



INTERNATIONAL FLAME RESEARCH FOUNDATION

# AMERICAN FLAME RESEARCH COMMITTEE

## LIST OF PAPERS AVAILABLE IN THE CD

### TOWARD EFFICIENT ZERO EMISSION COMBUSTION ADVANCES IN AIR-FUEL AND OXY-FUEL TECHNOLOGIES

2001 Joint AFRC-JFRC International Combustion Symposium  
9<sup>th</sup> -12<sup>th</sup> September, 2001 - KAUAI, HAWAII - USA  
Hyatt Regency Kauai

(Price: US\$ 100.00 for IFRF Members and US\$ 150.00 for Non-IFRF Members)

#### JOINT PLENARY SESSIONS

Symposium Co-Chairpersons:

- Robert Gemmer, Program Manager, U.S. DOE
- Hideki Murakami, Senior Researcher, Nippon Steel Corp

1. **Industries of the Future**  
Denise Swink, Deputy Assistant Secretary, Office of Industrial Technologies, U.S. Department of Energy (DOE)
2. **The International Energy Agency**  
Hans-Jorgen Koch, Director, Energy Efficiency, Technology and R&D, IEA
3. **Supersonic Flight and Cooking Over Wood-Burning Stoves - Challenges to the Combustion Community**  
Irv Glassman, Professor Emeritus, Princeton University

#### DAY 1 Monday, September 10, 2001

#### JOINT SESSION 1: SENSORS/CONTROLS AND COMBUSTION MODELING

Session Chair:

- Bob Gallagher, Manager, Diagnostics and Remote Sensing Department, Combustion Research Facility, Sandia National Laboratories (SNL)
1. **Tunable Diode Laser Sensing for Combustion Monitoring and Control**  
Ron Hanson, Professor, Stanford University
  2. **Applications of Absorption and Emission Spectroscopies for Process Control in Commercial Steelmaking**  
Sarah Allendorf, Department Manager, SNL
  3. **Multiscalar Measurements for Combustion Model Validation**  
Rob Barlow, SNL
  4. **Numerical Simulation of Industrial Processes Coupling Combustion Chamber and Load Calculations**  
Marc Till, Modeling Program Manager, Air Liquide
  5. **Turbulent Combustion Modeling**  
Luc Vervisch, Prof., INSA de Rouen CNRS

6. **Large Eddy Simulations for Turbulent Combustion**  
Denis Veynante, Research Fellow, Ecole Central
7. **Large-Eddy Simulations of Spray Flames**  
Suresh Menon, Professor, Georgia Tech
8. **The Role of Reduced Chemistry in Applied Combustion Modeling**  
Jürgen Warnatz, Professor, University of Heidelberg
9. **Applied Combustion Modelling of Furnaces and Boilers**  
Philip Smith, Professor/Chair, University of Utah
10. **Current Status of Engine Combustion Modeling with Application to the Optimization of IC Engine Design for Reduced Emissions**  
Rolf Reitz, University of Wisconsin

## DAY 2 Tuesday, September 11, 2001

### JOINT SESSION 2: OXY-FUEL TECHNOLOGIES AND APPLICATIONS

#### Session Chairs:

- Robert Gemmer, Program Manager, U.S. Department of Energy (DOE)
- Hideki Murakami, Senior Researcher, Nippon Steel Corporation

1. **Overview of Application Technologies Using Oxy-Fuel Combustion in Japan**  
Toshio Suwa, General Manager, Nippon Sanso
2. **Oxygen Generation for Energy Systems**  
Ted McMahon, Project Manager, National Energy Technology Laboratory (NETL)

### PARALLEL SESSIONS 2A, 2B, 2C, 2D:

#### Session 2A: Combustion Dynamics and Emissions

Chair: Dr. Steve Turns, Professor, Pennsylvania State University

1. **The Effects of Oxygen Index on Soot, Radiation, and Emissions Characteristics of Turbulent Jet Flames: Experiments & Modeling**  
Stephen R. Turns, Professor, Pennsylvania State University
2. **Novel Concepts for Ultra Low Emission and High Efficiency Natural Gas Combustion**  
David Rue, Manager Industrial Combustion Processing, GTI
3. **Turbulent Combustion in a Separated-Jet Burner**  
Luc Vervisch, Professor, INSA de Rouen CNRS
4. **Turbulent Combustion Modeling of Nonpremixed Steel Gases**  
Olivier Gicquel, Maître de Conférence, Ecole Centrale Paris/Laboratoire EM2C/CNRS

#### Session 2B: Combustion in the Steel Industry

Chair: Dr. Toshiaki Hasegawa, Division Manager, Nippon Furnace

1. **Oxy-Combustion for Reheat Furnaces: Major Benefits Based on a Mature Technology**  
Olivier Delabroy, Air Liquide
2. **The Development of Oxy-Fuel Combustion Technology for Use in Heating Furnace Applications**  
Andrew Brown, Product Manager, Linde Gas AG
3. **Industrial Reheating Furnace Designing by Using Numerical Simulation**  
Hideki Murakami, Researcher, Nippon Steel Corp

4. **TDLAS for Combustion Gas Analysis in a Steel Reheating Furnace**  
John Niska, Researcher, MEFOS

### Session 2C: Process Heaters

Chair: Rasik Patel, Manager, Thermal Design, Technip

1. **Retrofitting Ultralow NO<sub>x</sub> Burners in a Refinery Process Heater-- A Case History**  
Carol Schnepfer, CFD Engineer, John Zink Company, LLC
2. **Developing and Retrofitting Ultra Low NO<sub>x</sub> Burners in a Refinery Furnace**  
Jim G. Seebold, Chief Pyrolater, Chevron Corp.
3. **Using Ultra Lean-Premix Combustion and Staged Fuel to Achieve NO<sub>x</sub> Emissions Similar to Selective Catalytic Reduction (SCR) Systems**  
Jason McAdams, Development Engineer, John Zink Company, LLC

### Session 2D: International Energy Agency (IEA)

Chair: Bob Gemmer, Symposium Co-Chair, Program Manager, DOE

1. **Fractal Dimension Analysis During Flame Growth Period in an S. I. Engine**  
Kazuie Nishiwaki, Professor, Ritsumeikan University
2. **Applications of Interferometric Laser Imaging Technique to the Planer Measurements of Size and Velocity Distribution for Denser Spray Flows**  
Masanobu Maeda, Professor, Keio University
3. **Soot Formation in a Ethylene/Acetal Diffusion Flame**  
Thomas Gerber, Head Reaction Analysis, Paul Scherrer Institute

## PARALLEL SESSIONS 3A, 3B, 3C, 3D

### Session 3A: Coal Combustion

Chair: Eddie Chui, Group Leader, CANMET Energy Technology Center

1. **CFD Modeling and Pilot Scale Validation of Oxy-Coal Combustion**  
Eddie H. Chui, Group Leader, CANMET EnergyTech. Centre
2. **The Use of Modelling to Design and Optimize Low-NO<sub>x</sub> Burners for Coal-Fired Applications**  
Matt Miyasato, GE Energy and Environmental Research Corporation
3. **Numerical Simulation for the Heat and Mass Transfer and the Particle Trajectory in the Pulverized Coal Pyrolizer**  
Tashiaki Saito, Senior Researcher, Nippon Steel Corporation
4. **Utilization of Reduced Mechanism Methods in CFD Simulations for Improved NO<sub>x</sub> Predictions in Utility Boilers and Furnaces**  
Marc Cremer, Manager, Engineering Analysis, Reaction Engineering International

### Session 3B: Combustion in the Steel Industry

Chair: Dr. Hideki Murakami, Senior Researcher, Nippon Steel

1. **Numerical Simulation and Experimental Investigation on the Regenerative Burner**  
Wentao Rao, Baosteel Technology Center
2. **Bethlehem Steel's Evaluation of a Low-NO<sub>x</sub> Oxy-Fuel Burner**  
Anthony Martocci, Program Manager, Corporate Energy Affairs, Bethlehem Steel, Inc.
3. **Development of 1MW-Class HiTAC Regenerative Burner with Built-in Type Ceramic Honeycomb Media Cassettes (HiTAC: High Temperature Air Combustion)**  
Makoto Miyata, Manager, Nippon Furnace Kogyo Kaisha, Ltd.

### **Session 3C: Process Heaters**

Chair: Dr. Jim Seebold, Chief Pyrolater, Chevron

1. **Sub 10 PPM NO<sub>x</sub> Burner for Refinery Process Heaters**  
Marianne Zimola, Process Design Engineer, John Zink Company, LLC
2. **Application of CFD to the PetroChemical Industry: Systems Analysis of Process Burner Issues**  
Carol Schneper, CFD Engineer, John Zink Company, LLC
3. **Development Work Applying Advanced High Temperature Air Combustion Technology for Steam Reformer Furnace**  
Toshiaki Yoshioka, Chiyoda Corporation

### **Session 3D: International Energy Agency**

Chair: Bob Gemmer, Program Manager, US DOE

1. **Direct Numerical Simulation of Chemically Reactive Flows**  
Christos E. Frouzakis, Paul Scherrer Institute
2. **Visualization Techniques for Soot Diagnostics**  
Giorgio Zizak, Research Director, CNR-Tempe
3. **Planar Out-of-focus Imaging to Study Reactive Spray**  
R. Calabria and P. Massoli, Istituto Motori CNR
4. **Analysis of the Intake Air Flow in a GDI Engine by a New Prototype Steady State Test Rig**  
M. Auriemma, F.E. Corcione, S. Diana, G. Police, and G. Valentino, Istituto Motori CNR

### **PARALLEL SESSIONS 4A, 4B, 4C, 4D:**

#### **Session 4A: Coal Combustion**

Chair: Carlo Castaldini, President, CMC-Engineering

1. **Simulator Development of Entrained Flow Coal Gasfires at High Temperature and High Pressure Atmosphere**  
Hiroaki Tominaga, Assistant Manager, Idemitsu Kosan Co., Ltd.
2. **Coal Char Combustion Reactivity in O<sub>2</sub>/CO<sub>2</sub> Recycle Applications**  
Christopher Shaddix, Principal Member Technical Staff, SNL
3. **Ash and Deposit Formation in Waste Incinerators - Impact on Heat Transfer**  
Flemming Frandsen, Research Associate Professor University of Denmark

#### **Session 4B: Combustion in the Glass Industry**

Chair: Wataru Fujisaki, Senior Researcher, Tokyo Gas

1. **A Numerical Investigation of the Impacts of Oxy-Fuel Firing Patterns on Glass-Melt Flow in a Glass Furnace**  
Michael Petrick, Manager Analysis Simulation and Modeling Group, Argonne National Laboratory
2. **Development of an Oxygen Combustion Burner for Melting Furnaces and Rapid Heating Equipment**  
Kazuma Kiyohira, Osaka Gas Co. Ltd.
3. **Development of Oxy-Natural Gas Combustion Technology for Glass Melter**  
Wataru Fujisaki, Senior Researcher, Tokyo Gas Co. Ltd

#### **Session 4C: Combustion Modeling**

Chair: Dr. Werner Dahm, Chief Technical Specialist, NGB Technologies, Inc.

1. **Collaboratories Enabling Combustion Research**  
Larry Rahn, Research Manager, SNL
2. **The Influence of Chemical Mechanisms and Radiative Heat Loss in a Laboratory-Scale Experimental Burner**  
Lawrence Cloutman, Physicist, Lawrence Livermore National Laboratory
3. **Improved Prediction of Flame Properties in Oxy-Fuel and Air-Fuel Combustion Systems**  
Werner Dahm, Chief Technical Specialist, Combustion Systems, NGB Technologies, Inc.

#### **Session 4D: International Energy Agency**

**Chair: Bob Gemmer, Program Manager, US DOE**

1. **Effect of Turbulence on Stratified Charge Combustion in Idealized Conditions**  
Yasuo Moriyoshi, Assoc. Professor, Chiba U.
2. **Experimental and Numerical Studies on Spark Ignition Process of Combustible Mixtures**  
Mitsuhiro Tsue, Associate Professor, University of Tokyo
3. **Characteristics of Spray and its Combustion of Fuel Composed of that with Boiling Temperature and that with Low Boiling Temperature**  
Hajime Fujimoto, Doshisha University

### **DAY 3 Tuesday, September 12, 2001**

#### **PARALLEL SESSIONS 5A, 5B, 5C, 5D:**

##### **Session 5A: Biomass**

**Chair: Kevin Davis, Reaction Engineering International**

1. **Biomass Energy Technologies, an Overview**  
Kevin Whitty, Research Faculty Member, University of Utah
2. **State of the Art in Black Liquor Gasification Technology**  
Kevin Whitty, Research Faculty Member, University of Utah
3. **Biomass Powder Gasification in a Cyclone Gasifier**  
Hassan Salman, Student, Lulea University of Technology

##### **Session 5B: Oxy-Boilers**

**Chair: Alex Slavejkov, Leader Combustion COE, Air Products and Chemicals**

1. **Oxygen Enrichment in Boilers**  
Ovidiu Marin, Research and Development Group Manager, American Air Liquide
2. **A Study on CO<sub>2</sub> Capture from a Gas-Fired Boiler by Oxyfuel Combustion without Flue Gas Recycle**  
John Boden, Senior Combustion Specialist, BP Amoco
3. **CFD Analysis of 500,000 Btu/Hr Combustor Using Enriched O<sub>2</sub> and Recycled Flue Gas**  
Dinesh Gera, Senior Consulting Engineer, Fluent, Inc.

##### **Session 5C: Power Generation**

**Chair: Ron Lutwen, President and CEO, SFT, Inc.**

1. **A Comparison of Gas Turbine Combustion Concepts Suitable for Integration with CO<sub>2</sub> Sequestration**

Kent Casleton, Team Leader, U.S. Department of Energy, National Energy Technology Laboratory

2. **High Efficiency and Near Zero Emission Power Generation With Gas Turbine and Oxygen Enhanced Heat Recovery**  
Hisashi Kobayashi, Corporate Fellow, Praxair

### **Session 5D: International Energy Agency**

Chair: Bob Gemmer, Symposium Co-Chair, Program Manager, DOE

1. **HCCI Combustion Research at Sandia National Laboratories**  
Jay Keller, Manager, Combustion and Engines and Hydrogen Energy, SNL
2. **A Comparative Study of Soot Formation in Diesel Engines by 3D Modelling and Spectroscopic Measurements**  
B. M. Vaglieco, Istituto Motori-CNR
3. **Qualitative Laser-Induced Incandescence Measurements of Particulate Emissions During Transient Operation of a TDI Diesel Engine**  
Peter Witze, Technical Staff, SNL

### **PARALLEL SESSIONS 6A, 6B, 6C, 6D**

#### **Session 6A: Biomass**

Chair: Kevin Whitty, Research Faculty Member, University of Utah

1. **Fiber Cane for Closed Loop Biomass/Coal Co-Firing**  
Lee Jakeway, Project Engineer, Hawaii Commercial & Sugar Co.
2. **Characterizing Biomass Fuels for Cofiring Applications**  
David Johnson, Research Assistant, Pennsylvania State University
3. **Effect of Moisture and Variable Char Reactivity on Biomass/Coal Cofiring Units**  
Dinesh Gera, Senior Consulting Engineer, Fluent, Inc.

#### **Session 6B: Boilers**

Chair: Ken Nagara, Mechanical Engineer, Ishikawajima-Harima Heavy Industries Co., Ltd.

1. **Ultra Low-NOx FIR Burner for Vertical-Fired Once-Through Package Boilers**  
Ken Nagara, Mechanical Engineer, Ishikawajima-Harima Heavy Industries Co., Ltd.
2. **The Application of Gas Conditioning Technology for NOx Reduction on Five Watertube Boilers**  
Jim Seebold, Chief Pyrolater, Chevron
3. **Optimized Burner-Boiler System to Minimize Cost of Ultra-Low NOx Combustion**  
John Sullivan, VP, Alzeta Corporation

#### **Session 6C: Power Generation**

Chair: Ovidiu Marin, Research and Development Group Manager, Air Liquide America

1. **Demonstration of an Ultra-Low NOx Surface-Stabilized Combustor at High Pressure in a One-Megawatt Saturn Gas Turbine**  
Robert Kendall, Alzeta Corporation
2. **Zero Emission, Advanced Power Generation**  
Ovidiu Marin, Research and Development Group Manager, Air Liquide
3. **Rapid Absorption Process SO2 Reduction System and LoTOx Nitrogen Oxide Reduction System at the Medical College of Ohio**  
Ronald Lutwen, President and CEO, SFT, Inc.

### Session 6D: International Energy Agency

Chair: Bob Gemmer, Symposium Co-Chair, Program Manager, DOE

1. **Quantitative Laser-Induced Incandescence Measurements of Particulate Matter from the Exhaust of a Direct Injection Spark Ignition Automobile**  
Gregory J. Smallwood, Research Scientist, National Research Council Canada
2. **Qualitative Laser-Induced Incandescence Measurements of Particulate Emissions During Transient Operation of a TDI Diesel Engine**  
Peter Witze, Technical Staff, SNL
3. **FFT Analysis Method of Inline Hologram Images for Small Particles and Slender Wires**  
Kumihito Nagayama, Kyushu U.

### PARALLEL SESSIONS 7A, 7B, 7C, 7D

#### Session 7A: Biomass

Chair: Larry Bool, Senior Development Associate, Praxair

1. **Dynamic Mathematical Combustion Models Applied to Practical Systems**  
Sjaak van Loo, Head of Department, TNO
2. **A New Bio Fuel Based Boiler Concept for Small District Heating Systems**  
Joakim Lundgren, Student, Lulea University of Technology
3. **Oxygen Enhanced Combustion of Biomass and Biosolids**  
Lawrence Bool, Senior Development Associate, Praxair
4. **Practical Experience with Ash and Deposit Formation in Danish Biomass-Fired Boilers**  
Flemming Frandsen, Research Associate Professor, University of Denmark

#### Session 7B: Boilers

Chair: Tim Webster, Director of Marketing, John Zink Company, LLC

1. **Ultra Low-NOx Gas Fired Boiler Burner Design Requiring No FGR Fan**  
Jason McAdams, Development Engineer, John Zink Company LLC
2. **Information Necessary to Improve and Measurements to Verify Models of Nitrogen Oxide Formation in Boilers**  
John Pohl, Ultra-Systems Technology
3. **Ultra Low-Nox Fir Burner for Vertical-Fired Once-Through Package Boilers**  
Ken Nagara, Mechanical Engineer, Ishikawajima-Harima Heavy Industries Co, Ltd.
4. **The Characteristics of Cylindrical Water-Cooled Furnaces When Burning Liquid, Gaseous, or Dual Liquid-Gas Fuels**  
Nasr M. Alkadi, Energy Consultant, West Virginia University

#### Session 7C: Sensors and Controls

Chair: Charles Benson, Vice President, Arthur D. Little, Inc.

1. **Tunable Diode Laser Sensor Characterization for Harsh Combustion Monitoring**  
William Von Drasek, American Air Liquide
2. **Multiple Channel Tunable Diode Laser Sensors for Industrial Combustion Monitoring**  
Peter DeBarber, Senior Scientist, MetroLaser, Inc.
3. **Evaluation of and On-Line Technique for Corrosion Characterization in Furnaces**  
Kevin Davis, Manager, Engineering Development, Reaction Engineering International

4. **Development of Laser-Based Infrared Imaging Technologies for the Detection of Fugitive Emissions of Natural Gas and Volatile Organic Species**  
Tom Kulp, SNL

#### **Session 7D: International Energy Agency**

**Chair: Bob Gemmer, Program Manager, DOE**

1. **Influence of Dimethoxymethane (DMM) Addition as in Light Fuel Oil on the Flame Emission in a Domestic Hot Water Boiler**  
Philippe Ngendakumana, Senior Research Engineer, University of Liegeo
2. **Influence of the Addition of Methylal (DMM) on the Structure of a Flat Premixed Rich Ethylene Oxygen Argon Flame**  
Jacques Vandooren, Professor, Universite Catholique de Louvain
3. **Ultra-Low NO<sub>x</sub> Premixed Industrial Burners**  
Robert K. Cheng, Senior Scientist, Lawrence Berkeley Laboratory
4. **SuperBoiler® Technology Development**  
Joseph Rabovitser, Gas Technology Institute

#### **PARALLEL SESSIONS 8A, 8B, 8C, 8D**

##### **Session 8A: Biomass**

**Chair: Lee Jakeway, Project Engineer, Hawaiian Commercial & Sugar Company**

1. **Assessing the Risk of Spontaneous Ignition of Coal or Biomass and Its Application to Large Piles**  
Bernard M. Gibbs, University of Leeds
2. **Biomass Combustion in Circulating Fluidized Bed Boilers-Modeling of NO and N<sub>2</sub>O Emissions**  
Bernard Gibbs, U. Leeds
3. **Factors Affecting Formation of Dioxins and Furans from Combustion of High Chloride Waste Wood**  
Fernando Preto, Research Scientist, CANMET Energy Technology Centre

##### **Session 8B: High Temperature Combustion**

**Chair: Sho Kobayashi, Corporate Fellow, Praxair, Inc.**

1. **Coupling Between Atomization and Combustion in Liquid Fuel - Oxygen Flames**  
Olivier Delabroy, Air Liquide
2. **Investigation of Recirculated Gas Entrainment and Mixing Aiming at NO<sub>x</sub> Reduction in Oxygen Enriched Air Combustion**  
Makoto Nishimura, Kobe Steel, Ltd.
3. **Experimental Approach to Characterize LFO Atomisers for High Temperature Air Combustion**  
Hanna Hakulinen, Process Engineer, Tampere University

##### **Session 8C: Sensors and Controls**

**Chair: John Sullivan, President, Azeta Corporation**

1. **Steady-State Experimental Results for the Cordmais Once Through 600 MW Pulverized Coal Power Plant**  
Cedric Le Masson, Research Engineer, EDF R&D
2. **Application of High-Order Statistics on a UV/IR Scanner Signal Processor as a Low NO<sub>x</sub> Pre-Mix Burner Controller**  
Roy Caldwell, Manager, Research and Development, Forney Corporation

3. **Spectroscopic Observation of Non-Luminous Flames in an Industrial High Efficiency Test Furnace During Regenerative Combustion of a Coal Gas**  
Toru Minote, Senior Research Engineer, NKK Corporation

**Session 8D: International Energy Agency**

**Chair: Bob Gemmer, Symposium Co-Chair, Program Manager, DOE**

1. **IEA Executive Committee Meeting**

\*\*\*\*\*

**Would you be interested in ordering the proceedings on CD? Please take contact with:**



**Dr. Jordan Loftus  
AFRC Technical Secretary  
5122 Contour Place  
Houston, TX 77096-4116  
USA  
Email: [afrcjl@earthlink.net](mailto:afrcjl@earthlink.net)**

**or contact us at**



**IFRF Communications Centre  
Rooswijkweg 130  
1951 MK Velsen Noord  
The Netherlands  
Tel. No.: +31 251 291 600  
Fax No.: +31 251 291 599  
Email: [info@ifrf.net](mailto:info@ifrf.net)**