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Symposium Program

AECM3 1989
Paris, France

Page Time Activity

Tuesday, July 18

8:00 Registration

9:30 WELCOME

SESSION 1: TESTING

✓ 16 10:00 **New Directions in Testing.** *T. J. Fowler, J. A. Blessing, and P. J. Conlisk* (Monsanto Chemical Company, U. S. A.)

28 10:30 **Development of Control Methods by Acoustic Emission in Composite Materials Tubes, Part I.** *C. Hervé, M. Cherfaoui, and J. Roget* (Cetim, France); *M. Truchon* (SneaP, France); and *X. DuFour* (SBPI, France)

33 11:00 **A Procedure for Acceptance Testing of FRP Balsa Wood Core Pressure Vessels.** *P. Ouellette, S. V. Hoa, and L. Li* (Concordia University, Canada)

11:30 BREAK

SESSION 2: INSPECTION

✓ 42 12:00 **Acoustic Emission Technology for the Development of Composite Materials in Automobile Industry.** *N. Sato* (Toyota, Japan)

52 12:30 **Development of Production Acoustic Emission Evaluation Criteria from Qualification Torque Load Testing of Graphite/Epoxy Power Transmission Shafts.** *J. M. Rodgers* (Hartford Steam Boiler Inspection Technologies, U. S. A.) and *D. W. Okey* (Sundstrand Aviation, U. S. A.)

13:00 LUNCH

SESSION 3: CURING

✓ 63 14:30 **Acoustic Emission Characterization of Differently Conditioned Carbon/Peek Laminates.** *G. Mensitieri and R. Teti* (University of Naples, Italy) and *G. Borzacchiello and C. Sabatino* (Aeritalia G.V.T., Italy)

73 15:00 **Influence of Environmental Conditions during Materials Processing by Felicity Ratio Measurement.** *A. Lemascon, A. Blazer, and A. GrosPierre* (Centre Technique des Industries Mécaniques, France) and *M. C. Yrieix* (Electricité De France - Les Renardières, France)

15:30 BREAK

SESSION 4: FRICTION

AECM3 1989
Paris, France

- 83 16:30 **Sources for Thermally Induced Acoustic Emission.** *S. Nyström and P. A. Gradin* (Swedish Plastics and Rubber Institute, Sweden)
- 84 17:00 **Distinguishing Acoustic Emission Generated by Actual Damage Progression from Non-Relevant AE in Graphite Epoxy Composites.** *A. Mittelman and I. Roman* (The Hebrew University of Jerusalem, Israel)

WORKS IN PROGRESS

- 92 17:30 **An Attempt to Analyse Laminate Failure Mechanisms by Acoustic Emission.** *D. Perreux, D. Varchon, and C. Oytana* (Laboratoire de Mécanique Appliquée, France)
- 97 17:45 **Study by Acoustic Emission of Damage Development in Carbon Fibre Reinforced Composites.** *C. Martin, J. M. Dartyge, and E. Morel* (Institut National de Recherche Chimique Appliquée, France)

Wednesday, July 19

SESSION 5: ENVIRONMENTAL EFFECTS

- 101 9:00 **Service Life Prediction of Glass Reinforced Plastic under Stress Corrosion Condition by Acoustic Emission.** *L. Golaski* (Technical University of Kielce, Poland) and *J. Ranachowski* (Polish Academy of Sciences, Poland)
- 109 9:20 **Evaluation of Degradation Behavior on GFRP in Hot Water by Acoustic Emission.** *H. Hamada, Z. Maekawa, and T. Morii* (Kyoto Institute of Technology, Japan)
- 119 9:40 **Acoustic Emission Analysis of GFR Thermoplastic Composites.** *R. Teti* (University of Naples, Italy) and *K. Bastioli and G. Romano* (Istituto G. Donegani, Italy)
- 129 10:00 **Environmental Effects on Advanced Fibre Hybrid Composites--an Acoustic Emission Study.** *R. Gopalan, H. N. Sudheendra, and M. R. Madhava* (National Aeronautical Laboratory, India) and *B. Dattaguru* (Indian Institute of Science, India)
- 137 10:20 **An Acoustic Emission Monitoring of Bending Tests on a Hygrothermal Aged PA66 Matrix/Glass Fibre Composite.** *C. Allie and D. Valentin* (Centre des Matériaux, France)

10:40 BREAK

SESSION 6: AEROSPACE APPLICATION I

- 144 11:10 **Ariane 4 Spelda--Flight Proving by Acoustic Emission.** *P. T. Cole* (Dunegan Pac, Ltd., Great Britain) and *N. Thomas* (BAe Space & Communications, Great Britain)

- 151 11:40 **AE Inspection of Carbon-Fiber Reinforced Structures for Aerospace Applications.** *J. Block* (Institute for Structural Mechanics, Federal Republic of Germany)
- 160 12:10 **Correlation of Felicity Ratio and Strength Behavior of Impact-Damaged Spherical Composite Test Specimens.** *J. W. Whittaker and W. D. Brosey* (Martin Marietta Energy Systems, Inc., U. S. A.) and *M. A. Hamstad* (University of Denver, U. S. A.)
- 168 12:30 **Felicity Ratio Behavior of Pneumatically and Hydraulically Loaded Spherical Composite Test Specimens.** *J. W. Whittaker and W. D. Brosey* (Martin Marietta Energy Systems, Inc., U. S. A.) and *M. A. Hamstad* (University of Denver, U. S. A.)
- 12:50 LUNCH
- SESSION 7: AEROSPACE APPLICATION II**
- 180 14:20 **Determining the Reliability Increase of Rocket Motors Due to Acoustic Emission Monitoring.** *G. F. Hawkins* (The Aerospace Corporation, U. S. A.)
- 184 14:50 **Delayed Acoustic Emission: A Rheological Approach.** *N. Rochat, R. Fougères, and P. Fleischmann* (INSA, France)
- WORKS IN PROGRESS
- 194 15:10 **Acoustic Emission Conditions for Failure Prediction of Winding Carbon Structures.** *C. LeFloc'h and S. Beziers* (Aerospatiale Aquitaine Plant, France)
- 15:30 BREAK
- SESSION 8: AEROSPACE APPLICATION III**
- 200 16:00 **Proof Testing of Unidirectional GFRP Using Acoustic Emission Technique.** *J. J. Masson and D. Valentin* (Centre des Matériaux, France)
- 207 16:30 **Standard Test to Quantify the Knee in the AE vs. Load Curve as a Material Parameter for Composites.** *J. R. Mitchell* (Physical Acoustics Corp., U. S. A.)
- 218 17:00 **Acoustic Emission Studies for Precision Composite Spacecraft Structures.** *T. J. Delany* (Hartford Steam Boiler Inspection Technologies, U. S. A.)
- SESSION 9: FRACTURE MECHANICS**
- 227 17:30 **Fracture Behavior and Acoustic Emission Response of Center-Hole GFRP Laminates.** *G. Caprino and R. Teti* (University of Naples, Italy)
- 228 18:00 **Application of Acoustic Emission for Monitoring Fracture Mechanics in Composite Materials.** *Z. Burzić and M. Zrilić* (Aeronautical Institute, Yugoslavia) and *S. Sedmak and D. Mitraković* (University of Belgrade, Yugoslavia)

Thursday, July 20

**SESSION 10: SIGNAL PROCESSING,
INSTRUMENTATION**

- 230 9:00 **Pattern Recognition Analysis of Acoustic Emission Signals from Carbon Fiber/Epoxy Composites.** *K. Kawamoto* (Osaka Gas Co., Ltd., Japan) and *K. Ono* (University of California, U. S. A.)
- ✓ 240 9:25 **Acoustic Emission Signal Classification of Graphite/Polyphenylene Sulfide Composite Subjected to Mode II Fracture.** *S. V. Hoa and I. C. Smith* (Concordia University, Canada)
- 250 9:50 **Statistical Analysis of Acoustic Emission Signals Associated with Fatigue Damage in CFRP Composites.** *A. Maslouhi, C. Roy, and D. Proulx* (Université de Sherbrooke, Canada); *M. Cherfaoui* (Centre Technique des Industries Mécaniques, France); and *D. G. Zimcik* (Canadian Space Agency, Canada)
- 259 10:15 **Advanced AE Instrumentation System for Versatile and Precise Use by Waveform-Microdata Processing.** *H. Oyaizu and K. Yamaguchi* (University of Tokyo, Japan)
- ✓ 268 10:40 **Recognition on Fracture Modes and Behavior in FRP by AE Waveform-Microdata.** *K. Yamaguchi, H. Oyaizu, J. Johkaji, and Y. Kobayashi* (University of Tokyo, Japan)
- 11:00 BREAK

SESSION 11: CHARACTERIZATION

- 278 11:30 **Acoustic Analysis of the Accumulation of Cracks in CRFP Cross-Ply Laminates under Tensile Loading.** *J. P. Favre and J. C. Laizet* (ONERA, France)
- ✓ 286 12:00 **Acoustical Detection of Transverse Cracking in a Crossply Composite.** *M. R. Gorman and S. M. Ziola* (Naval Postgraduate School, U. S. A.) and *J. L. Koury* (Air Force Astronautics Laboratory, U. S. A.)
- ✓ 298 12:30 **Energy Distribution Analysis of Acoustic Emission Signals from the Tensile Testing of CFRP.** *O. Y. Kwon and D. J. Yoon* (Korea Standards Research Institute, Korea)
- 13:00 LUNCH

SESSION 12: MICROANALYSIS: INTERFACES

- 304 14:30 **Identification of the Acoustic Signals Generated by the Rupture of SiC Fibre/Metallic Matrix Composites.** *M. C. Merienne and J. P. Favre* (ONERA, France)
- 313 15:00 **Acoustic Emission: A Microinvestigation Technique for Interface Mechanisms in Fibre Composites.** *D. Rouby* (INSA de Lyon, France)
- 323 15:30 **Analysis of AE-Events from Single Fibre Pull-Out Experiments.** *W. Mielke, A. Hampe, O. Hoyer, and K. Schumacher* (Federal Institute for Materials Research and Testing, Federal Republic of Germany)

16:00 BREAK

**SESSION 13: MICROMECHANISMS:
METALMATRIX COMPOSITE**

- 332 16:30 **Work Hardening and Fiber-Breaking Induced by Plasticity in a Short Carbon Fiber Pure Aluminum Matrix Composite.** *Y. Kagawa and T. Kishi* (University of Tokyo, Japan) and *P. Fleischmann* (INSA de Lyon, France)
- 342 17:00 **Acoustic Emission Characterization of the Deformation and Fracture Process of a Metal Matrix Composite.** *O. Y. Kwon* (Korea Standards Research Institute, Korea) and *K. Ono* (University of California, U. S. A.)
- 350 17:30 **On the Measurement of Large Amplitude Acoustic Emission from 6061 Aluminum/Boron Specimens with a Center Notch.** *H. A. Scarton, G. J. Dvorak, and P. A. Van Laak* (Rensselaer Polytechnic Institute, U. S. A.) and *S. Han* (Tuskegee University, U. S. A.)

Friday, July 21

SESSION 14: INSTRUMENTATION

- 358 9:00 **Stress Wave Sensing--An Approach to Monitoring Composite Structures Using Simple Integrated Acoustic Emission Systems.** *T. J. Holroyd and N. Randall* (Stresswave Technology, Ltd., Great Britain)
- 365 9:30 **Acoustic Emission Amplitude Analysis by Logarithmic Rate Cartography.** *Y. Surrel and A. Vautrin* (E.N.S.M., France)
- 375 10:00 **An Accurate Acoustic Emission Location Method Adapted for Composite Materials.** *A. Bouheraoua* (A.M.D., France)

10:30 BREAK

SESSION 15: ACOUSTO-ULTRASONIC

- 380 11:30 **An Acousto-Ultrasonic Study on Tensile Failure of Fibre Reinforced Polypropylene Composites.** *P. K. Sengupta and D. Mukhopadhyay* (University of Calcutta, India) and *K. K. Phani and N. R. Bose* (Central Glass & Ceramic Research Institute, India)
- 386 12:00 **Combined Use of Stress Wave Factors and Acoustic Emission in Tensile Testing of CF/EP and KF/EP.** *B. Melve and T. Berge* (SINTEF, Norway)
- 392 12:30 **A Comprehensive Guide to the Literature on Acoustic Emission from Composites, Supplement II.** *T. F. Drouillard* (Rockwell International Corporation, U. S. A.)

13:00 OFFICIAL LUNCH

15:00 END OF SYMPOSIUM

Professional Program

Fourth International Symposium on Acoustic Emission From Composite Materials Seattle, WA

Keynote Addresses

- 11 “Microfracture Analysis of Ceramics and Composites by Acoustic Emission”
Professor Teruo Kishi, University of Tokyo, Japan
- “Relations between Acoustic Emission and Rheological Behavior”
Dr. Pierre Fleischmann, INSA de Lyon, France

Tuesday, July 28, 1992

Session 1 —Material Studies

- 19 *A Preliminary Investigation of the Acoustic Emission Generated During the Deformation and Fracture of Graphite-Borosilicate Glass Composites*
S. Carpenter, University of Denver, USA
- 29 *Acoustic Emission Characterization of Damage Evolution During Tensile Testing of SiC/BMAS Ceramic Composites*
I. Roman, Hebrew University, Israel; L. Zawada, Wright Laboratory, USA
- 36 *Acoustic Emission Behaviour of Advanced Stitched Composites by RTM Process under Impact Loads*
C. Caneva, N. Bonora, M. Marchetti, University of Rome, Italy; M. Mazzola, Colleferro, Rome, Italy
- 44 *Acoustic Emission Behavior during Tensile Fracture of Resin-Impregnated Strands of Pitch-Based Carbon Fiber*
A. Nanjyo, M. Mohri, Nippon Oil, Japan; K. Ono, University of California (UCLA), USA

Session 2 —Material Studies

- 55 *Acoustical Analysis of Transverse Lamina Cracking in CFRP Laminates under Tensile Loading*
I. Ohsawa, I. Kimpara, K. Kageyama, T. Suzuki, University of Tokyo, Japan
- 65 *Characterization of Fiber Failure in Graphite-Epoxy Composites*
A. Mittelman, I. Roman, Hebrew University, Israel
- Fracture Behavior Prediction of Impacted GRFP Laminates through Acoustic Emission*
T. Teti, G. Caprino, University of Naples, Italy

Session 3—Material Studies

- 71** *AE Testing of Glass/Carbon Hybrid Composites with Polypropylene, Modar, Epoxy, Vinylester and Phenolic Matrices*
B. Melve, SINTEF, Norway, A. Lemascon, CETIM, France; M. Robinson, Loughborough University, UK
Acoustic Emission from Single-Point Abrasion of Metal Matrix Composites
O. Kwon, Korea Research Institute of Standards and Science, Korea; K. Ono, University of California (UCLA), USA
- 79** *The Use of Acoustic Emission to Monitor Fatigue Damage in Short Fiber Reinforced Thermoplastics*
C. Hoppel, R. Panghorn, B. Tittmann, Pennsylvania State University, USA
- 89** *A Study on Fracture Mechanisms of Short Fiber Reinforced PET by Acoustic Emission Method (Effects of Notch Length and Fiber Content)*
M. Suzuki, S. Kida, S. Morohashi, H. Miyashita, Kanazawa Institute of Technology, Japan

Session 4—Material Studies

- 99** *Application of Acoustic Emission to the Study of Microfissure Damage to Composites used in the Aeronautic and Space Industries*
R. Perami, R. Grezes-Besset, W. Prince, Universite Paul Sabatier, France
- 109** *Interfacial Shear Properties and Acoustic Emission Behavior of Model Aluminum and Titanium Matrix Composites*
I. Roman, Hebrew University, Israel; S. Krishnamurthy, D. Miracle, Wright Laboratory, USA
- 115** *Amplitude Distribution Modelling and Ultimate Strength Prediction of ASTM D-3039 Graphite/Epoxy Tensile Specimens*
J. Walker, E. Hill, Embry-Riddle Aeronautical University, USA
Acoustic Emission during Cracking of Fibre Reinforced Composites Loaded in Mode II
L. Golaski, Kielce Technological University, Poland

Wednesday, July 29, 1992

Session 1—Structural Integrity—Concrete Applications

- 132** *Rate Process Analysis of AE Activity to Evaluate the Deterioration of Concrete by Core Tests*
K. Matsuyama, Nippon Koei, Japan; M. Ohtsu, Kumamoto University, Japan
- 139** *Discrimination of Cracking and Estimation of Cracking Width Developed in Reinforced Concrete Structures by Acoustic Emission*
T. Okamoto, H. Fujiwara, S. Kajio, Nihon Cement, Japan; S. Yuyama, Nippon Physical Acoustics, Japan
- 147** *Acoustic Emission Characteristics of Aramid FRP Bars and a FRP Reinforced Concrete Beam*
H. Chen, Z. Sami, H. Gang Rao, West Virginia University, USA
- 157** *AE Measurements on the Corrosion Detection in Reinforced Concrete Beams*
M. Ohtsu, Kumamoto University, Japan; Y. Murakami, Hazama-Gumi, Japan

Session 2—Structural Integrity Applications

- 165 *Experimental Approach of Damage Evolution in GRP Pipes by Application of the CARP Procedure for Acoustic Emission Monitoring*
M. Yrieix, C. Boveyron, EDF, France; C. Herve, M. Cherfaoui, CETIM, France;
- 175 *An Acoustic Emission Pre-Failure Warning System for Composite Structural Tests*
W. Hardrath, B. Dykes, D. Ulm, Boeing Commercial Airplane Group, USA
- 182 *Acoustic Emission Monitoring of Damage Initiation and Development in a Motor Car Part under Dynamic Load*
R. Waeber, DKI Deutsches Kunststoff-Institut, Germany
- 187 *Characterization of Failure Mechanisms in Graphite /Epoxy Tensile Test Specimens Using Acoustic Emission Data*
T. Ely, E. Hill, Embry-Riddle Aeronautical University, USA

Session 3—Structural Integrity Applications

- 200 *Commercial FRP Testing - Some Case Histories*
M. Peacock, Det Norske Veritas, USA
- 209 *The Development of a Standard Testing Procedure to Yield an Acoustic Emission vs. Strain Curve*
B. Winkler, M. Fasnacht, Temple University, USA;
J. Dombach, J. Mitchell, Physical Acoustics, USA
- 229 *Design Improvements in FRP Chemical Process Equipment Resulting from Acoustic Emission Examination*
P. Conlisk, Monsanto Company, USA

Session 4—Structural Integrity Applications

- 237 *Intensity Analysis*
T. Fowler, J. Blessing, F. Strauser, Monsanto Company, USA
- 247 *What Are We Really Hearing? - A Case Study*
J. Lawson, Independent Testing Laboratories, USA
- 257 *The Use of Acoustic Emission Testing in Fiberglass Reinforced Plastic Process Equipment*
J. Bustillos, L. Craigie, Dow Chemical, USA

Thursday, July 30, 1992

Session 1—Applications—State of Art

- The Application of the Artificial Neural Network for the Classification of Acoustic Emission Signals During CFRP Fatigue Loading*
A. Maslouhi, C. Roy, H. Kioua, Universite de Moncton, Canada
- 266 *Bench Mark Exercise on AE Measurements from Carbon Fiber - Epoxy Composites*
A. Lucia, Group for Acoustic Emission from Aeronautic Materials (EAMA), Italy
- 273 *Applying Neural Network to AE Signal Processing*
H. Chen, C. Chen, West Virginia University, USA

Pattern Recognition of AE Signals from Carbon Fiber-Epoxy Composites

G. Solomos, A. Lucia, A. Caretta, Commission of the European Communities, JRC., Italy

282 *Interpretation of Optically Detected Acoustic Emission Signals*

R. Huber, J. Wagner, Johns Hopkins University, USA; T. Fowler, Monsanto Company, USA;
T. Crump, E.I. duPont de Nemours, USA

Session 2—Applications –Works-In-Progress

292 *AE Signal Trends During Long Cycle Fatigue of FRP/Balsa Wood Core Vessels*

S. Hoa, P. Ouellette, L. Li, Concordia University, Canada

300 *Acoustic Emission Monitoring of Fracture Process of SiC/Al Composites Under Cyclic Loading*

J. Lee, J. Kim, Pusan National University, Korea; D. Yoon, O. Kwon, Korea Standards Research Institute, Korea

AE-Testing of Thermoplastic Lined Composite Process Vessels

B. Moursund, N. Morris, Norsk Hydro, Norway; B. Melve, Statiol Research Center, Norway

310 *Use of Acoustic Emission Monitoring to Characterize the Quality of Coated Paper*

P. Gradin, S. Nystrom, Swedish Institute of Materials Technology, Sweden

Session 3—Applications—Specialized

314 *Application of Pattern Recognition Techniques to Acousto-Ultrasonic Testing of Kevlar Composite Panels*

Y. Hinton, U.S. Army Laboratory Command, USA

322 *Acoustic Emission for High Temperature Monitoring of Processing of Carbon/Carbon Composite*

B. Tittmann, Pennsylvania State University, USA

331 *Monitoring the Resistance Welding of Thermoplastic Composites Through Acoustic Emission*

L. D'Antonio, C. Sabatino, Alenia, Italy; A. Ortona, J. Gillespie, University of Delaware, USA;

341 *Utilization of PVDF Sensors to Determine Impact Damage in Graphite/Epoxy Plates by Acousto-Ultrasonic Technique*

S. Hoa, I. Smith, Concordia University, Canada

Session 4—Applications—Wood

352 *Evaluation of Piezoelectric Sensor to Wood Coupling Systems*

S. Quarles, R. LeMaster, University of California at Berkeley, USA; M. Hamstad, University of Denver, USA

362 *Development of an AE On-line Inspection System for the Plywood Production Process*

K. Sato, M. Ishibashi, M. Fushitani, Tokyo University of Agriculture and Technology, Japan

370 *Use of AE in Evaluating Creep from Wood Composites*

F. Beall, University of California at Berkley, USA

377 *Monitoring Abrasive Machining Processes in Wood with Acoustic Emission*

R. LeMaster, University of California at Berkley, USA

Acoustic Emission Analyses of Bamboo Reinforced Epoxy Composites

X. Xian, Chinese Academy of Sciences, China; F. Shin, Hong Kong Polytechnic, China

Friday, July 31, 1992

Session 1—Signal Analysis

Theory of Transient Elastic Wave Propagation in a Plate and its Application to Acoustic Emission

N. Hsu, D. Eitzen, National Institute of Standards and Technology, USA

387 *Propagation Studies of AE-Sounds in Woven Carbon-Fiber/Epoxy, Aramid Fiber/Epoxy, and Glass Fiber Mat/Epoxy*

B. Melve, STATOIL, Norway; M. Hval, SINTEF, Norway

395 *Plate Wave Acoustic Emission Composite Materials*

M. Gorman, Naval Postgraduate School, USA

401 *Determination of the Elastic Properties of Composite Materials Using Simulated AE Signals*

W. Sachse, M. Veidt, L. Niu, Cornell University, USA

Session 2—Signal Analysis—Literature Review

411 *Acoustic Emission Source Location in Thin Plates Using Cross-Correlation*

S. Ziola, M. Gorman, Naval Postgraduate School, USA

418 *Propagation of Flexural Mode AE Signals in Gr/Ep Composite Plates*

W. Prosser, NASA Langley Research Center, USA; M. Gorman, Naval Postgraduate School, USA

428 *Inverse Analysis in the Two-Dimensional PMMA Model with a Slit*

M. Ohtsu, M. Shigeishi, Kumamoto University, Japan

436 *An Examination of Acoustic Emission Evaluation Criteria for Aerospace Type Fiber/Polymer Composites*

M. Hamstad, University of Denver, USA

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Dr. Pierre Fleischmann, France

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J. Lee - Korea
R. Waerber - Germany
J. Lenain - France
K. Ono - United States
T. Kishi - Japan

WEDNESDAY, JULY 12, 1995

- 129 **8.30 Keynote address “Acoustic Emission as an Aid for Investigating the Deformation and Fracture Mechanisms of Paper”**
 Prof. T. Yamauchi, Faculty of Agriculture, Kyoto University; Japan

Session 1 - Material Studies

- 9.00 The Influence of Polymers on Paper Strength Investigated by the Use of Acoustic Emission Monitoring**
 S. Forsberg and P.A. Gradin, SCA Research; Sweden
- 9.15 Investigation of Damage Development in Paper Using Acoustic Emission Monitoring**
 P.A. Gradin and S. Nyström, SISY; Sweden
- 139 **9.30 Effect of Temperature on Fracture of Spruce in Compression Using Acoustic Emissions**
 J.E. Berg and P.A. Gradin, Mid Sweden University; Sweden
- 149 **10.00 The Deterioration of Foamglas® under Compression Studied With the Acoustic Emission Technique**
 M. Wevers, D. Tsamtsakis, P. DeMeester, and E. Uria, University of Leuven; H. Strauven, Pittsburgh Corning Europe; Belgium
- 10.30 Refreshment Break**

Session 2 - Material Studies

- 160 **10.45 Acoustic Emission Behavior of Experimental Dental Resin Composite Containing Spherically Shaped Filler Particles**
 K.-H. Kim, J.H. Park, Kyungpook National University; M.Y. Choi, Korea Research Institute of Standard and Science; Korea; T. Kishi, The University of Tokyo; Japan
- 170 **11.15 Acoustic Emission Analysis of Laminate Failure Mechanisms with Reference to Failure Criteria**
 L. Golaski, Kielce University of Technology; Poland; K. Ono; University of California; USA
- 179 **11.45 Acoustic Emission from Composite Laminates With Simple Damage Characteristics**
 R. Joffe, J. Varna, and L.A. Berglund, Luleå University of Technology; Sweden
- 12.15 Lunch Break**

Session 3 - Material Studies

- 187 **13.15 Results of the Acoustic Emission Monitoring of Pre-Cure Contaminated Carbon Fibre Composite Material Tested Using the Interlaminar Shear Test**
 S.E. Mason, G.M. Hall, and K.L. Watson, University of Portsmouth; UK
- 197 **13.45 AE Pattern Recognition Analysis of the Fracture of Glass Fibre Composites Exposed to Hot-Wet Conditions**
 K. Ono, Q. Huange, and J.-Y. Wu, University of California; USA
- 205 **14.15 Acoustic Emission as a Predictor of Delamination Criticality**
 J.C. Thesken and A. Henriksson, FFA; Sweden
- 216 **14.45 Acoustic Emission as a Non-Destructive Testing Technique to Follow Up Damage Evolution in SiC Particle Reinforced Aluminum Matrix Composite**
 M. Wevers, A. Niklas, M. Surgeon, L. Froyen, and L. Delay, University of Leuven; Belgium
- 15.15 Refreshment Break**

Session 4 - Material Studies

- 227 **15.30 AE monitoring in Fatigue Tests on Al₂O₃ Reinforced Aluminium Alloy**
 A. Aiello, C. Caneva, and F. Stivali, University of Rome “La Sapienza;” C. Santulli, CCR-Euratom; Italy
- 233 **16.00 Fracture Mechanism Analysis of SiC/SiC Composites in ILSS Test by AE Spherical Radiation Pattern Method**
 Y.T. Lee, S.T. Kim, and T.S. Lee, Yeungnam University; M. Shiwa, JAPEC Research Center; T. Kishi, The University of Tokyo; Korea
- 240 **16.30 Acoustic Emission Study of Micro-Failure Mechanisms of Dual Basalt Filaments Reinforced Epoxy Composites (DFC)**
 J.-M. Park, Gyeongsang National University; J.-H. Lee, Pusan National University; Korea

THURSDAY, JULY 13, 1995

- 253 **8.30 Keynote address “Acoustic Emission Testing Trials Onboard Offshore Platforms”**
 B. Melve, Statoil; Norway

Session 1 - Structural Integrity

- 262 **9.00 Acoustic Emission Testing of a Fullscale Fighter Aircraft**
 M. Knuuttila and D. Lindahl, Saab Military Aircraft; Sweden
- 263 **9.30 Revisions to the CARP Recommended Practice for Tanks and Vessels**
 T. Fowler, The University of Texas at Austin; USA
- 273 **10.00 Techniques for Using Acoustic Emission to Produce Smart Tanks for Natural Gas Vehicles**
 J.R. Mitchell, Physical Acoustics Corp.; N. Newhouse, Brunswick Composites; USA
- 10.30 Refreshment Break

Session 2 - Structural Integrity

- 289 **10.45 Localization of Acoustic Emission at Fracture Fibre Composites**
 V.S. Krivobodrov, Research Centre “Composite;” Russia
- 293 **11.15 Fracture Mechanisms of FRPC by Means of AE Monitoring (Effects of Nozzle Diameter and Screw Design)**
 M. Suzuki, S. Kida, and M. Wakamatsu, Kanazawa Institute of Technology; Japan
- 302 **11.45 AE Monitoring During Cure Cycle of Metal/Metal (2024 T3 Alloy) Adhesive Joints for Quality Assessment**
 C. Santulli and G. Solomos, Emea, CEC Joint Research Centre; A. Calabrò, CIRA; C. Caneva, University of Rome;
 L.D. Antonio, ALENIA; Italy
- 12.15 Lunch Break (Advisory Committee Meeting)

Session 3 - Concrete Applications

- 312 **14.00 Use of Acoustic Emission to Study Fatigue Damage of Concrete**
 B. Redjel, University of Annaba; Algeria
- 322 **14.30 Effects of Silica Fume Additions on Mechanical Performances of Concrete Composites - Investigations by AE and gas permeability**
 R. Pérami, F. Bosc, and W. Prince, Université Paul Sebatier de Toulouse; France
- 15.00 Refreshment Break

Session 4 - Concrete Applications

- 332 **15.45 AE Generating Behavior under Concrete Placement and Application to Process Control**
 M. Ohtsu, Kumamoto University; Y. Murakami, Hazama Corp.; S. Yuyama, Nippon Physical Acoustics Ltd.; Japan
- 340 **16.15 Synthetic Fibre Reinforced Cement Composites A Study of Fracture Processes by the AE Method**
 I. Rudzinski and L. Golaski, Kielce University of Technology; Poland

FRIDAY, JULY 14, 1995

Session 1 - Structural Integrity

- 349 **8.30 Differences in Generation and Detection of Acoustic Emission Based on a Large Number of AE Sensors on Graphite/Epoxy Pressure Vessels**
K.S. Downs, Lockheed Martin; M.A. Hamstad, University of Denver; USA
- 359 **9.00 Acoustic Emission Measurements for Verification of Failure Computations in Stiffened Composite Panels**
I.C. Skrna-Jakl and F.G. Rammerstorfer, Vienna University of Technology; E.K. Tschegg, Inst. of Lightweight Structures; Austria
- 369 **9.30 Damage Accumulation and Acoustic Emission During Creep in Pressurized Glass Fibre Reinforced Epoxy Pipes**
R. Anderssen, P. Nygård, and B. Melve, C.G. Gustafson, Norwegian Institute of Technology; Norway
- 379 **10.00 Acoustic Emission from Defects in Adhesive Tubular Joints in Glass Fibre Epoxy Pipes**
B. Moursund, Norsk Hydro; B. Melve, Statoil; Norway
- 10.30 Refreshment Break**

Session 2 - Concrete Applications

- 385 **10.45 On the Application of the Acoustic Emission Method for the Prognosis of Hard Concrete at Early Ages**
E.G. Nesvijski, Protec International Co.; USA
- 393 **11.15 Inspection, Diagnosis, Monitoring of Reinforced Concrete Structures and Construction by the Acoustic Emission Method**
G. Muravin and L. Lezvinsky, MPD; Israel
- 403 **11.45 SiGMa Analysis of Fracture Process Zone in Notched Concrete Beams**
M. Shigeishi and M. Ohtsu, Kumamoto University; S. Yuyama, Nippon Physical Acoustics Ltd.; Japan
- 12.15 Summary and Concluding Remarks**

AECM-6 Symposium Program

MONDAY, 1 JUNE 1998

EDUCATIONAL SEMINAR

Introduction to Acoustic Emission in Composite Materials

A one-day educational seminar that will provide background information for those new to the field of acoustic emission from composites, and will summarize existing codes and standards.

Chair: Raymond Tobin, Acoustic Emission Inspection

- 8:30 a.m. **Introduction to Acoustic Emission**
 S. Ternowchek, Physical Acoustics
- 9:15 a.m. **Introduction to Composite Materials**
 R. Crawford, Crawford Troy Fiberglass
- 10 a.m. **Refreshment Break**
- 10:15 a.m. **Codes and Standards**
 T. Fowler, University of Texas at Austin
- 11 a.m. **Speaker TBA**
- 11:45 a.m. **Acoustic Emission Testing of Furan RTP**
 R. Tobin, Acoustic Emission Inspection, J. Fisher, FMC
- 12:30 p.m. **Lunch Break** (on your own)
- 1:30 p.m. **New Concepts for Acoustic Emission Detection and Measurement in Crack Growth in Noisy Environments**
 H. Dunegan, Dunegan Engineering Consultants
- 2:15 p.m. **Speaker TBA**
- 3 p.m. **Refreshment Break**
- 3:15 p.m. **Field Test Case Studies**
 J. Bustillos, Dow Chemical
- 4:45 p.m. **Acoustic Emission Inspection of Composite Pressure Vessels in the Aerospace Industry**
 M. Hamstad, University of Denver

TUESDAY, 2 JUNE 1998

CARP CODES AND PROCEDURES

Chair: Stanley Botten, Independent Testing Lab

- 8:15 a.m. **Opening Address**
 S. Botten, Independent Testing Lab
- 8:30 a.m. **John Teti Plenary Lecture: Acoustic Emission: A Mature NDT Technology with Worldwide Applications and Standards**
 S. Vahaviolos, Physical Acoustics Corporation
- 9:10 a.m. **Acoustic Emission Testing of Carbon Fiber Composite Offshore Drilling Risers 13**
 C. Barnes, G. Ramirez, University of Texas at Austin
- 9:35 a.m. **Acoustic Emission Testing of ASME Section X FRP Pressure Vessels 23**
 M. Droge, Dupont
- 10 a.m. **Refreshment Break**
- 10:15 a.m. **Recommended Practice for Acoustic Emission Evaluation of FRP Tanks and Pressure Vessels 33**
 T. Fowler, University of Texas at Austin
- 10:40 a.m. **Summary of Work in Progress: Source Location on Fiber Reinforced Composites**
 Y. Promboon, University of Texas at Austin
- 10:55 a.m. **Recommended Procedure for Determination of Design Strain Limit in FRP Specimens 34**
 P. Ziehl, T. Fowler, University of Texas at Austin
- 11:20 a.m. **Acoustic Emission for Cyclic Damage on FRP Pipes Fabricated Following RTP-1 Methods and Specifications**
 G. Ramirez, University of Texas at Austin

- 11:45 a.m. **Standard Test Method for Acoustic Emission Examination of FRP Fan Blades** 39
 T. Crump, Dupont
- 12:10-1:40 p.m. **Lunch Break** (on your own)
 International Advisory Committee Lunch (by invitation only)

RESEARCH AND DEVELOPMENT IN COMPOSITE TESTING

Chair: Thomas Crump, DuPont

- 1:40 p.m. **Acoustic Emission Source Simulation for Integrity Evaluation of UD-GRFP's with Different Filter/Matrix Interfacial Quality** 48
 K. Ono, University of California at Los Angeles
- 2:05 p.m. **Acoustic Emission Signature Analysis of Composite Materials**
 C. Barnes, University of Texas at Austin
- 2:30 p.m. **Wave Form Analysis of Acoustic Emission During Pressurization of FRP Composites**
 I. Baran, J. Schmidt, Foundry Research Institute (Poland); L. Golaski, Kielce Technical University (Poland); K. Ono, University of California at Los Angeles
- 2:55 p.m. **Evaluation of Crack Propagation in C/C Composites by Acoustic Emission Source Analysis**
 J. Koo, University of Tokyo (Japan)
- 3:20 p.m. **Refreshment Break**
- 3:40 p.m. **Use of Acoustic Emission to Evaluate Source Location and Impact Damage Severity in Composite Pipes**
 G. Ramirez, Y. Promboon, M. Engelhardt, University of Texas at Austin
- 4:30-6:30 p.m. **Tabletop Exhibits**
- 7-9 p.m. **Riverbarge Dinner Cruise** (optional-see registration form)

WEDNESDAY, 3 JUNE 1998

APPLICATIONS OF CARP TESTING

Chair: Phil Cole, Physical Acoustics Ltd. (United Kingdom)

- 8:30 a.m. **Keynote Speaker: Waveform Analysis of Acoustic Emission in Composites** 61
 William Prosser, NASA Langley Research Center
- 9:15 a.m. **Neural Network Burst Pressure Prediction in Fiberglass/Epoxy Pressure Vessels Using Acoustic Emission** 71
 E. Hill, Embry-Riddle Aeronautical University; M. Fisher, Lockheed Martin
- 9:40 a.m. **Acoustic Emission Testing – A Composite Tank Manufacturer's Experiences** 82
 J. Richter, Tankinetics
- 10:05 a.m. **Refreshment Break**
- 10:25 a.m. **Design and Acoustic Emission Testing of FRP Equipment** 87
 C. Garza, Dow Chemical
- 10:50 a.m. **Acoustic Emission Evaluation of Field Tests on FRP Materials Using the Three Way System** 97
 S. Botten, Independent Testing Lab
- 11:15 a.m. **Acoustic Emission of Large Scale Composite Aerospace Structures** 108
 P. Cole, Physical Acoustics Ltd (United Kingdom)
- 11:40 **Proof Testing of an FRP Pipe Joint**
 M. Peacock, Matrix Inspection & Engineering
- 12:05-1:35 p.m. **Lunch Break** (on your own)

ACOUSTIC EMISSION DEVELOPMENT IN APPLICATIONS

Chair: Martin Peacock, Matrix Inspection & Engineering

- 1:35 p.m. **Acoustic Emission Monitoring During Thermal Cycling of Metal Matrix Composites**
 C. Caneva, University of Rome (Italy)

2:00 p.m.	Investigation of Plastic Deformation and Fracture of Porous Metals on the Basis of Acoustic Emission Method V. Polyakov, A. Egorav, I. Svistun, S. Shapovalov, Altay State University (Russia)	
2:25 p.m.	Fracture Mode Classification in Locally Loaded Cross-Ply CFRP Coupons using Wavelet Transform	114
	Y. Mizutani, K. Nagashima, M. Takemoto, Aoyama Gakuin University (Japan); K. Ono, University of California at Los Angeles	
2:50 p.m.	Acoustic Emission Signature Analysis in 4-D Image	124
	E. Nesvijski, Universidade de Santa Maria (Brazil)	
3:15 p.m.	Refreshment Break	
3:40 p.m.	Acoustic Emission Testing of RTP-1 Demonstration Vessel E. Ternowchek, Physical Acoustics	
4:05-4:30 p.m.	Acoustic Emission Testing of GRP Composites Progressively Damaged by Fatigue and Environmental Exposure	231
	J. Hale, G. Kotsikos, University of Newcastle upon Tyne (United Kingdom)	
6:30-10 p.m.	Institute of Texan Cultures Symposium Awards Banquet (optional-see registration form)	

THURSDAY, 4 JUNE 1998

ACOUSTIC EMISSION IN CONCRETE APPLICATIONS

Chair: Stanley Botten, Independent Testing Lab

8:30 a.m.	Keynote Speaker: Quantitative Evaluation of Crack and Damage in Concrete by Acoustic Emission	135
	M. Ohtsu, Kumamoto University (Japan)	
9:10 a.m.	Acoustic Emission Application for Diagnosis of Deteriorated Concrete of Harbor Structures	145
	A. Ishibashi, K. Matsuyama, Nippon Koei Ltd (Japan)	
9:35 a.m.	Acoustic Emission Application for Detecting Steel Corrosion in Reinforced Concrete P. Berkowitz, A. Unal, T. Fowler, J. Jirsa, University of Texas	
10 a.m.	Crack Extension in Concrete by SiGMA	153
	M. Munwam, M. Ohtsu, Kumamoto University (Japan)	
10:25 a.m.	Refreshment Break	
10:45 a.m.	Acoustic Emission Characteristics of Full-Scale Concrete-Piles Under Bending and Shear Load	163
	T. Shiotani, Tobishima (Japan)	
11:10 a.m.	Bedrock Observation by Captured Acoustic Emission	173
	T. Shiotani, Tobishima (Japan); K. Monma, Public Works Research Institute (Japan)	
11:35 a.m.	Acoustic Emission Monitoring of Reinforced Concrete Structures	183
	C. Barnes, University of Texas at Austin	
Noon-1:30 p.m.	Lunch Break (on your own)	
1:30 p.m.	Acoustic Emission Monitoring of Prestressed Concrete Girders	192
	T. Fowler, University of Texas at Austin; L. Yopez, Universidad Catolica de Guayaquil (Ecuador)	
1:55 p.m.	Evaluation Criteria for Acoustic Emission Examination of Reinforced Concrete Structures	201
	M. Ohtsu, Kumamoto University (Japan); S. Yuyama, Nippon Physical Acoustics (Japan); T. Okamoto, Nihon Cement (Japan); T. Kishi, The University of Tokyo (Japan)	
2:20 p.m.	Acoustic Emission Testing of Furan RTP R. Tobin, Acoustic Emission Inspection	
2:45 p.m.	Property Evaluation of Thermal-Sprayed Metallic Coatings for Acoustic Emission Analysis	211
	A. Ishida, M. Takemoto, Aoyama Gakuin University (Japan); K. Ono, University of California at Los Angeles	
3:10 p.m.	Sources of Acoustic Emissions in Heterogeneous Materials and Cracking Processes	221
	W. Prince, R. Perami, Universite P Sabatier de Toulouse (France)	
3:35 p.m.	Refreshment Break	
3:55-4:30 p.m.	Panel Session: Discussion on CARP subjects	
6:30- 7:30 p.m.	After-Hours Tour of the Alamo (one ticket included in registration fee, advance registration required)	