AECM–5

Fifth International Symposium on Acoustic Emission From Composite Material

July 10-14, 1995
Sundsvall’s KonferensCenter, Hotel Sundsvall
Sundsvall, Sweden

Sponsored by:

- Committee on Acoustic Emission from Reinforced Plastics (CARP)
- The American Society for Nondestructive Testing (ASNT)
- Sundsvall’s Material Days and regional sponsors
Symposium Organising Committee

Chairman:
Paul Howgate
AECM Organising Committee, Sweden
+ 46 60 17 48 30 (phone)
+ 46 60 17 51 40 (fax)

Programme and Papers Chairman:
Dr. Bjorn Melve
Statoil, Norway
+ 47 73 96 72 86 (fax)

CARP Chairman:
Prof. Marvin A. Hamstad
University of Denver, USA
+ 1 303 871-4450 (fax)

Publicity Chairman:
Prof. Per A. Gradin
AECM-5 Organising Committee, Sweden
+ 46 60 17 51 40 (fax)

Pre-Symposium Educational Seminar Chairman:
Dr. Adrian A. Pollock
Physical Acoustics Corporation, USA
+ 1 609 895-9726 (fax)

ASNT Conference Coordinator:
Ms. Tina O’Donnell
ASNT, USA
+ 1 614 274-6003 (phone)
+ 1 614 274-6899

Keynote Speakers:
Dr. Tatsuo Yamauchi
Kyoto University, Japan
+ 81 75-753-6300 (fax)

and, Dr. Bjorn Melve
Statoil, Norway
+47 73 96 72 86 (fax)

Papers Committee:
T. Fowler, USA
J.C. Lenain, France
B. Melve, Norway
B. Moursund, Norway
P.A Gradin, Sweden
T. Kishi, Japan
J. Summerscales, UK
A.T. Marquez, Portugal

International Advisory Committee:
Claudio Caneva, Italy
Philip Cole, UK
Suong V. Hoa, Canada
Oh Yang Kwon, Korea
Kanji Ono, USA
Itzhak Roman, Israel
Roy Wäber, Germany
J.C. Lenain, France
Per A Gradin, Sweden
Bjorn Melve, Norway
Ryszard Pyrz, Denmark
Teruo Kishi, Japan
**Session 1 - Material Studies**

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.45</td>
<td>High Sensor Density Acoustic Emission Monitoring of Graphite/ Epoxy Pressure Vessels</td>
<td>K.S. Downs, Lockheed Martin; M.A. Hamstad, University of Denver; USA</td>
</tr>
<tr>
<td>9.15</td>
<td>Acoustic Analysis of Delamination Propagation in CFRP Cross-Ply Laminates under Static and Cyclic Loadings</td>
<td>F. Lachaude, L. Michel, B. Lorrain, and R. Barriol, Ecole Nationale Supérieure d'Ingénieurs de Construtions Aéronautiques; France</td>
</tr>
<tr>
<td>9.45</td>
<td>Acoustic Emission to Monitor Crack Accumulation in Cross-Ply CFRP in Conditions of Mechanical Loading or Thermal Cycling</td>
<td>J.-P. Favre and C. Raud, Onera Dept. of Materials; France</td>
</tr>
</tbody>
</table>

10.15 Refreshment Break

**Session 2 - Material Studies**

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.30</td>
<td>Multiple Cracking in Composite Laminates Characterised by Acoustic Emission, Microstructure and Mechanical Response</td>
<td>S. Andersen and H. Lilholt, Riso National Laboratory; Denmark</td>
</tr>
<tr>
<td>11.00</td>
<td>AE and AU Monitoring of Degradation in Composites Due to High Temperature Exposure and Mechanical Loading</td>
<td>S. Béland, Institute for Aerospace Research; A. Maslouhi and H. Saadoui, Université de Moncton; C. Roy, Université de Sherbrooke; Canada</td>
</tr>
<tr>
<td>11.30</td>
<td>A New Approach to Modelling and Analysis for Uncertainty in Acoustic Emission Testing of Composites – Part I</td>
<td>R. Ganesan and S. V. Hoa, Concordia University; Canada</td>
</tr>
<tr>
<td>11.30</td>
<td>Acoustic Emission Characteristics of GFRP Composites as a Function of the Interface Quality and Its Aging</td>
<td>P. Krawczak and J. Pabiot, Ecole des Mines de Douai; France</td>
</tr>
</tbody>
</table>

12.30 Lunch Break

**Session 3 - Material Studies**

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.30</td>
<td>Acoustic Emission and Residual Strength in Fatigue Loaded Notched Carbon/Epoxy Composites</td>
<td>A. Henriksson and J.C. Thesken, FFA; Sweden</td>
</tr>
<tr>
<td>14.30</td>
<td>Two Parameter Description of the AE-Rate Behavior of Glass-Fibre Reinforced Epoxy and Polyester under Static Tensile Loading</td>
<td>A. J. Brunner, R. Nordstrom, and P. Flüeler, EMPA Swiss Federal Laboratories for Materials Testing and Research, Switzerland</td>
</tr>
</tbody>
</table>

15.00 Refreshment break

**Session 4 - Material Studies**

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.15</td>
<td>On Use of Piezoelectric Polymers as Wideband Acoustic Emission Displacement Sensors for Composites</td>
<td>M. Hamstad, University of Denver; USA</td>
</tr>
<tr>
<td>16.30</td>
<td>Mechanical Properties and Acoustic Emission of Al-Fe Matrix Composites</td>
<td>I. Roman and F. Zeides, The Hebrew University of Jerusalem, Israel, G. Stamek, M. Peters and W. A. Kaysser, DLR; Germany</td>
</tr>
</tbody>
</table>
WEDNESDAY, JULY 12, 1995

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

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

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. Strausven, Pittsburgh Corning
Europe; Belgium

10.30 Refreshment Break

Session 2 - Material Studies

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

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

11.45 Acoustic Emission from Composite Laminates With Simple Damage Characteristics
R. Joffe, J. Varna, and L.A. Berglund, Luleä University of Technology; Sweden

12.15 Lunch Break

Session 3 - Material Studies

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

13.45 AE Pattern Recognition Analysis of the Fracture of Glass Fibre Composites Exposed to Hot-Wet Conditions
K. Ono, Q. Huang, and J.-Y. Wu, University of California, USA

14.15 Acoustic Emission as a Predictor of Delamination Criticality
J.C. Thesken and A. Henriksson, FFA; Sweden

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

15.30 AE monitoring in Fatigue Tests on Al₂O₃ Reinforced Aluminium Alloy
A. Aiello, C. Caneva, and F. Stivalli, University of Rome “La Sapienza,” C. Santulli, CCR-Euratom; Italy

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

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

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

9.00 Acoustic Emission Measurements for Verification of Failure Computations in Stiffened Composite Panels
I.C. Skrana-Jakl and F.G. Rammerstorfer, Vienna University of Technology; E.K. Tschegg, Inst. of Lightweight Structures; Austria

9.30 Damage Accumulation and Acoustic Emission During Creep in Pressurized Glass Fibre Reinforced Epoxy Pipes
R. Anderssen, P. Nygard, and B. Melve, C.G. Gustafson, Norwegian Institute of Technology, Norway

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

10.45 On the Application of the Acoustic Emission Method for the Prognosis of Hard Concrete at Early Ages
E.G. Nesvijski, Protecs International Co., USA

11.15 Inspection, Diagnosis, Monitoring of Reinforced Concrete Structures and Construction by the Acoustic Emission Method
G. Muravin and L. Lezvinsky, MPD; Israel

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