, was chaired by T. T. Chiao of Lawrence Livermore National Laboratory, Livermore, CA. The papers presented are summarized below.

T. A. Sewell (McDonnell Douglas, St. Louis) presented the results of his work on the use of high-performance liquid chromatography (HPLC) for quality assurance of graphite/epoxy materials. The use, evolution, and reliability of HPLC certify the resin matrix composition of Hercules' AS/3501-6 graphite/epoxy matrix material were discussed.

Y. Tajima (Lockheed-California, Burbank, CA) described the development of a specification for 177°C curing epoxy/graphite materials. Developing the new specification involved new analytical methods as well as the design of a “batch acceptance processability” laminate to determine the suitability of the batch to construct large laminates with a specified process cycle.

R. J. Hinrichs (Applied Polymer Technology, Costa Mesa, CA) summarized his work on control of composite cure processes, involving ways to characterize important processing factors such as pressure gradients and thermal gradients. Methods for assuring uniform thermal histories were discussed.

C. M. Tung (Rockwell Science Center, Thousand Oaks, CA) described the chemorheological characterization of B-stage printed wiring board resins. Her objectives were to investigate how well advanced polymer characterization techniques apply to these resins, with the aim of improving quality control. Results showed that liquid chromatography, dynamic viscoelastic measurements, and thermal analyses are effective characterization techniques.

C. E. Browning (Air Force Wright Aeronautical Labs, Wright-Patterson Air Force Base, OH) reported the development of a four-point shear test for graphite/epoxy composites. The inability of the conventional short-beam shear test to yield interlaminar shear failures prompted this work. Results showed that the new method consistently produces the desired failure mode.

J. C. Duke, Jr. (VPI&SU, Blacksburg, VA) treated nondestructive evaluation (NDE) of composite materials in terms of a philosophy, an approach, and an example. He discussed the need to simultaneously address both parts of the NDE problem—having a suitable description of an imperfection and having a suitable model of the material that determines the significance of the defect. He reviewed the basic philosophy regarding NDE and specifically mentioned an example of boron-carbide-coated, boron-fiber-reinforced, titanium-metal-matrix composite material.

J. L. Kardos (Washington University, St. Louis, MO) discussed his work on the modeling of various aspects of composite processing. He examined the development of the capability to describe a complex process that involves heat, mass, and momentum transfer with simultaneous chemical reactions in a multiphase system under conditions of time-dependent material properties and boundary conditions. His early emphasis has been on modeling those processes critical to the formation and movement of voids in a laminate.

G. S. Springer (University of Michigan, Ann Arbor, MI) also addressed the modeling of the curing process of graphite/epoxy composites. His model simulating the curing of epoxy-matrix composites relates the resin properties, the cure cycle, and the curing stresses and strains. It provides (a) the temperature inside the materials as a function of position and time, (b) the degree of resin conversion as a function of position and time, (c) the resin viscosity as a function of position and time, (d) the resin flow into the bleeders as a function of time, and (e) the stress-strain distributions inside the material after curing. A method was presented that can be used with the model to establish the optimum cure cycle in a given application.

A. O. Kays (Lockheed-Georgia, Marietta, GA) reported on the characterization of some solvent-resistant thermoplastic resin matrix/graphite fiber reinforced composites, discussing their processability and resultant mechanical and physical properties as well as their capabilities and limitations. Thermoset resins investigated included polyethylene terephthalate (PET), polybutylene terephthalate (PBT), polyphenylene sulfide (PPS), and polyether etherketone (PEEK).

R. A. Kline (General Motors Research Labs, Warren, MI) described his work on the mechanisms of damage initiation and propagation in sheet molding compound (SMC) composites. SMC is an attractive candidate for automotive applications, but little is known about its failure mechanisms. His work examined the relation between specimen microstructure and internal damage initiated during mechanical testing. He found that matrix cracking is a principal mode of damage initiation.

D. J. Gleason (McDonnell Douglas, St. Louis, MO) discussed her work on the characterization of quick-cure composites. She investigated two composite materials which can be quick-cured or vacuum-bag cured (Hexcel's HX 565/T-300 and Celanese's diallyl phthalate/C-6000) and which have the potential of reducing fabrication costs. Results for the particular mechanical properties characterized showed that the quick-cure systems were inferior to current graphite/epoxy systems. However, they may be cost-effective in applications such as those having minimum gage requirements where graphite/epoxy is less efficient.

C. E. Browning, Symposium Chairman
Air Force Wright Aeronautical Laboratories
Wright-Patterson Air Force Base, OH 45433
Calendar on Composites

13–14 July 1982
Jointing in Fiber Reinforced Plastics
Imperial College, London, England
Contact: F. L. Matthews
Aeronautics Department, Imperial College, London SW7 2BY, England

19–23 July 1982
Computer Workshop: Mechanical Behavior of Fiber Composite Materials
Chicago, IL
Contact: L. K. De Grand
Center for Educational Development, Illinois Institute of Technology
10 West 31st St., Chicago, IL 60616 (312-567-3167)

1–6 Aug. 1982
Review of Progress in Quantitative Nondestructive Evaluation
UCSD, San Diego, CA
Contact: D. O. Thompson
Ames Laboratory, Energy and Mineral Resources Research Institute
Iowa State University, Ames, IA 50011

2–6 Aug. 1982
International Conference on Finite Element Methods
Shanghai, China
Contact: Dr. Y. K. Cheung
Department of Civil Engineering, University of Hong Kong

6–10 Sept. 1982
Third Riso International Symposium on Metallurgy and Materials Science: Fatigue and Creep of Composite Materials
Roskilde, Denmark
Contact: H. Lilholt or R. Talreja
Metallurgy Department, Riso National Laboratory, 4000 Roskilde, Denmark

12–17 Sept. 1982
International Symposium on Adhesive Joints: Their Formation, Characteristics, and Testing
Kansas City, MO
Contact: Dr. K. L. Mittal, Symposium Chairman
IBM Corporation, Bldg. 400-40E, Hopewell Junction, NY 12533 (914-897-6630)

12–14 Oct. 1982
14th National SAMPE Technical Conference
Atlanta, GA
Contact: Marge Smith
SAMPE, P.O. Box 613, Azusa, CA 91702 (213-334-1810)

Fourth International Conference on Composite Materials
Tokyo, Japan
Contact: Prof. T. Hayashi
c/o Japan Society for Composite Materials
Business Center for Academic Societies Japan
2-4-16, Yayoi, Bunkyo-ku, Tokyo 113, Japan

10–12 Nov. 1982
Technical Conference on Polyimides: Synthesis, Characterization, and Applications
Ellenville, NY
Contact: Dr. K. L. Mittal, Program Chairman
IBM Corporation, Bldg. 300-40E, Hopewell Junction, NY 12533 (914-897-6630)

14–19 Nov. 1982
ASME Winter Annual Meeting
Phoenix, AZ
Contact: American Society of Mechanical Engineers
United Engineering Center, 345 East 47th Street, New York, NY 10017

13 Dec. 1982
Symposium on Effects of Defects in Composite Materials
San Francisco, CA
Contact: Kathy Greene
ASTM, 1916 Race St., Philadelphia, PA 19103

15–17 Dec. 1982
ASTM-ASME-ASM-SAE Symposium on Multiaxial Fatigue
San Francisco, CA
Contact: Kathy Greene
ASTM, 1916 Race St., Philadelphia, PA 19103 (215-299-5414)

12–14 April 1983
28th National SAMPE Symposium and Exhibition
Anaheim, CA
Contact: Marge Smith
SAMPE, P.O. Box 613, Azusa, CA 91702 (213-334-1810)

14–15 Sept. 1983
Testing, Evaluation, and Quality Control of Composites
Surrey University, Guildford, England
Contact: Tim Feest, Conference Organizer
IPC Science and Technology Press, Guildford, Surrey, GU2 5BH, England