

World of Composites

News articles and announcements of interest to the composites technical community

Long Fiber Reinforcement of Thermoplastics Seen as Growing Influence in Europe

Long fiber reinforcement provides thermoplastic materials having improved impact resistance without sacrifice of stiffness, as well as improved stiffness without loss of impact strength. Loss of stiffness is a common difficulty with conventional impact improvement systems, such as elastomer modification or plastification, and frequently impact properties suffer with increasing stiffness by short fiber reinforcement or crosslinking.

Long fiber reinforcement also allows high levels of fiber incorporation, in some cases as high as 80% or even more. Frequently it is *fiber* that is needed in the final part, and resin acts mainly as a binder; therefore in many cases the higher the fiber level the more desirable the compound, assuming processing is practical and other problems do not arise.

Long fiber materials are supplied in several formats in the European marketplace:

- granular products such as those from ICI, Hoechst-Celanes, and others
- reinforced sheet products (GMT) such as those from Shell/Symalit, BASF/Elastogran, and numerous others
- powder-impregnated reinforcement fibers such as those from the FIT process and others
- thermoplastic bulk molding compounds such as those available in Germany and others
- thermoplastic fibers commingled with reinforcement fibers such as those produced in Germany and France
- thermoplastic prepreps using high-performance fibers and resins, such as CETEX and APC-2.

The total business of long and continuous fiber reinforced thermoplastics in Europe is estimated to be some DM 60 million at present, and is forecast to rise very dramatically to over DM 1 billion in a relatively short period of only six years.

CONSULTEX, a leading European plastics consulting company in Switzerland with over 15 years experience in the reinforced thermoplastics industry has just published its latest multi-client study detailing the European technology and commercial positions of the product areas listed above. *Long and Continuous Fiber Reinforced Thermoplastics—The Prognosis for Europe*, published in Nov. 1989 is presently available to subscribers. Further information about the study is available from Dr. Howard Hornfeld, Consultex SA, CH-1261 Bogis-Bossey, Switzerland, Telephone: (022) 776-1145, Fax: (002) 776 58 00.

SACMA Publishes Nine Recommended Composite Test Methods

The Suppliers of Advanced Composite Materials Association (SACMA) recently released nine recommended methods for testing composite materials, including:

- Compressive Properties of Oriented Fiber-Resin Composites
- Compression After Impact Properties of Oriented Fiber-Resin Composites
- Open Hole Compression Properties of Oriented Fiber-Resin Composites
- Tensile Properties of Oriented Fiber-Resin Composites
- Open Hole Tensile Properties of Oriented Fiber-Resin Composites
- Inplane Shear Stress-Strain Properties of Oriented Fiber-Resin Composites
- Apparent Interlaminar Shear Strength of Oriented Fiber-Resin Composites by the Short Beam Method
- Calculation of Fiber Volume of Composite Test Laminates
- Conditioning of Composite Test Laminates

The recommended methods are the result of a coordinated effort by more than 14 composite materials suppliers and parts manufacturers who reviewed all available composite airframe material specifications, selected the most appropriate elements, and compiled them into a single document. The methods were subsequently reviewed and adopted by the Association's Regular Members who represent between 90 to 95 percent of all the fiber producers and prepreggers in the "Free World."

SACMA Recommended Methods are not "national consensus standards." However, they do represent an "association consensus" and SACMA is coordinating with ASTM to obtain Society approval of new methods as well as modification of existing ASTM standards where better definition is warranted. Use of the SACMA Recommended Methods will allow the advanced composite materials community to provide test data that can be compared to data from multiple sources, thereby reducing questions on the validity of test data: questions that now impede development of an accredited composites data base.

"This program is the first of many efforts by the Association to accelerate the composite standardization effort," said John Hall, SACMA Chairman of the Board. Other areas of focus nearing completion are a Recommended Test Method for Bearing Strength Properties of Oriented Fiber-Resin Composites, Recommended Bar Code Labeling Practice, plus a Recommended Method for Lot Acceptance of Carbon Fibers and Related Test Methods.

Copies of the SACMA Recommended Methods may be purchased from the Association at a cost of \$30 (includes shipping/handling).

Call for Papers

Announcing the second international conference on Interfacial Phenomena in Composite Materials (IPCM '91) to be held at Katholieke Universiteit Leuven, Leuven, Belgium, 17-19 Sept. 1991. The conference chairman is Professor I. Verpoest, De-

partment of Metallurgy and Materials Engineering, Catholic University of Leuven, Belgium, and the conference co-chairman is Dr. F. R. Jones, School of Materials, University of Sheffield, United Kingdom. The conference is organized and sponsored by the journal, *Composites*, jointly with the Catholic University of Leuven and the University of Sheffield.

IPCM '89, an International Conference on Interfacial Phenomena in Composite Materials, was organized at the University of Sheffield, United Kingdom, in Sept. 1989. It was the first conference to be held in Europe that specifically explored the optimization of interfaces in composites. In 10 keynote lectures, 45 papers, and some 25 posters, scientists from all over the world discussed the recent advances in understanding and optimizing fibre-matrix interfaces for appropriate mechanical properties and environmental resistance of composite materials.

Following the immense success of IPCM '89, it was decided to organize a second international conference, IPCM '91, at the Catholic University of Leuven, Belgium. *Interfacial Phenomena in Composite Materials '91* will focus attention on three main areas in the field of interfaces in composite materials:

- (1) Interface characterization and analysis
 - fibre and particulate filler surface structure
 - surface treatments and coatings of fibres
 - surface and interface characterization techniques
- (2) Interface micromechanics
 - mechanisms of adhesion in polymer, ceramic, glass, and metal matrix composites
 - stress-strain analysis for micromechanical phenomena in composites
 - direct and indirect measurement techniques for reinforcement/matrix adhesion characteristics
- (3) Influence of the interface on macro-properties of composites
 - relation between micro- and basic macro-mechanical properties of composites (strength and stiffness in tension, compression, bending, shear)
 - influence of the interface on composite performance in fatigue, impact, wear
 - interface related environmental effects, including corrosion, moisture, thermal cracking

These topics will be reviewed in nine keynote lectures. Papers will be presented orally in parallel sessions, with polymer matrix composites on the one hand and metal and ceramic matrix composites on the other. These presentations will be completed by a poster session, and by workshops during which some "hot-topics in composite interface research" will be discussed in depth.

A call for papers relating to research in the above areas is issued. Intending authors are requested to register initial interest with the Conference Organizer as soon as possible.

Extended abstracts of a minimum of 400 words (approximately two pages) and including at least one or two figures or tables, will be required by Monday, 15 Oct. 1990. Final manuscripts for publication in the proceedings will be required by *Friday, 5 April 1991*.

For information, intending authors should indicate their preference for either oral or poster presentation, when submitting their abstract. However, the final decision regarding those papers for oral presentation will rest with the conference organizers.

Further details are available from: Janet Miles, conference organizer, Butterworth Scientific Ltd., PO Box 63, Westbury House, Bury Street, Guildford, Surrey GU2 5BH, United Kingdom, Telephone: 0483 300966, Telex: 859556 SCITEC G, Fax: 0483 301563.

ASTM Composites Activities

Three ASTM committees, D-30, E-9, and E-24, are actively studying composite materials. They coordinate their efforts and frequently meet at the same time and co-sponsor symposia. This column will briefly outline the composite material activities of each of these committees.

Committee D-30 on High Modulus Fibers and Their Composites

The bulk of ASTM activity in composite materials is performed in this committee. The committee has approximately 300 active members; it celebrated its 25th anniversary in 1989. D-30's mandate is to develop standards, sponsor symposia, stimulate research, and exchange technical information pertaining to fibers having a Young's modulus greater than 20 GPa (3×10^6 psi) and composites fabricated from these fibers. Ron Zabora of Boeing Commercial Airplanes is the chairman of Committee D-30.

The committee is divided into three subcommittees: D30.01 on Editorial, Definitions, and Nomenclature, chaired by Elizabeth Goeke of the Army Materials Technology Lab.; D30.02 on Research and Mechanics, chaired by Glenn Grimes of Lockheed Aeronautical Systems Co.; D30.04 on High Performance Fibers and Composites, chaired by Richard Fields of Martin Marietta. Activities of a fourth subcommittee, D30.03 on Automotive/Industrial Composites, have been combined with those of subcommittee D30.04. D-30 also supports a number of task groups that address specific areas of composite material technology.

D-30 held its last meeting on 6-9 Nov. 1989 in Orlando, FL. A prime feature of the meeting was a two day symposium titled Composite Materials: Fatigue and Fracture, Third Symposium. Committee and task group sessions were, of course, also held at that time. Highlights of these activities are reviewed in the following paragraphs.

Symposium

Dr. T. Kevin O'Brien of the U.S. Army Research and Technology Activity (AVSCOM) chaired this symposium, which featured 48 papers presented in nine sessions. Sessions were devoted to matrix cracking and delamination, fatigue and fracture, interlaminar fracture toughness, delamination analysis, and strength and impact. A Special Technical Publication containing all papers will be issued.

D30.02

This subcommittee performs a variety of functions. It is responsible for stimulating research, investigating long-range testing problems, and planning symposia and lectures. A number of task groups have been established under this committee to carry out these missions. A list of these task groups and a short summary of each groups current activities is as follows:

- *Interlaminar Fracture Toughness*—This group has written draft test methods for Mode I (Double Cantilever Beam Test), Mode II (End-Notched Flexure Test) and Mixed Mode (Edge Delamination Test and Cracked Lap Shear Test) testing. Round-robin tests have been performed on three materials: ICI's PEEK, Hercules' 3501-6, and American Cyanamid's CYCOM 907. Results of these tests were reviewed at the last meeting. It is anticipated that the test methods will be sent to D30.04 for ballot in the near future. In the meantime, efforts are underway to draft test methods to determine fatigue delamination onset for both Mode I and Mode II loadings.

- *Compression Testing*—In cooperative efforts with SACMA and JANNAF, this group has implemented round-robin testing on five proposed test methods. They are: Open Hole Compression, Compression after Impact, a Thick Section Test method, a Modified ASTM D 695 compression method, and a procedure to measure the compression strength of filament wound composites. Specimen preparation is being completed; preliminary test results will be reviewed at the next meeting.

- *Specimen Preparation*—A series of guidelines has been prepared by this group. They cover procedures to lay-up and cure laminates, cut specimens, machine specimens, mount strain gages, and report data. Draft guidelines have been prepared and are being reviewed by the committee. The guidelines will be going to ballot in the near future.

- *Metal Matrix Composites*—This is a joint effort between ASTM and the (NASP) Material Maturation Program. Test procedures for quasi-static tension and tension-tension fatigue test have been prepared. Round-robin testing featuring silicon carbide/titanium, SCS-6/B21s, specimens is planned.

- *Fractography and Failure Analysis*—In response to requests from members, a set of failure analysis guidelines are being prepared based on work performed by Boeing and Northrop under contract to the Air Force.

In addition to the task groups listed above, three new groups were established at the last meeting. They will address NDE/NDI test procedures, bolt bearing test methods, and coordination of international test methods. All three groups will hold planning sessions at the next committee meeting.

Plans for the next symposium were also reviewed at the D30.02 meeting.

- *Future Symposia*—The next symposium will be held on 24 and 25 April 1990 in San Francisco, CA. It will be titled Tenth Symposium of Composite Materials: Testing and Design. Dr. Glenn Grimes organized the conference, which will feature 25 papers. Dr. James Whitney of the Air Force Materials Laboratory will give the keynote address.

D30.04. This subcommittee is responsible for the development and administration of the committee's test methods, specifications, and standard guides. The subcommittee sent seven test methods (C 613-67, D 2585-68, D 2586-68, D 3171-76, D 3479-76, D 3518-76, and D 3800-79) for Main Committee ballot as reapprovals in October 1989. Actions to resolve negative votes were reviewed at the last meeting. In addition, D30.04 is beginning a modernization and updating effort on all existing documents.

D-30 will hold its next committee and task group meetings on 26 and 27 April 1990 in San Francisco, CA. All meetings are open and attendance is welcome.

Committee E-9 on Fatigue

Committee E-9 has a twenty year history of composite materials activities. Recently, after a two year hiatus, it re-established its efforts in fatigue of composites by founding subcommittee E9.03 on Fatigue of Advanced Materials. This subcommittee is planning research efforts that will lead to test standards in cooperation with the other ASTM committees. E9.03 is especially interested in the thermal-mechanical fatigue of heat resistant materials such as metal matrix and ceramic matrix composites. These composites include particulate reinforced systems, whisker and long fiber reinforced materials, and eutectoid alloys. Michael Mitchell of Rockwell is the chairman of subcommittee E9.03.

E-9 will hold its next meeting during the week of 23 April 1990 in San Francisco. In addition, subcommittee E9.03 will be co-sponsoring a symposium with D-30 and E-24 on 12 Nov. 1990. The symposium will be titled Cyclic Deformation, Fracture, and Nondestructive Evaluation of Advanced Materials. Several papers dealing with metal matrix and ceramic matrix composites will be presented.

Committee E-24 on Fracture Testing

The scope of Committee E-24 indicates that it is responsible for the promotion of knowledge and advancement in the field of fracture testing. To meet this goal, the committee promotes the research and development of methods for appraisal of fracture resistance, develops test methods and practices, and sponsors technical meetings. E-24 recently founded subcommittee E24.07 on the Fracture of Advanced Materials. It is divided into two task groups E24.07.01 on Fracture of High Performance Ceramic Materials and E24.07.02 on Translaminar Fracture of Advanced Composites. Subcommittee E24.07.03 is chaired by John Underwood of Army Armament Research Development and Evaluation Center.

In their last meeting on 8 Nov. 1989, E24.07.01 defined their scope as follows:

To promote research and development in methods and specimen design for translaminar fracture testing of advanced composites.

To develop standard test methods for measurement of translaminar fracture properties of advanced composites.

The task group is considering general categories of test specimen configurations, end-item application, and test materials for study. Configurations include tensile panels, bend bars, and pressurized cylinders. Applications are primarily defense components with penetration or impact damage. Initial test materials would be carbon/polymer and metal matrix laminates.

The next E-24 committee meetings will be held on 23-26 April 1990 in San Francisco, CA.

Calendar on Composites

The following meetings may be of interest to researchers in the field of composite materials.

23 April 1990

Rapid Load Fracture Testing

San Francisco, CA

Contact: Dorthy Savini, ASTM, 1916 Race St., Philadelphia, PA 19103; Telephone: 215-299-5431

24 April 1990

First Symposium on Fatigue Lifetime Predictive Techniques

San Francisco, CA

Contact: Dorthy Savini, ASTM, 1916 Race St., Philadelphia, PA 19103; Telephone: 215-299-5431

24-25 April 1990

10th Symposium on Composite Materials: Testing and Design

San Francisco, CA

Contact: Dorthy Savini, ASTM, 1916 Race St., Philadelphia, PA 19103; Telephone: 215-299-5431

21-25 May 1990

11th US National Congress of Applied Mechanics

Tucson, AZ

Contact: C. F. Chen, University of Arizona, Dept. of Aerospace and Mechanical Engineering, Tucson, AZ 85721

29-31 May 1990

11th Annual International SAMPE Conference and Exhibition

Basle, Switzerland

Contact: Dr. Howard Hornfield, CONSULTEX SA, SAMPE CONFERENCE, CH-1261 Bogis-Bossey/VD, Switzerland

29 May - 1 June 1990

IUTAM Symposium on Inelastic Deformation of Composite Materials

Troy, NY

Contact: Professor George J. Dvorak, Department of Civil Engineering, Rensselaer Polytechnic Institute, Troy, NY 12181; Telephone: 518-276-6940

3-6 June 1990

SEM Spring Conference on Experimental Mechanics and Manufacturers Exhibit

Albuquerque, NM

Contact: Kathy Ramsay, Conference Manager, SEM, 7 School St., Bethel, CT 06801; Telephone: 203-790-6373

6-8 June 1990

TMS: Symposium on High Performance Composites for the 1990's

Morristown, NJ

Contact: TMS, Barbara J. Kamperman, Meetings Manager, 420 Commonwealth Drive, Warrendale, PA 15086; Telephone: 412-776-9050

7-8 June 1990

International Conference on Micromechanics of Failure of Quasi-Brittle Materials

Albuquerque, NM

Contact: SEM, 7 School St., Bethel, CT 06801; Telephone: 203-790-6373

10-13 June 1990

American Society of Composites 5th Technical Conference

East Lansing, MI

Contact: Dr. Lawrence T. Drzal, Composite Materials and Structures Center, B100 Research Complex, Michigan State University, East Lansing, MI 48824-1326

24-27 June 1990

5th Japan-US Conference on Composite Materials

Tama-City, Japan

Contact: Kenneth L. Reifsnider, Chairman, U.S. Organizing Committee, 5th Japan-US Conference on Composite Materials, 120 Patton Hall, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061

26-28 June 1990

22nd National Symposium on Fracture Mechanics

Atlanta, GA

Contact: Dorthy Savini, ASTM, 1916 Race St., Philadelphia, PA 19103; Telephone: 215-299-5431

27-30 June 1990

Advanced Structural Inorganic Composites

Montecatini Terme, Italy

Contact: 7th CIMTEC Satellite Symposium 2, PO Box 174, 48018 Faenza, Italy; Telephone: 546-664143

23-28 July 1990

4th International Congress on Computational and Applied Mathematics

K. U. Leuven, Belgium

Contact: R. Piessens, K.U. Leuven, Department of Computer Science, Celestijnenlaan 200A, B-3030 Heverlee, Belgium; E-MAIL: PIESSENS&CS.KULEUVEN.AC.BE
FAX: + + 32 16-20 53 08

29 July - 3 August 1990

International Conference on Advances in Structural Testing, Analysis and Design

Bangalore, India

Contact: Professor B. Dattaguru, Department of Aero Engineering, Indian Institute of Science, Bangalore 560 012, India; Telephone: 344411 EXT 2438, FAX: 0812-341683

1-3 August 1990

SEM: Experimental Mechanics for Composites

Blacksburg, VA

Contact: Society for Experimental Mechanics, Inc., 7 School Street Bethel, CT 06801; Telephone: 203-790-6373, FAX: 203-790-1658

20-24 August 1990

9th International Conference on Experimental Mechanics

Copenhagen, Denmark

Contact: Vagn Askegaard, Afdelingen for Baerende Konstruktioner, Structural Engineering, Tech University of Denmark, Bldg. 118, DK 2800 Lyngby, Denmark

20-24 August 1990

3rd International Symposium on Advanced Composites in Emerging Technologies

Patras, Greece

Contact: Professor S.A. Paipetis, COMP'90 Symposium, P. O. Box 1134, 261 10 Patras, Greece

27-30 August 1990

2nd World Congress on Computational Mechanics

Stuttgart, Federal Republic of Germany

Contact: Conference Secretary, Institute for Computer Applications, Pfaffenwaldring 27, D-7000 Stuttgart 80, Federal Republic of Germany; FAX: 0711-685-3500

27-31 August 1990

Durability of Polymer Based Composite Systems for Structural Applications

Brussels, Belgium

Contact: Durability 90, Mrs. Bourlau, VUB-T.W. (KB), Pleinlaan, 2, B-1050 Brussels, Belgium; Telephone: 32/2/641.29.22 FAX: 32/2/641.2928

25-28 September 1990

ECCM-4 4th European Conference on Composite Materials: Eurocomposites and New Materials

Stuttgart, Federal Republic of Germany

Contact: DLR, Institut Fur Bauweisen und Konstruktionsforschung, Pfaffenwaldring 38-40, D-7000 Stuttgart 80/Federal Republic of Germany

1-5 October 1990

Eighth European Conference on Fracture

Torino, Italy

Contact: Conference Secretariat, IGF C/O Centro Congressi Internazionale C.SO Tassoni, 32 - 10143 Torino, Italy; Telephone: 39-(0)-11-740625-761870, FAX: 39-(0)11-761640

10-12 October 1990

14th Polish Symposium on Experimental Mechanics of Solids

Jadwisin, Warsaw, Poland

Contact: Professor Jacek Stupnicki, DSC, Warsaw University of Technology, Nowowiejska 24, 00-665 Warszawa, Poland; Telex: 81 33 07, Telephone: 21 54 63, FAX: 21 68 92

12 November 1990

Symposium on Cyclic Deformation, Fracture, and Nondestructive Evaluation of Advanced Materials

San Antonio, TX

Contact: Dorothy Savini, ASTM, 1916 Race St., Philadelphia, PA 19103; Telephone: 215-299-5431

12-13 November 1990

Fretting Fatigue Test Methods and Apparatus

San Antonio, TX

Contact: Dorothy Savini, ASTM, 1916 Race St., Philadelphia, PA 19103; Telephone: 215-299-5431

13-14 November 1990

Symposium on Damage Detection and Quality Assurance

San Antonio, TX

Contact: Dorothy Savini, ASTM, 1916 Race St., Philadelphia, PA 19103; Telephone: 215-299-5431

13-15 November 1990

Symposium on Composites: Processing, Microstructure and Properties

Orlando, FL

Contact: Michael D. Sacks, Program Chair, Department of Materials Science and Engineering, 157 A Rhines Hall, University of Florida, Gainesville, FL

3-6 December 1990

EUROMECH 269; Experimental Identification of the Mechanical Characteristics of Composite Materials and Structures

St. Etienne, France

Contact: Professor A. Vautrin, Department of Mechanical and Materials Engineering, Ecole Des Mines De Saint-Etienne, 42023 St. Etienne Cedex 2, France

2-5 January 1991

The Second Pan American Congress of Applied Mechanics (PACAM II)

Valparaiso, Chile

Contact: Professor D. Mook Department of Engineering Science and Mechanics, Virginia Tech, Blacksburg, VA 24061-0219, USA; Telephone: 703-231-6841

7-12 January 1991

Third International Conference on Constitutive Laws for Engineering Materials: Theory and Applications and Workshop on Innovative Use of Materials in Industrial and Infrastructure Design and Manufacturing

Tucson, AZ

Contact: Professor Chandra S. Desai, Department of Civil Engineering Mechanics, University of Arizona, Tucson, AZ 85721; Telephone: 602-621-2266, FAX: 602-621-2550

17-19 January 1991

Interfacial Phenomena in Composite Materials

Leuven, Belgium

Contact: Janet Miles, Conference Organiser, Butterworth Scientific Ltd., P. O. Box 63, Westbury House, Bury Street, Guildford, Surrey GU2 5BH, United Kingdom; Telephone: 0483 300966, TELEX: 859556 SCITEC G, FAX: 0483 301563

8-10 April 1991

AIAA/ASME/ASCE/AHS/ASC 32nd Structures, Structural Dynamics and Materials (SDM) Conference

Baltimore, MD

Contact: Ron Kollmansberger, 16761 Via Del Campo Court, San Diego, CA; Telephone: 619-592-2423

Summer 1991

American Society of Composites 6th Technical Conference

Telephone: 513-255-9080

7-9 October 1991

22nd Midwestern Mechanics Conference

Rolla, MO

Contact: Professor Romesh C. Batra, Department of Mechanical and Aerospace Engineering and Engineering Mechanics, University of Missouri-Rolla, Rolla, MO 65401-0249; Telephone: 314-341-4589

27 October – 1 November 1991

IUTAM Symposium on Local Mechanics Concepts for Composite Materials Systems

Blacksburg, VA

Contact: J. N. Reddy, Department of Engineering Science and Mechanics, Virginia Tech, Blacksburg, VA 24061-0219, USA; Telephone: 703-231-6744 FAX: 703-231-4574

Summer 1992

6th US-Japan Conference on Composite Materials

San Diego, CA

Contact: Kenneth L. Reifsnider or M. W. Hyer, Department of Engineering Science and Mechanics, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061-0219; Telephone: 703-231-5077 or 703-231-5372, FAX: 703-231-4574

Summer 1992

American Society of Composites 7th Technical Conference

Telephone: 513-255-9080

Send items for this calendar to:

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Blacksburg, VA 24061-0219

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