Impacts of Fuel Quality on Power Production

October 26 –31, 2014

Snowbird Resort & Conference Center
Snowbird, Utah

Conference Chairman:
N. S. Harding
N. S. Harding & Associates, USA

Conference Co-Chairs:

F. J. Frandsen
Technical University of Denmark, Denmark

R. Gupta
University of Alberta, Canada

M. Hupa
Abo Akademi University, Finland

J. Maier
University of Stuttgart, Germany

C. Mueller
Clyde Bergemann, Germany

Y. Ninomiya
Chubu University, Japan

D. A. Tillman
Consultant, USA

T. F. Wall
University of Newcastle, Australia

F. Wigley
Imperial College, UK

F. Winter
Vienna University of Technology, Austria
Conference Sponsors:

University of Newcastle (Australia)

Engineering Consultants Group (USA)

Clyde Bergemann (Germany)

Imerys (USA)

Electric Power Research Institute (USA)

N. S. Harding & Associates (USA)
Sunday, October 26, 2014

16:00 – 18:45  Conference Registration  GOLDEN CLIFF ENTRANCE
19:00 – 21:00  Opening Reception  GOLDEN CLIFF ROOM

Monday, October 27, 2014

07:00 – 08:00  Breakfast Buffet  MAGPIE ROOM
08:00 – 08:10  Welcome – Stan Harding, N. S. Harding & Associates  BALLROOM 1

SESSION 1: Fuel Preparation and Additives
Session Chair:

08:10 – 08:40  Grinding and Combustion Characteristics of Low HGI Bituminous Coal
M. Ikeda, A. Yamamoto, A. Nakajima, T. Ishikawa, and H. Shirai
Central Research Institute of Electric Power Industry, JAPAN

08:40 – 09:10  Improving Coal Quality for Power Production Using Electronic Sorting Technology
M. Kiser and G. Luttrell
Virginia Technical University, USA
C. Roos
Mineral Separations Technology, USA

09:10 – 09:40  Powder Characteristics of Torrefied and Pelletized Biomass
M. Strandberg, K. Kollberg, and A. Nordin
Umeå University, SWEDEN

09:40 – 10:10  Evaluation of Advanced Coal Cleaning Processes for Near Zero Emissions
N. S. Harding
N. S. Harding & Associates, USA
J. Sanchez
Electric Power Research Institute, USA

10:10 – 10:30  Coffee Break  BALLROOM 1 LOBBY

10:30 – 11:00  Mitigating Alkali Related Slagging and Fouling and Corrosion Problems in Utility Boilers with Engineered Combustion Additives
T. Landon, M. Perronnet, D. Osby and A. Campen
Imerys, USA

11:00 – 11:30  Waste Gypsum Board as a Fuel Additive in Combustion of Grass and Waste Derived Fuel – Bench- and Full-scale Studies
P. Piotrowska, A. Rebbling, and D. Boström
Umeå University, SWEDEN
I.-L. Nätzelius, A. Grimm, and M. Öhman
Luleå University of Technology, SWEDEN

11:30 – 12:00  Dry Additive Desulphurization Performance of Central European Lignite in a BFBC
J. Hrdlička, P. Skopec, L. Pilař, T. Dlouhý, and F. Hrdlička
Czech Technical University in Prague, CZECH REPUBLIC
**Full-scale Study on Application of Halloysite Additive in a Hybrid Installation Co-firing High Shares of Agricultural Biomass with Pulverized Coal**
S. Kalisz, K. Mroczek, S. Ciukaj and M. Pronobis  
*Silesian University of Technology, POLAND*

12:30 – 14:00  **Lunch**  
*MAGPIE ROOM*

14:00 – 18:00  **Poster Session**  
*BALLROOM 1*

*The character and sulfation behavior of oxy-fuel fired fly ash*
*University of Newcastle, AUSTRALIA*  
R. Spörl  
*University of Stuttgart, GERMANY*

*Effect of inorganic particulates on the condensation behavior of heavy metal vapors upon flue gas cooling*
Y. Meng, J. Chen, T. Namioka, N. Yamada, and Y. Ninomiya  
*Chubu University, JAPAN*

*Estimating the Performance of New Fuels and Fuel Blends in Utility Boilers*
N. S. Harding and S. A. Cooper  
*N. S. Harding & Associates, USA*

*Ash as a Resource for Construction Materials and Soil Conditioning*
F. J. Frandsen, A. J. Damoe, H. Hougaard-Nielsen, V. Hansen, D. S. Müller-Stöver  
*Technical University of Denmark, DENMARK*

*Fate of Inorganic Species during Biomass Devolatilization in a Drop Tube Furnace*
D. R. Wagner, P. Holmgren, A. Persson, D. Boström, and M. Broström  
*Umeå University, SWEDEN*  
R. Molinder and H. Wiinikka  
*Energy Technology Centre, SWEDEN*

*Investigating Corrosion Memory – The influence of historic boiler operation on current corrosion rate*
M.D. Paz, D. Zhao, S. Karlsson, J. Liske and T. Jo  
*Chalmers University of Technology, SWEDEN*

*Validation of reacting flow models via tunable diode laser absorption spectroscopy*
D. R. Wagner, Z. Qu, M. Broström, and F. M. Schmidt  
*Umeå University, SWEDEN*

*Ash Melting, Mineralogy and Deposition Characteristics of Three Indonesian Coals*
S. Gupta and T. Wall  
*University of Newcastle, AUSTRALIA*  
*Pusan National University, KOREA*  
D. French  
*CSIRO, AUSTRALIA*
Modeling of a Furnace Slagging Using Available Data and its Improvement
A. Alekhnovich
ZAO The Ural Heat Engineering Laboratory, RUSSIA
M. Yu. Chernetskiy and A. A. Dekterev
Russian Academy of Sciences and Siberian Federal University, RUSSIA

Coal Combustion
R. Hatt
Coal Combustion Inc., USA

Slag Formation
R. Hatt
Coal Combustion Inc., USA

18:00 – 19:00 Dinner MAGPIE ROOM

Monday, October 27, 2014 (Continued)

SESSION 2: Corrosion BALLROOM 1
Session Chair:

19:00 – 19:30 Down-time Corrosion in Boilers
F. Jones, D. Ryde, and A. Hjörnhede
SP Technical Research Institute of Sweden, SWEDEN

19:30 – 20:00 Development of Thermal Spraying Materials through Several Corrosion Tests for heat-exchanged Tubes of Incinerators
J. Chen and Y. Ninomiya
Chubu University, JAPAN
H. Naganuma and Y. Sasaki
Tohoku Electric Power Engineering & Construction, Co., Ltd., JAPAN
M. Noguchi and H. Cho
Ebara Environmental Plant Co., Ltd., JAPAN
Y. Ueki, R. Yoshiiie, and I. Naruse
Nagoya University, JAPAN

20:00 – 20:30 Real-time Corrosion Monitoring during Co-firing of Accordant Energy’s ReEngineered Feedstock
J. Beutler, K. Davis, and T. Shurtz
Reaction Engineering International, USA
D. Bai and R. Jafari
Accordant Energy LLC, USA
W. Cox
Corrosion Management Ltd., UK

20:30 – 21:00 Improvement of the Accuracy of Short-term Corrosion Probe Measurements by Addition of a Mass-loss Probe
S. Retschitzegger
BIOENERGY 2020+ GmbH, AUSTRIA
T. Brunner and I. Obernberger
BIOS BIOENERGIESYSTEME GmbH and Graz University, AUSTRIA
Tuesday, October 28, 2014

07:00 – 08:00  Breakfast Buffet  MAGPIE ROOM

08:00 – 08:05  Welcome – Stan Harding, N. S. Harding & Associates  BALLROOM 1

08:05 – 08:35  **Energy Trends – Recent and Future Fuel Related Challenges**  
S. Enestam, P. Bjorklund, N. Engblom, M. Hamaguchi, M. Rautanen, and H. Wallmo  
*Valmet Power Oy*, FINLAND

**SESSION 3: Deposition & Blending Issues – Full-scale**  
Session Chair:

08:35 – 09:05  **Optimisation of Process Analysis and Adjustment of the Cleaning Strategy for a Modern Coal-fired Power Plant**  
N. Heißen, M. Schumacher, B. Patel, and C. Mueller  
*Clyde Bergemann GmbH*, GERMANY

09:05 – 09:35  **Speciation of Iron and Separation of Magnetite from Ash Deposits Collected from the Combustion of Lignite Mixed with Silica Additive**  
L. Zhang, B. Dai, and A. DeGirolamo  
*Monash University*, AUSTRALIA  
X. Wu  
*Shanghai Boiler Works Co. Ltd.*, CHINA

09:35 – 10:05  **Investigation of Iron-rich Initial Layer Deposits at the Inlet of the Superheater Level in a Large Pulverized Fuel Power Plant**  
S. Babat, R. Sporl, J. Maier, and G. Scheffknecht  
*Institute of Combustion and Power Plant Technology*, GERMANY

10:05 – 10:30  Coffee Break  BALLROOM 1 LOBBY

10:30 – 11:00  **Role of Potassium in Deposit Formation during Wood Pellet Combustion**  
M. Paneru, S. Babat, J. Maier and G. Scheffknecht  
*Institute of Combustion and Power Plant Technology*, GERMANY

11:00 – 11:30  **Full-scale Co-combustion of Municipal Sewage Sludge and Demolition Wood Chips in a Combined Heat and Power Plant**  
N. Skoglund  
*Umeå University*, SWEDEN  
L. Bäfver and C. Renström  
*Pöyry Swedpower AB*, SWEDEN  
J. Fahlström  
*Ragn-Sells Miljöksult AB*, SWEDEN  
E. Holmén  
*ENA Energy AB*, SWEDEN

11:30 – 12:00  **Predicting Coal Blend Performance and Ash Deposition Characteristics for Plant Suitability**  
R. Watkins  
*FirstEnergy Corp.*, USA
Program

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12:00 – 12:30  **An On-site Fuels Management System; AccuTrack Application at Conemaugh Station**
A. Garaventa
NRG Energy – Conemaugh Station, USA
M. Santucci
Engineering Consultants Group, USA

12:30 – 14:00  Lunch

14:00 – 18:00  **Poster Session Available**

15:00 – 18:00  **Visit to University of Utah Combustion Facilities**  Meet by BALLROOM 1

18:00 – 19:00  Dinner

**Tuesday, October 28, 2014 (Continued)**

**SESSION 3: Deposition & Blending Issues – Full Scale (Con’t.)**  BALLROOM 1
Session Chair:

19:00 – 19:30  **Selecting a Fuel Blend for Scrubbed Units at Monroe Power Station**
D. A. Tillman
Fuels and Combustion Consultant, USA
A. Dobrzanski
DTE Energy, USA

19:30 – 20:00  **Firing Petroleum Coke/PRB Blends in a Modern Power Plant**
A. Dobrzanski
DTE Energy, USA
D. A. Tillman
Fuels and Combustion Consultant, USA

20:00 – 20:30  **Full-scale Torrified Wood Testing at Southern Company**
D. O’Connor
Electric Power Research Institute, USA
D. Boylan
Southern Company, USA

20:30 – 21:00  **Ash Formation and Partitioning in a Cyclone Fired Boiler**
S. A. Benson, S. Patwardhan, and A. Ruud
Microbeam Technologies, USA
A Freidt
Minnkota Power Coop., USA
J. Houn
BNI Coal Ltd., USA
Wednesday, October 29, 2014

07:00 – 08:00  Breakfast Buffet  MAGPIE ROOM

08:00 – 08:05  **Welcome** – Stan Harding, N. S. Harding & Associates  BALLROOM 1

08:05 – 08:35  **High-Quality Fuel and Ash Databases: How BRISK is Pushing toward a Standard of Fuel Data Storage**  
F. J. Frandsen  
*Technical University of Denmark, DENMARK*  
M. Zevenhoven  
*Åbo Akademi Process Chemistry Centre, FINLAND*  
R. Visser  
*ECN Biomass, THE NETHERLANDS*

**SESSION 4: Oxy-fuel Firing**

**Session Chair:**

08:35 – 09:05  **Predicting Deposit Build-up in Oxy-fuel and Air-fired Pulverized Coal Combustion**  
A Brink, D. Lindberg, and M. Hupa  
*Åbo Akademi University, FINLAND*  
M. Escoto de Tejada, M. Paneru, J. Maier, and G. Scheffknecht  
*University of Stuttgart, GERMANY*  
A. Pranzitelli and M. Pourkashanian  
*University of Leeds, UK*

09:05 – 09:35  **High Pressure Conversion of NOx and Hg and Their Capture as Aqueous Condensates in Oxy-fuel CO2 Compression**  
R. Stanger, T. Ting, and T. Wall  
*University of Newcastle, AUSTRALIA*

09:35 – 10:05  **Char Gasification and Na Evaporation during Oxy-fuel Combustion: Experiment and CFD Modeling**  
A DeGirolamo, J. Zhang, F. Low, M. Woo, and L. Zhang  
*Monash University, AUSTRALIA*

10:05 – 10:30  Coffee Break  BALLROOM 1 LOBBY

10:30 – 11:00  **Fly Ash and Deposit Transformations in Air and Oxy-fuel Combustion**  
R. Sporl, M. Paneru, S. Babat, G. Stein-Brzozowska, S. Ott, J. Maier, and G. Scheffknecht  
*Institute of Combustion and Power Plant Technology, GERMANY*

11:00 – 11:30  **Ash Formation in Oxy-fuel Combustion with Various Flue Gas Recycle Options**  
Z. Zhan, A. Fry, D. Yu, M. Xu, and J. O. L. Wendt  
*University of Utah, USA*

11:30 – 12:00  **Oxy-coal Power Boiler Simulation and Validation Through Extreme Computing**  
P. Smith, J. Thornock, Y. Wu, S. Smith, and B. Isaac  
*University of Utah, USA*  
P. Chapman, D. Sloan, D. Turek, Y-M. Chen, and A. Levasseur  
*Alstom Power, USA*
<table>
<thead>
<tr>
<th>Time</th>
<th>Session Title</th>
<th>Speaker(s)</th>
<th>Institution(s)</th>
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<tbody>
<tr>
<td>12:00 – 12:30</td>
<td><strong>Co-combustion of Coal and Biomass in O₂/CO₂-atmosphere</strong></td>
<td>S. Brinker and R. Weber</td>
<td><em>Clausthal University of Technology, GERMANY</em></td>
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<tr>
<td>12:30 – 13:15</td>
<td>Lunch</td>
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<td><strong>MAGPIE ROOM</strong></td>
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<td>13:15 – 13:45</td>
<td><strong>Session 5: Emissions</strong></td>
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<td><strong>BALLROOM 1</strong></td>
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<td>R. Spörli and J. Maier</td>
<td><em>University of Stuttgart, GERMANY</em></td>
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<td>13:45 – 14:15</td>
<td><strong>Real-time In-Situ Detection of Potassium Release during Combustion of Pelletized Biomass using Tunable Diode Laser Absorption Spectroscopy</strong></td>
<td>Z. Qu, J. Fagerström, E. Steinvall, M. Broström, C. Boman, and F. M. Schmidt</td>
<td><em>Umeå University, SWEDEN</em></td>
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<tr>
<td>14:15 – 14:45</td>
<td><strong>Behavior of Cu and the Production of PCDD/F in a Multi-fuel Fired BFB Boiler</strong></td>
<td>C. J. E. Bajamundi and P. Vainikka</td>
<td><em>VTT Technical Research Centre and University of Jyvaskyl, FINLAND</em></td>
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<td>M. Hedman and J. SilvennoinenENG</td>
<td><em>Valmet Power Oy, FINLAND</em></td>
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<td>T. HeinanEN</td>
<td><em>Stora Enso Newsprint and Book Paper, FINLAND</em></td>
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<td>J. Konttinen</td>
<td><em>Tampere University of Technology, FINLAND</em></td>
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<td>14:45 – 15:15</td>
<td><strong>Effect of Temperature on the Formation of Submicron Particles (PM₁) during Combustion of a Zhundong Coal</strong></td>
<td>X. Zeng, B. Fan, D. Yu, and M. Xu</td>
<td><em>Huazhong University of Science and Technology, CHINA</em></td>
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<tr>
<td>16:00 – 18:00</td>
<td>Conference Activity – Wear warm clothes!</td>
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<td><strong>MAGPIE ROOM</strong></td>
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<td>19:00 – 21:00</td>
<td>Conference Dinner</td>
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<td><strong>MAGPIE ROOM</strong></td>
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**Fuel Quality Impacts – The First 50 Years**

T. F. Wall
*University of Newcastle, AUSTRALIA*
N. S. Harding
*N. S. Harding & Associates, USA*
F. J. Frandsen
*Technical University of Denmark, DENMARK*
Thursday, October 30, 2014

07:00 – 08:00  Breakfast Buffet  MAGPIE ROOM

08:00 – 08:05  Welcome – Stan Harding, N. S. Harding & Associates  BALLROOM 1

SESSION 6: Deposition & Blending Issues – Pilot-scale  Session Chair:

08:05 – 08:35  Characteristic and Mechanism of Agglomeration Processes in a Fluidized Bed Reactor  
R. Michel, J. Kaknics, E. de Bilbao, and J. Poirier
CNRS, FRANCE

08:35 – 09:05  Investigation of Corrosion and Fouling in Syngas Cooler Tubes  
B. Wang, V. Kurian, N. Mahapatra, F. Martens, and R. Gupta
University of Alberta, CANADA

09:05 – 09:35  Residual Ash Formation during Suspension-firing of Biomass. Effects of Residence Time and Fuel Type  
A. J. Damoe, F. J. Frandsen, P. A. Jensen, H. Wu, and P. Glarborg
Technical University of Denmark, DENMARK

J. Fagerstrom, A. Rebbling, E. Steinvall, D. Boström, and C. Boman
Umeå University, SWEDEN
J. Olwa and M. Öhman
Luleå University of Technology, SWEDEN

10:05 – 10:30  Coffee Break  BALLROOM 1 LOBBY

10:30 – 11:00  Characterization of Thermochemical Fuel Properties of Microalgae and Cyanobacteria  
K. Werner, P. Piotrowska, C. Boman, and D. Boström
Umeå University, SWEDEN
F. Gentili and M. Holmlund
Swedish University of Agricultural Sciences, SWEDEN

11:00 – 11:30  CO-KCl-SO2 Interactions in an 80 kW Propane-fired Flame  
T. Ekvall, K. Andersson, and F. Johnsson
Chalmers University of Technology, SWEDEN

11:30 – 12:00  Agglomeration Tendencies of Algae and Wood Mixtures in Fluidized Bed Incineration  
C. Sevonius, P. Yrjas, and M. Hupa
Åbo Akademi University, FINLAND
P. Piotrowska and D. Bostrom
Umeå University, SWEDEN
### Program Impacts of Fuel Quality on Power Production

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<tr>
<td>12:00 – 12:30</td>
<td>Co-firing of Pulverized Coal with Pinion Pine/Juniper Wood in Raw, Torrefied and Pyrolyzed Forms</td>
<td>MAGPIE ROOM</td>
</tr>
</tbody>
</table>
| E. Eddings and R. Okerlund  
*University of Utah, USA*  
D. Hanks  
*Utah State University, USA*  
R. Coates  
*Amaron Energy, USA*  
S. Bell  
*U. S. Forest Service, USA* | | |
| 12:30 – 14:00 | Lunch                                                                 | MAGPIE ROOM       |
| 14:00 – 18:00 | Poster Session Available                                               | BALLROOM 1        |
| 18:00 – 19:00 | Dinner                                                                | MAGPIE ROOM       |

**Thursday, October 30, 2014**

**SESSION 7: Fundamental Studies**  
**Session Chair:**

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<tr>
<td>19:00 – 19:30</td>
<td>Inorganic Phase Transformation of Miscanthus Ashes in Fluidized Bed Reactors</td>
<td>BALLROOM 1</td>
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</tbody>
</table>
| J. Kaknics, R. Michel, and J. Poirier  
*CNRS, FRANCE* | | |
| 19:30 – 20:00 | Coal Ash Particle Deposition Modelling: A Closer Look at Various CFD Submodels | BALLROOM 1        |
| A M. Beckmann, M. Mancini, and R. Weber  
*Clausthal University of Technology, GERMANY* | | |
| 20:00 – 20:30 | Size, Shape and Density Changes of Biomass Particles during Devolatilization in a Drop Tube Furnace | BALLROOM 1        |
| P. Holmgren, A. Persson, D. R. Wagner, and M. Broström  
*Umeå University, SWEDEN*  
K. Umeki  
*Luleå University of Technology, SWEDEN*  
R. Molinder and H. Wiinikka  
*Energy Technology Centre, SWEDEN* | | |
| 20:30 – 21:00 | The effect of particle size, temperature, and residence time on biomass devolatilization behavior in a wire-mesh reactor | BALLROOM 1        |
| D. R. Wagner and M. Broström  
*Umeå University, SWEDEN* | | |
Friday, October 31, 2006

07:00 – 08:00  Breakfast Buffet  
MAGPIE ROOM

08:00 – 08:05  Welcome – Stan Harding, N. S. Harding & Associates  
BALLROOM 1

SESSION 7: Fundamental Studies (Con’t.)  
Session Chair:

08:05 – 08:35  The Prediction of Particle Size Distribution during Pulverized Fuel Combustion Using SEM and CFD Methods and Its Impact on Ash Deposition Rates  
U. Kleinhans and C. Wieland  
Technische Universität München, GERMANY  
H. Spiethoff  
Technische Universität München and Bavarian Center for Applied Energy Research, GERMANY

08:35 – 09:05  Slag Formation during Pressurized Entrained-flow Gasification of Woody Biomass: A Thermochemical Equilibrium Study  
C. Ma and M. Öhman  
Luleå University of Technology, SWEDEN  
M. Carlborg and R. Backman  
Umeå University, SWEDEN

09:05 – 09:35  Reactions Between Ash Forming Elements and Two Mullite Based Refractories in Entrained Flow Gasification of Wood  
M. Carlborg, D. Boström and R. Backman  
Umeå University, SWEDEN  
M. Öhman  
Luleå University of Technology, SWEDEN

09:30 – 10:05  Influence of Biomass Particle Properties and Pyrolysis Conditions on Char Reactivity  
A Strandberg, D. R. Wagner, P. Holmgren, and M. Broström  
Umeå University, SWEDEN  
R. Molinder and H. Wiinikka  
Energy Technology Centre, SWEDEN  
K. Umeki  
Luleå University of Technology, SWEDEN

10:05 – 10:30  Coffee Break  
BALLROOM 1 LOBBY

10:30 – 11:00  Ash Melting Behavior during the Combustion of Chinese Xinjiang High-Alkali Coal Blended with Low-Alkali Coal  
X. Wu, B. Dai, L. Zhang, and X. Xu  
Monash University, AUSTRALIA  
X. Xu and J. Zhang  
Shanghai Boiler Works Co Ltd, CHINA

11:00 – 11:30  Changes in Composition of Superheater Deposits due to Temperature Gradients  
D. Lindberg, J. Niemi, M. Engblom, P. Yrjas, T. Laurén, and M. Hupa  
Åbo Akademi University, FINLAND
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<tr>
<td>11:30 – 12:00</td>
<td><strong>Independent Effects of Surface and Gas Temperature on Coal Flyash Deposition in Gas Turbines at Temperatures up to 1400°C</strong></td>
<td>R. Laycock and T. H. Fletcher</td>
<td>Brigham Young University, USA</td>
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<td>12:00 – 12:30</td>
<td><strong>Characterization of Mineral Matter Particles in Coal Combustion and Biomass and RDF Co-firing</strong></td>
<td>C. Thiel and M. Beckmann</td>
<td>Technische Universität Dresden, GERMANY</td>
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<td>W. Spiegel</td>
<td>CheMin Gmbh, GERMANY</td>
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<tr>
<td>12:30 – 12:45</td>
<td><strong>Concluding Remarks/Richard W. Bryers Awardees</strong></td>
<td>N. S. Harding</td>
<td>N. S. Harding &amp; Associates, USA</td>
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<tr>
<td>12:45</td>
<td>Pick up box lunches</td>
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<td>BALLROOM 1 LOBBY</td>
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