



Virtual

Thirty-Eighth Annual COAL CONFERENCE

University of Pittsburgh · Swanson School of Engineering

TECHNICAL PROGRAM

**Clean Coal-based Energy/Fuels
and the Environment**

September 20-23, 2021

Hosted by:



University of
Pittsburgh

WELCOME!

On behalf of the Conference Advisory Board, Conference Committees, and the University of Pittsburgh, we welcome you to the Thirty-Seventh Annual International Pittsburgh Coal Conference, which will be held September 20-23, 2021 online via Zoom due to COVID-19. The Conference is hosted by the University of Pittsburgh, USA.

The theme of this year's conference "Clean Coal-based Energy/Fuels and the Environment" covers wide spectrum of important topics on energy and environmental issues and technologies, which are directly related to extraction and utilization of coal and its byproducts. This year's Technical Program includes two parallel oral tracks on Tuesday (09-21-2021), two parallel oral tracks on Wednesday (09-22-2021) and one oral track on Thursday (09-23-2021). All tracks begin at 8:05 and end at 16:25 each day. The Exhibits will be held September 23, 2021 from 8:50 to 14:15. Detailed information about the technical sessions are available in page 7 of the Technical Program.

This year's invited Plenary Speakers are: (1) Dr. Jennifer Wilcox: Principal Deputy Assistant Secretary for Fossil Energy; (2) Dr. Brian Anderson: Director, National Energy Technology Laboratory (NETL) - Department of Energy, USA; (3) Dr. Xu Shisen: Director of the Dept. of Science and Technology, China Huaneng Group, CHINA; (4) Mr. Charles McConnell: Energy Center Officer, The Center for Carbon Management in Energy (CCME) - University of Houston, USA; (5) Dr. Dan Hancu: Carbon Capture Technology Manager, National Energy Technology Laboratory (NETL) - U.S. Department of Energy, USA; and (6) Mr. Bruce Hensel: Technical Executive, Electric Power Research Institute, Inc. (EPRI), USA.

We express our sincere gratitude to the Plenary Speakers and Moderators for their support and involvement, to all the authors and co-authors of the technical papers and to all the members of the Technical Program Committee. Special thanks go to the topic coordinators, co-chairs and speakers for their invaluable contributions to the 2021 technical program.

As the chair of the Advisory Board of the Conference, I deeply appreciate your participation and interest in this year's Conference and we invite you to join us next year for the Thirty-ninth Annual International Pittsburgh Coal Conference, hopefully in-person, at the Westin Convention Center Hotel in Pittsburgh, PA, USA.

Sincerely,

Massood Ramezan, Chair



Senior Technical Advisor at Key Logic Systems, USA

The International Pittsburgh Coal Conference

EXECUTIVE DIRECTOR:

Dr. Badie I. Morsi

CONFERENCE OFFICE:

University of Pittsburgh, Swanson School of Engineering
Pittsburgh Coal Conference

3700 O'Hara Street, 940 Benedum Hall, Pittsburgh, PA 15261 USA
Tel: +1-412-624-7440 Email: ipcc@pitt.edu www.pccpitt.org

CONFERENCE OVERVIEW

MONDAY, SEPTEMBER 20, 2021

OPENING REMARKS	08:05 - 08:15
PLENARY SESSION I	08:15 - 10:00
LUNCH	10:00 - 11:15
PLENARY SESSION II	11:15 - 13:00

TUESDAY, SEPTEMBER 21, 2021

CONCURRENT TECH. SESSIONS	08:05 - 09:45
BREAK	09:45 - 09:55
CONCURRENT TECH. SESSIONS	09:55 - 11:55
LUNCH	11:55 - 12:35
CONCURRENT TECH. SESSIONS	12:35 - 14:15
BREAK	14:15 - 14:25
CONCURRENT TECH. SESSIONS	14:25 - 16:25

WEDNESDAY, SEPTEMBER 22, 2021

CONCURRENT TECH. SESSIONS	08:05 - 09:45
BREAK	09:45 - 09:55
CONCURRENT TECH. SESSIONS	09:55 - 11:55
LUNCH	11:55 - 12:35
CONCURRENT TECH. SESSIONS	12:35 - 14:15
BREAK	14:15 - 14:25
CONCURRENT TECH. SESSIONS	14:25 - 16:25

THURSDAY, SEPTEMBER 23, 2021

CONCURRENT TECH. SESSIONS	08:05 - 09:45
BREAK	09:45 - 09:55
CONCURRENT TECH. SESSIONS	09:55 - 11:55
LUNCH	11:55 - 12:35
CONCURRENT TECH. SESSIONS	12:35 - 14:15
BREAK	14:15 - 14:25
CONCURRENT TECH. SESSIONS	14:25 - 16:25

Virtual
Exhibit:



U.S. DEPARTMENT OF
ENERGY



NATIONAL
ENERGY
TECHNOLOGY
LABORATORY

Thursday (09-23-2021)	
Exhibit	
9:55 - 11:15	<p style="color: red; font-weight: bold;">“How to Work With NETL?”</p> <p>Thomas Sarkus, Sr. Managerial & Technical Advisor Science & Technology Strategic Plans & Programs</p>

Times listed are Eastern Standard Time (Local Pittsburgh, PA, USA)

CONFERENCE OVERVIEW

MONDAY, SEPTEMBER 20, 2021

08:05-08:15 OPENING REMARKS (Prof. Badie Morsi)

PLENARY SESSION I

8:15-10:00

Moderator: Dr. Massood Ramezan and Prof. Richard Bajura

8:15-8:45 **Dr. Jennifer Wilcox**

Principal Deputy Assistant Secretary for Fossil Energy, Department of Energy, USA
"The Role of Carbon Capture in Helping to Achieve Net Zero Carbon Emissions Goals"

8:45-9:15 **Dr. Brian Anderson**

Director, National Energy Technology Laboratory,(NETL) - Department of Energy, USA
"Paving the Way to a Decarbonized Energy Future"

9:15-9:45 **Dr. Xu Shisen**

Director of the Dept. of Science and Technology, China Huaneng Group, CHINA
"CCUS in China "

PLENARY SESSION II

11:15-13:00

Moderator: Mr. Thomas Sarkus and Mr. Richard Winschel

11:15-11:45 **Charles McConnell**

Energy Center Officer, The Center for Carbon Management in Energy (CCME)
University of Houston, USA
"The Energy Transition and How to Achieve Real Sustainability "

11:45-12:15 **Dr. Dan Hancu**

Carbon Capture Technology Manager, National Energy Technology Laboratory (NETL)
U.S. Department of Energy, USA
"Carbon Capture Program Update: Progress towards decarbonizing power and industrial sectors"

12:15-12:45 **Mr. Bruce Hensel**

Technical Executive, Electric Power Research Institute, Inc. (EPRI), USA
"Forty Years of EPRI Research on CCP Leaching"

Times listed are Eastern Standard Time (Local Pittsburgh, PA,

Virtual Conference FAQ's

All participants are expected to conduct themselves in a professional and respectful manner during the conference and abide by all applicable University policies and procedures. While this conference is a public discussion, participants may not record any session.

How do I join a session?

Conference staff will email the Zoom meeting details to all paid conference attendees the day before the conference. It is recommended that you test Zoom before the conference.

How do I ask a question during a session?

To submit a question to the speaker, type it into the Zoom chat box. The session co-chair will read questions from the chat to the speaker.

I am giving an oral presentation, what do I need to do during my session?

Please sign in to the Zoom session 10-15 minutes before your scheduled presentation time. At the start of your scheduled presentation time the session co-chair will announce your presentation and conference staff will play your pre-recorded video presentation. Following the video there will be 5 minutes of live question and answer. The session co-chair will read you any questions submitted in the chat by session attendees. Audio is required (video is optional).

I am giving a poster presentation, what do I need to do during my session?

At the start of your scheduled presentation time the session co-chair will announce your poster and conference staff will display your poster for 20 minutes. After all posters in your session have been displayed, there will a combined question and answer session for all posters in that session. Please sign in to the Zoom session 10-15 minutes before your scheduled Q&A time. The session co-chair will read to you any questions submitted in the chat by session attendees. Audio is required (video is optional).

Oral Presentation Sessions

	Day - 1 Tuesday (09/21/2021)		Day - 2 Wednesday (09/22/2021)		Day - 3 Thursday (09/23/2021)
	Track 1	Track 2	Track 1	Track 2	Track 1
8:00 - 8:05	Opening Session	Opening Session	Opening Session	Opening Session	Opening Session
8:05 - 8:25	Gasification Technologies - 1 (Session 1)	Coal Science - 1 (Session 2)	Combustion Technologies - 1 (Session 9)	Coal Mining, Preparation and Handling (Session 10)	Power Plants - 1 (Session 17)
8:25 - 8:45					
8:45 - 9:05					
9:05 - 9:25					
9:25 - 9:45	Break				
9:45 - 9:55	Break				
9:55 - 10:15	Gasification Technologies - 2 (Session 3a)	Coal Science - 2 (Session 4)	Combustion Technologies - 2 (Session 11a)	Sustainability and the Environment (Session 12)	Power Plants - 2 (Session 18)
10:15 - 10:35					
10:35 - 10:55					
10:55 - 11:15	Rare Earth Elements - 1 (Session 3b)		Carbon Management - 1 (Session 11b)		
11:15 - 11:35					
11:35 - 11:55	Lunch				
11:55 - 12:35	Lunch				
12:35 - 12:55	Rare Earth Elements - 2 (Session 5)	Coal Bed Methane and Shale Gas (Session 6)	Carbon Management - 2 (Session 13)	Coal Ash Management (Session 14)	Power Plants - 3 (Session 19)
12:55 - 13:15					
13:15 - 13:35					
13:35 - 13:55					
13:55 - 14:15	Break				
14:15 - 14:25	Break				
14:25 - 14:45	Rare Earth Elements - 3 (Session 7)	Value-Added Products from Coal - 1 (Session 8)	Carbon Management - 3 (Session 15)	Value-Added Products from Coal - 2 (Session 16)	Clean Coal Demonstration and Commercial Projects (Session 20)
14:45 - 15:05					
15:05 - 15:25					
15:25 - 15:45					
15:45 - 16:05					
16:05 - 16:25					

Times listed are Eastern Standard Time (Local Pittsburgh, PA, USA)

TECHNICAL PROGRAM—ORAL PRESENTATIONS

ORAL SESSIONS Tuesday, September 21 08:00—16:25

SESSION 1

GASIFICATION TECHNOLOGIES—1

Alberto Pettinau and David Lyons

8:05 The Influence of Interactions Among Calcium, Silicon and Aluminum on Coal Gasification, Guanghua Lu Yonghui Bai, and Guangsuo Yu, Ningxia University, CHINA

8:25 Neutron-Scattering Diagnostics for Improved Gasifier Modeling, Charles E.A. Finney, Costas Tsouris, James E. Parks II, Oak Ridge National Laboratory, Oak Ridge, USA.

8:45 Effect of Gasifying Agent During Microwave-Assisted Coal Gasification, Candice Ellison and Mark Smith, National Energy Technology Laboratory, Leidos Research Support Team, Morgantown, WV, USA

9:05 Real-Time Measurement of Cavity Growth in Lab-Scale Underground Coal Gasification by Electrical Capacitance Tomography, Qigeng Zhou, and Lele Feng, School of Safety Engineering, China University of Mining and Technology, Xuzhou, CHINA

9:25 Overview of DOE/FE Gasification Program R&D, Jai-woh Kim, U.S. Department of Energy, Washington DC, USA; David Lyons, U.S. DOE, National Energy Technology, Morgantown, WV, USA

SESSION 2

COAL SCIENCE—1

Allan Kolker and Atsushi Ishihara

8:05 Thermal Behavior of Crystalline Minerals in Argonne Premium Coals Under Air and Argon Atmospheres-Comparison Between Bituminous, Subbituminous and Brown Coals, Hung Nguyen, Tadanori Hashimoto, Yu Tsuchimori, and Atsushi Ishihara Kurima Machiya-Cho, Tsu City, Mie, JAPAN; Masakatsu Nomura, Osaka University, Osaka, JAPAN

8:25 Thermal Desorption of Mercury Compounds from Coal in the Conical Spouted Bed Reactor, Lida Yan, Zheng Yao, and Carlos E. Romero, Lehigh University Energy Research Center, Bethlehem, PA, USA; Quang Truong, Advanced Cooling Technologies, Inc., Lancaster, PA, USA; Huazhi Chen, Zhanjiang University of Science and Technology, Zhanjiang, Guangdong, China

8:45 Prediction of Maceral Content Based on Physical and Chemical Properties, Zhao, Zhen Li, Jing Chang, and Huaiqing Zhang, Xi'an University of Science and Technology, Xi'an, 710021, P. R. China.

9:05 Judging the geological origin of Cretaceous coals from the Wulantuga coal-hosted Ge deposit, Shengli coalfield, northeastern China: Insights from coal petrology and geochemistry, Xiaoshuai Wang, Yifan Chen, Yuegang Tang, Tengda Ma, Guoying Yan, College of Geoscience and Surveying Engineering, China University of Mining & Technology (Beijing), Beijing, China

9:25 Overview on Mercury Control Options for Coal-Burning Power Plants, Evan J. Granite, US-DOE, NETL, Pittsburgh, PA, USA

SESSION 3a

GASIFICATION TECHNOLOGIES—2

Alberto Pettinau and David Lyons

9:55 Integrating Biomass and Waste into High Pressure Partial Oxidation Processes: A Thermo-Economic Multi-Objective Optimization Using Flowsheet Modelling, Philip Rößger, Ludwig Seidl, Fred Compart, Bernd Meyer, and Andreas Richter, Process Engineering, TU Bergakademie, Freiberg, GERMANY

10:15 A Detailed Study of the Co-Gasification Behavior of Sewage Sludge and Coal in an Entrained-Flow Gasifier, Shiqing Johannes Scherer, and Andreas Richter, TU Bergakademie Freiberg, Germany; Tobias Ginsberg, and Christian Wolfersdorf, RWE Power AG, Werkstraße, Bergheim, Germany

10:35 Expanded Transient Multi-Fuel Modeling of the HMI Updraft Moving-bed Gasifier Performance for Industrial Scale CHP Applications, Liqiang Lu, Yupeng Xu, Leidos Research Support Team – NETL, USA; Jia Yu, ORISE Research Program – NETL, USA; Mehrdad Shahnam, U.S. Department of Energy – NETL, USA; Rolf E. Maurer, David P. Thimsen, Hamilton Maurer International, Inc. Hudson, IL, USA; Brent J. Sheet, University of Alaska Fairbanks, Fairbanks, AK, USA; Alberto Pettinau, Sotacarbo – Società Tecnologie Avanzate Low Carbon S.p.A., Carbonia, ITALY

10:55 Comprehensive Optical Investigation of Different Flame Types in a Multi-Feed Test Facility, Mohsen Gharib, Paul Tischer, and Andreas Richter, TU Bergakademie Freiberg, Germany

SESSION 3b

RARE EARTH ELEMENTS—1

Evan Granite and Allan Kolker

11:15 Datamining Analysis of Rare Earth Element Recovery Research Trends – A Path Forward with Functionalized Silica Sorbents, Walter C. Wilfong, McMahan L. Gray, Qiuming Wang, Tuo Ji, Fan Shi, NETL, Pittsburgh, PA USA

11:35 Rare Earth Elements (REE) Distribution on Commercial Coal and Respective Combustion Ashes from a Portuguese Thermoelectric Power Plant, Ana Cláudia Santos, Alexandra Guedes, and Bruno Valentim, Institute of Earth sciences-Porto pole, Department of Geosciences, Environment and Spatial Plannings, Faculty of Sciences, University of Porto, Portugal

SESSION 4

COAL SCIENCE—2

Leslie Ruppert and Brian Shafer

9:55 Acid-Leached USY Zeolites Catalysts for Catalytic Cracking of Coal Tar, Zhuozhuo Wu, Zhiyuan Yang, Xiaoqian Ju, Yinyan Li, and Xinbo Duan, University of Science and Technology, Xi'an, P. R. China.

10:15 Preparation of Sludge Semi-Coke Water Slurry by Low Temperature Thermo-Alkali Modified Sludge and its Slurry Property, Yaqian Yao, Zhiyuan Yang, Hanbo Zhu, Zhuoyue Meng, and Qi Zhang, University of Science and Technology, Xi'an, P. R. China.

10:35 Survey of Research on Direct Carbon Fuel Cells, Evan J. Granite, US-DOE, Pittsburgh, Pennsylvania, USA

10:55 Simulation of Oxygen and Moisture Adsorption of Lignite and Its Active Groups in Low-Temperature Oxidation Environment, Jianqiao Zhao, Lulu Fan, Xianliang Meng, Ruizhi Chu, Jiabin Wu, Yang Zhou, and Peng Liu, China University of Mining and Technology, Xuzhou, Jiangsu, CHINA

11:15 Research on Construction of Macromolecular Structure Model of Shenfu Coal, Huaiqing Zhang, Anning Zhou, Zhen Li, Kai Zhao, and YongAn Chen, Xi'an University of Science and Technology, Xi'an, P. R. China

SESSION 5

RARE EARTH ELEMENTS—2

Evan Granite and Allan Kolker

12:35 Transforming Coal Resources Into Rare Earth Elements, Critical Minerals, and Other Nonfuel Products, Michael L. Free, and Prashant K. Sarswat, University of Utah, Salt

TECHNICAL PROGRAM—ORAL PRESENTATIONS

Lake City, UT, USA; Landon Allen, Madison, AL, USA

12:55 Evaluating Rare Earth Element Speciation and Fractionalization in Appalachian Abandoned Mine Lands, Brianna O'Neil-Hankle, John J. Lenhart, Chin-Min Cheng and Tarunjit Butalia, Department of Civil Environmental and Geodetic Engineering, The Ohio State University, Columbus Ohio, USA

13:15 Current Uses and Future Opportunities for US Industry in Rare Earth Elements and Critical Materials Technologies and Markets: Knowledge-Base Tool Development, Justin Richter, and Randy Vander Wal, Penn State University, USA

13:35 Characterization and Recovery of REE and Transition Metals from Acid Mine Drainage Treatment Solids, Mengling Stuckman, Support Contractor, NETL, Pittsburgh, PA, USA; Benjamin Hedin, Hedin Environmental, Pittsburgh, PA, USA; Christina Lopano, NETL, Pittsburgh, PA, USA; Joshua Miller, Oak Ridge Institute of Science and Education, Durham, NC, USA

13:55 Environmentally Responsible and Efficient Extraction of Rare Earth Elements from Powder River Basin Fly Ash, Patricia Saint-Vincent, NETL, Pittsburgh, PA, USA; Mengling Stuckman, NETL, Pittsburgh, PA, USA; Christina Lopano, U.S. DOE-NETL, Pittsburgh, PA, USA; Daniel Ross, NETL, Pittsburgh, PA, USA; Djuna Gulliver, U.S. DOE-NETL, Pittsburgh, PA, USA

SESSION 6

COAL BED METHANE AND SHALE GAS

Leslie Ruppert and Brian Shafer

12:35 Coal Structure: Visualizing Micro- and Mesopore Distributions Through Hierarchical 3D Pore Modeling for a Bituminous Coal, Guanwen Lu, Leone Family Department of Energy and Mineral Engineering and the EMS Energy Institute, Pennsylvania State University, University Park, PA, USA, and China University of Mining & Technology, Xuzhou, China; Justin K. Watson, Department of Material Science and Engineering, Nuclear Engineering Program, University of Florida, Gainesville, Florida, USA

12:55 Pilot Scale Testing and Economic Analysis of Thermal Desorption of Mercury from Bituminous Coal, Quang Truong, Srujan Rokkam, Advanced Cooling Technologies, Inc. Lancaster, PA, USA; Zheng Yao, Carlos Romero, Lehigh University Energy Research Center, Bethlehem, PA, USA and Bhima Sastri, U.S. Department of Energy, Office of Fossil Energy, Germantown, MD 20874, USA

13:15 Prediction of Gas Content in the Qinglong Coal Mine in Guizhou Province, China, by Artificial Neural Network, Wei

Gao, Key Laboratory of CBM Resources and Reservoir Formation Process, Ministry of Education (China University of Mining & Technology), Xuzhou, China; Jilin Wang (Corresponding author), School of Resources and Geosciences, China University of Mining & Technology, Xuzhou, China; Guanwen Lu, School of Resources and Geosciences, China University of Mining & Technology, Xuzhou, China

13:35 Research on Fracture Connection and Economic and Efficient Fracturing Technology in Shale Gas Reservoir, Zhijing Ma, Hebei University of Engineering, No. 19 Taiji Road, Handan Economic and Technological Development Zone, Hebei Province, Handan, 056038, China

13:55 Application of Long-Rich Directional Drilling for Gas Drainage of Adjacent Seams in Coal Mines with Severe Geological Conditions, Tomasz Topór, Grzegorz Leśniak, Renata Cicha-Szot, Małgorzata Słota-Valim, and Paweł Budak, Oil and Gas Institute - National Research Institute, Lubicz, Kraków, POLAND; G. Plonka, Polish Mining Group (PGG), Powstańców, Katowice; POLAND and R. Surma, Polish Mining Group (PGG) Zakład Górniczych Robót Inwestycyjnych, Granitowa, Bieruń, POLAND

SESSION 7

RARE EARTH ELEMENTS —3

Evan Granite and Richard Bajura

14:25 A Geo-Data Science Method for Assessing Rare Earth Element Occurrences in Coal and Other Sedimentary Systems, Andrew Bean, C. Gabe Creason, Scott Montross, R. Burt Thomas, Devin Justman, MacKenzie Mark-Moser, and Patrick Wingo, Leidos Research Support Team, Albany, OR, USA and Kelly Rose, NETL, Albany, OR, USA

14:45 High Yield and Economical Production of Rare Earth Elements from Coal Ash, Dorin V. Preda, Prakash B. Joshi, David P. Gamliel, Bryan E. Sharkey, Jeffrey Y. Yee, and Russel D. Lambert, Physical Sciences Inc., New England Business Center, Andover, MA, USA; James C. Hower, John G. Groppo, Jr., and Robert B. Jewell, University of Kentucky, Center for Applied Energy Research, Lexington, KY, USA; Todd Beers, Mike Schrock, and Brad Perrine, Winner Water Services, Sharon PA, USA

15:05 Rare Earth Elements from Coal and Related Materials: An Overview of Research at the National Energy Technology Laboratory, Thomas J. Tarka, NETL, Pittsburgh, PA, USA

15:25 Investigation of Life Cycle Assessment of Utilizing Waste Coal-based Feedstocks, Fatemeh Karbalaeisaleh, Raj Kiran, GreenPath Systems, Oklahoma, USA

15:45 Critical Minerals Sustainability, Mary Anne Alvin, NETL, Pittsburgh, PA, USA

16:05 Rare Earth Elements in Coal and Coal By-products: Research and Development in Wyoming, USA, Erin Phillips, Davin Bagdonas, J. Fred McLaughlin, Charles Nye, and Scott Quillinan, University of Wyoming, School of Energy Resources, Laramie, Wyoming, USA

SESSION 8

VALUE-ADDED PRODUCTS FROM COAL—1

John Duddy and Thomas Tarka

14:25 Research on Characteristics and Utilization of Residual Carbon in Dry Separation of Coal Gasification Fine Slag, Ying Gao, An-Ning Zhou, Zhen Li, Wei Zhao, Xi'an University of Science and Technology, CHINA

14:45 A Novel Process for Converting Coal to High-Value Polyurethane Products, Satya P. Chauhan, Dan Garbark, Jeff Cafmeyer, and Russ K Smit, Battelle Memorial Institute, Columbus, OH, USA

15:05 Manufacture of Carbon Foam in Continuous Process at Atmospheric Pressure, Rudolph Olson III, CFOAM LLC, Triadelphia, WV, USA; Dan Connell, CONSOL Energy, Canonsburg, PA, USA

15:25 Status of NETL's Carbon Ore to Products Program, Joseph Stoffa, NETL, Morgantown, WV, USA

15:45 High Yield of Carbon Fiber Precursor Pitch from Low Severity Direct Coal Liquefaction of Powder River Basin Coal, Charles S. Hill, Christopher Yurchick, and Charles Atkins, Ramaco Carbon, Sheridan, WY, USA; John Duddy, Suresh Parasher, and Paul Sadelski, HTI, Lawrenceville, NJ, USA

16:05 Advanced Coal Upgrading to Produce Improved Feedstocks for Coal-Derived Value-Added Product, Alexander Azenkeng, Nicholas E. Stanislawski, and Jason D. Laumb, University of North Dakota Energy & Environmental Research Center Grand, Forks, ND, USA

TECHNICAL PROGRAM—ORAL PRESENTATIONS

ORAL SESSIONS

Wednesday, September 22

08:00—16:25

SESSION 9

COMBUSTION TECHNOLOGY—1

Evan Granite and Eric Grol

08:05 Numerical Study on the Dispersion of Non-Spherical Particles in a Turbulent Round Jet, Wenshi Huang, Yang Zhang, Yuxin Wu, and Jingyu Wang, Tsinghua University, Beijing, China and Minmin Zhou, University of Utah, Utah, U.S.A.

08:25 Twice Ignition and Volatile Combustion of Isolated Coal Particles Under Low Oxygen Concentrations at Microgravity, Wantao Yang, Yang Zhang, Yuxin Wu, Junfu Lyu, and Hai Zhang, Key Laboratory for Thermal Science and Power Engineering of Ministry Education, Department of Energy and Power Engineering, Tsinghua University, Beijing, China

08:45 Direct Combustion of Fine Coal From Coal Waste, Fei Yi, Jeannine Elliott, Jeff Lind, Justin Feis, Bradley Spatafore, TDA Research, Inc., Golden, CO, USA

09:05 Parametric Analysis of SO_x and NO_x Removal in a Direct Contact Cooler for Pressurized Oxy-Combustion, Piyush Verma, Swarali Ghodkhande, Zachariah Wargel, Sebastian Klein, Zhiwei Yang, Washington University in Saint Louis, Saint Louis, MO, USA and Richard L. Axelbaum, Washington University in Saint Louis, Saint Louis, MO, USA, Consortium for Clean Coal Utilization

09:25 Effects of Turbulence-Radiation Coupling in Pressurized Oxy-Combustion, Lei Li, Samuel Ogunfuye, V'yacheslav Akkerman, West Virginia University, Morgantown, WV, USA; Richard L. Axelbaum, and Zhiwei Yang, Washington University in Saint Louis, Saint Louis, MO, USA

SESSION 10

COAL MINING, PREPARATION AND HANDLING

Richard Bajura and Richard Winschel

08:05 Hydrothermal Synthesis of NiMoS/SBA-15 Catalysts for the Hydrodesulfurization of Dibenzothiophene, Antony Rajendran, Tian-You Cui, and Wen-Ying Li, State Key Laboratory of Clean and Efficient Coal Utilization, Taiyuan University of Technology, Taiyuan, CHINA

08:25 CFD Simulations to Characterize

Coal Dust Explosions Severity Parameters in the Standard 20L-Vessel, Andrés Rodríguez Fernández, Alain Islas Montero, María Covadonga Betegón Biempica, Adrián Pandal Blanco, University of Oviedo, Gijón, Asturias, Spain; Emilio Martínez Pañeda, Imperial College London, London, UK

08:45 A Study on Self-Heating Characteristics of Coals, Tai-Cheng Li, Pai-Yi Wang, Research Engineer, Taiwan Power Company, NEW TAIPEI CITY, TAIWAN

09:05 An Overview on Air Dense Medium Fluidized Bed for Coal Beneficiation in China, Chenyang Zhou, Yumin Zhao, Liang Dong, Chenlong Duan, Yanjiao Li, Key Laboratory of Coal Processing and Efficient Utilization, School of Chemical Engineering & Technology, China University of Mining & Technology, CHINA

09:25 CFD Simulations of Coal Dust Dispersion in a 20L Spherical Vessel: An Assessment to Dust Explosion Tests, Alain Islas Montero, Andrés Rodríguez Fernández, University of Oviedo, María Covadonga Betegón Biempica, Adrián Pandal Blanco, University of Oviedo, Gijón, Asturias, Spain; Emilio Martínez Pañeda, Imperial College London, London, UK

SESSION 11a

COMBUSTION TECHNOLOGIES—2

Evan Granite and Eric Grol

09:55 Impact of Pressure on the PM₁ Formation from Char Combustion via Simulation, Zhengang Zhou, Yueming Wang, Lin Li, Southeast University, Nanjing, China; Huimin Liu, Huazhong University of Science and Technology, Wuhan, China; Xiaolong Li, Jost Wendt, Department of Chemical Engineering, University of Utah, Salt Lake City, UT, USA; Lunbo Duan, Southeast University, Nanjing, China

10:15 Pilot Study on Removal of Mercury, Sulfur and Nitrate from Coal-Flue Gas by Pulse Plasma, Jun Zhang, Chunbao Zhao, and Ri Li, Nanjing Vocational College of Information Technology, Nanjing, Jiangsu Province, CHINA; Yufeng Duan, Southeast University, Nanjing, Jiangsu Province, CHINA

10:35 Advanced Tools for Assessment of Direct-Fired sCO₂ Power Cycles, Andrew P. Chiodo, Huafeng (Dave) Wang, Kevin A. Davis, Reaction Engineering International, Midvale, UT, USA; Frederick Dryer, Sang Hee Won, and Tanvir Farouk, Mechanical Engineering, University of South Carolina, Columbia, SC, USA

SESSION 11b

CARBON MANAGEMENT—1

Nicholas Siefert and Bingyun Li

10:55 Evaluation of Nanoparticles in the Performance of CO₂ Desorption from Monoethanolamine (MEA) in a Randomly Packed Tower, Jian Liu, Chengdong Kong, Zhongxiao Zhang, Liu Yang, Institute of Thermal Energy Engineering, School of Mechanical Engineering, Shanghai Jiao Tong University, Shanghai, China

11:15 Effect of Shell Thickness of Core Shell MOF on CO₂ Adsorption and Separation, Xiaoqian Ju, Zhiyuan Yang, Yuhang Zhai, Xinbo Duan, and Changguo Wang, Xi'an University of Science and Technology, Xi'an, P. R. China.

11:35 Hydrogen for Decarbonized Electricity and Industrial Sectors—An R&D Perspective, David Lyons, U.S. DOE, National Energy Technology, Morgantown, WV, USA

SESSION 12

SUSTAINABILITY AND THE ENVIRONMENT

Massood Ramezan and Richard Winschel

09:55 Sustainable Development Model on Coal Supply for Coal-Fired Power Plants by using Multi-Objective Optimization with Economic, Environmental, and Social Aspects Consideration, Firly Rachmaditya Baskoro, Keisuke Nagasawa, Katsumi Morikawa, and Katsuhiko Takahashi, Dept. of System Cybernetics, Hiroshima University, Higashihiroshima, JAPAN

10:15 Enhanced CO₂ Physical Solvents for Biogas Upgrading, Robert Thompson, and Jeffrey Culp, NETL, Pittsburgh, PA, USA

10:35 Reactive Transport Modeling of Coal Fly Ash, A Column Study, Mina Mohebbi, Middle Tennessee State University, Murfreesboro, TN, USA

10:55 Characterization of Fine Coal Processing Waste and Its Technological Applications, Julia Meller Mendes Silva, Elen Machado de Oliveira, Elis Machado de Oliveira, Camila Machado de Oliveira, Thuani Gesser Muller, Gracieli Daniel Zanette José Luiz Westrup, and Michael Peterson, Reactors and Industrial Processes Research Group, Materials Science and Engineering, University of the Extreme South of Santa Catarina (UNESC), Criciúma, SC, Brazil Sabrina Tavares, and Rosimeri Venâncio Redivo, Rio Deserto, Urussanga, SC, Brazil

11:15 Life Cycle Water Consumption of Biomass Co-Firing Power Plants with Carbon Capture and Storage, Zitao Wu, University of Wyoming, Laramie, WY, USA; Haibo Zhai, Carnegie Mellon University,

TECHNICAL PROGRAM—ORAL PRESENTATIONS

Pittsburgh, PA, USA

SESSION 13

CARBON MANAGEMENT —2

Nicholas Siefert and Bingyun Li

12:35 Preparation and CO₂ Adsorption Properties of MOF Composites Doped by Ionic Liquid, Changguo Wang, Zhiyuan Yang, Xiaoqian Ju, Xinbo Duan, and Jintao Liu, Xi'an University of Science and Technology, Xi'an, P. R. China.

12:55 Characterization, adsorption isotherms and adsorption rate modelling of activated carbon sorbents for carbon dioxide capture, R.C. Everson, A. Jacobs, G.N. Okolo, J. R. Bunt, and F.van der Merwe, Centre of Excellence in Carbon-based Fuels, School of Chemical and Minerals Engineering, North-West University, Potchefstroom, South Africa.

13:15 Viscosity-Reducing Additives for Water-lean Solvents for Carbon Capture, Xu Zhou, Hunaid Nulwala, RoCo Global, Pittsburgh, PA, USA; Shiaoqiao (Scott) Chen, Carbon Capture Scientific, LLC, Bethel Park, PA, USA, and Hyung Kim, Department of Chemistry, Carnegie Mellon University, Pittsburgh, PA

13:35 Section 45Q Tax Credit Impacts on Carbon Management: Case Study Findings and Modeling Developments, Travis Warner, Derek Vikara, Arun Iyengar, Allison Guinan, Support Contractor, NETL, Pittsburgh, PA, USA; Amanda Harker Steele, Support Contractor, NETL, Morgantown, WV, USA; Christopher Nichols, NETL, Morgantown, WV, USA; Timothy Grant, David Morgan, Donald Remson, Luciane Cunha, and Peter Balash, NETL, Pittsburgh, PA, USA

13:55 Dual CO₂ Capture System to Process Flue Gases from Coal or Natural Gas Fired Boilers in One Train Plant, Ahmed Aboudheir, and Walid Elmoudir Delta CleanTech Inc., Regina, CANADA

SESSION 14

COAL ASH MANAGEMENT

Tarunjit Butalia and David Lyons

12:35 Transforming Rare Earth Oxides into Individual REE Metals, Howard McClintic, CTC Foundation, Arlington, VA 22202, USA

12:55 Rapid Spectroscopy Method for Determining Adsorption Properties of Flyash in Concrete Admixtures, Yongjun Chen, E. S. Arun Thamban, and Hisham Menkara, PhosphorTech Corporation, North Industrial Parkway, Kennesaw Georgia, USA

13:15 Nu-Rock Process to Convert All Ash From Coal Fired Power Stations into a

Usable Product and Abates Carbon Dioxide Emissions and Uses 2% of the Embodied Energy of a Concrete Product or Clay Fired Product, Maroun George M. Rahme, Nu-Rock Technology, Piper Power Station - Portland NSW Australia

13:35 Dewatering & Monitoring CCR - The Current State of Practice, Pierre Gauvin, and Greg Landry, Keller North America, USA

13:55 Environmental Justice Initiatives, Risk Assessment, and Coal Ash Management, Ari S Lewis, Gradient, Boston MA, USA

SESSION 15

CARBON MANAGEMENT —3

Nicholas Siefert and Bingyun Li

14:25 Highly Efficient Photocatalytic Structures and Processes for CO₂ Reforming to Solar Fuels, Yongjun Chen, E. S. Arun Thamban, and Hisham Menkara, PhosphorTech Corporation, Kennesaw, Georgia, USA

14:45 Chemical Energy Storage by Means of Carbon Dioxide Capture and Utilization, Mauro Mureddu, Sarah Lai, Francesca Ferrara, and Alberto Pettinau, Sotacarbo, Carbonia, ITALY

15:05 Open and Detailed Core Data from Domestic Carbon Storage Field Sites, Dustin Crandall, Thomas Paronish, NETL, Morgantown West Virginia, USA; Rhiannon Schmitt, NETL and ORISE, Morgantown West Virginia, USA; Sarah Brown, West Virginia Geological & Economic Survey, Morgantown West Virginia, USA

15:25 U.S. Department of Energy National Carbon Capture Center, Supporting Technology Development for Carbon Capture, CO₂ Utilization, and Direct Air Capture, Michele Corser, National Carbon Capture Center, Southern Company, Wilsonville, AL, USA

15:45 TEA of a Unique Process for Producing High-value Nanomaterials or CO₂ Capture and Sequestration, Rui Wang, and Husain E. Ashkanani, Department of Chemical and Petroleum Engineering, University of Pittsburgh, Pittsburgh, PA, USA ; Bingyun Li, Department of Orthopaedics, School of Medicine, West Virginia University, Morgantown, WV, USA; Badie I. Morsi, Department of Chemical and Petroleum Engineering, University of Pittsburgh, Pittsburgh, PA, USA

16:05 Pre-combustion CO₂ Capture using Ionic Liquids, Husain E. Ashkanani, Rui Wang, Wei Shi, Nicholas S. Siefert, Robert L. Thompson, Kathryn H. Smith, Janice A. Steckel, Isaac K. Gamwo, David Hopkinson, Kevin Resnik, and Badie I. Morsi, U.S. Department of Energy, NETL, Pittsburgh, PA,

USA

SESSION 16

VALUE-ADDED PRODUCTS FROM COAL —2

John Duddy and Joseph Stoffa

14:25 Preparation and HRTEM Characterization of Symbiosis of Coal-based Graphene and Coal-based Graphene Quantum Dots, Yuegang Tang, Ruiqing Li, Qili Che, Pengliang Ma, Jiangtao Fan, Peng Luo, College of Geoscience and Surveying Engineering, China University of Mining and Technology (Beijing), Beijing, China; Yangquan Xinyu, Geotechnical Engineering Co., Ltd., Yangquan, China

14:45 Application and Development of X-MAT® Coal Core Composites for Building Components, William Easter Semplastics, Oviedo, FL, USA

15:05 Taking Advantage of Oxygen Rich Subbituminous PRB Coal to Produce Hybrid Asphalt Additives using Renewable Carbon Sources, Jeramie J. Adams, Western Research Institute, Laramie, WY, USA; Devang Khambhati, Jianqiang Huo, William Schaffers, David Bell, Richard Horner, University of Wyoming School of Energy Resources, Laramie, WY, USA; Jean-Pascal Planche, Western Research Institute, Laramie, USA

15:25 Conversion of Coal Liquids to Isotropic Pitch for the Production of Mesophase Pitch, Cierra Crowe, E. Ashley Morris, Rachel Kaplan, and Matthew C. Weisenberger, University of Kentucky Center for Applied Energy Research, Lexington, KY 40511, USA

15:45 The Use of Softening Point and QI Content to Tune the Conversion of Isotropic Coal Tar Pitch to Mesophase Pitch Toward the Development of Multifilament Spinning for Carbon Fibers, Kirk Norasak, George Frank, Justin Lacy, John J. McHugh, and Matthew C. Weisenberger, University of Kentucky Center for Applied Energy Research, Lexington, KY 40511, USA

16:05 Formation of Coal Liquids from Various Seams of Coal with Direct Solvents, John J. McHugh, Rachel Kaplan, E. Ashley Morris, Matthew C. Weisenberger, University of Kentucky Center for Applied Energy Research, Lexington, KY 40511, USA

TECHNICAL PROGRAM—ORAL PRESENTATIONS

ORAL SESSIONS

Thursday, September 23

08:00—16:25

SESSION 17

POWER PLANTS —1

Ting Wang and Francis Lau

08:05 Removal of SO₂ and NO_x from Flue Gas by Adsorption over Activated Carbon at Cold Temperatures, Shiqing Wang, Lianbo Liu, Jinyi Wang, Huaneng Clean Energy Research Institute, Beijing, CHINA; Shiwang Gao, Hongwei Niu, Beijing Key Laboratory of CO₂ Capture and Process, Beijing, CHINA

08:25 High-Temperature Multi-Process Sensor Development for a PC-fired Unit, Hong-Shig Shim, Zhonghua Zhan, Kevin Davis, Andrew Chiodo, Marc Cremer, Reaction Engineering International, Boulevard, Midvale, UT, USA

08:45 SO₃/H₂SO₄ Continuous Real-Time Sensor Demonstration at a Power Plant, Jason Kriesel, Ilya Dunayevskiy, OptoKnowledge Systems, Inc., Torrance CA, USA; Brent Spang, Gary Shiimoto, Lawrence Muzio, Fossil Energy Research Corporation (FERCo), Laguna Hills, CA, USA; Andrea Biasioli, Yu-Chien Chien, Derek Dunn-Rankin, University of California, Irvine (UCI), Irvine CA, USA; Richard Himes, Electric Power Research Institute (EPRI), Palo Alto, CA, USA

09:05 Rapidly ramp cryogenic air separation unit without loss of O₂ product purity—application for low-carbon fossil-fuel plants, Mao Cheng, Piyush Verma, Zhiwei Yang, and Richard L. Axelbaum, Washington University in St. Louis, MO, USA

09:25 Simulation Study of the Start-up Period of Once-Through Boilers, Xuandai Ngo, Byungho Song, Department of Chemical Engineering, Kunsan National University, Gunsan, Korea; Jaehyeon Park, Dowon Shun and Jaegoo Lee, Korea Institute of Energy Research, Daejeon, Korea

SESSION 18

POWER PLANTS —2

Ting Wang and Francis Lau

09:55 Waste Heat Recovery in a Simulated Liquefied Natural Gas (LNG) Plant, Shisir Acharya, and Ting Wang, Energy Conversion and Conservation Center, University of New Orleans, New Orleans, LA, USA

10:15 Optimization by Automatic Control with Acoustic Gas Temperature

Measurement – Improvement of Efficiency, Emissions, and Plant Availability, Matthias Ritter, Manfred Deuster, Atul Sharma, Bonnenberg & Drescher GmbH, Aldenhoven Germany

10:35 Development of Adsorbents for the Removal of Elemental Mercury from Coal Gasification Gas, Md. Azhar Uddin, Kento Fujiyama, and Yoshiie Kato, Graduate School of Environmental and Life Science, Okayama University Japan

10:55 Unit Flexibility: Keep Your Coal Unit Viable and Marketable, Bruce J. Ogden, EAPC Industrial Services

11:35 Filling the Gaps: What Impacts Hydrated Lime Dry Scrubbing Performance?, Ian Saratovsky, Lhoist North America, Fort Worth, TX, USA

SESSION 19

POWER PLANTS —3

Eric Grol and Ting Wang

12:35 Accelerating Large-Scale Decarbonization of Coal Power Plants Through Improving Condenser Efficiency, Vinod Veedu, Matthew Nakatsuka, Sumil Thapa, and Alexander Ventura, Oceanit, Houston, TX, USA

12:55 FGD Effluent Treatment Modeling and Speciation Analysis Before & After Phys/Chem/Biological Treatment using Aqueous Chemistry Software, Nicholas Siefert, NETL, Pittsburgh, PA, USA; Britley Jones, Chemical and Biological Engineering Department, Princeton University, Princeton, NJ, USA

13:15 Effective Removal of Trace Levels of Toxic Heavy Metals from Flue Gas Desulfurization Wastewater Using SiO₂ Supported Hydrogel Sorbent, Qiuming Wang, Walter C. Wilfong, Brian Kail, Tuo Ji, Fan Shi, Support Contractor NETL, Pittsburgh, PA, USA; McMahan Cray, NETL, Pittsburgh, PA, USA

13:35 Development of a Novel Thermal Battery for the Flexibilization of Fossil-Fired Power Plants, Julio Bravo, Justin Caspar, Sudhakar Neti, Zheng Yao, Alparslan Oztekin, Carlos Romero, Shuoyu Wang, Ahmed Abdulridha, Clay Naito, Muhammad Suleiman, Spencer Quiel, Lehigh University ATLSS Engineering Research Center, Bethlehem, PA, USA, Yue Xiao, Devon Jensen, Chien-Hua Chen, Advanced Cooling Technologies, Lancaster, PA, USA

13:15 Hydrogen Blending with Natural Gas for Transportation Via Pipeline: Current Issues and Potential Solutions, David Lyons, U.S. DOE, National Energy Technology, Morgantown, WV, USA; Alfred Chang, Henry A. Long, III, Christopher Munson, Massood Ramezan, KeyLogic

Systems, Inc.

SESSION 20

CLEAN COAL DEMONSTRATION AND COMMERCIAL PROJECTS

Thomas Sarkus and Eric Grol

14:25 An Integrated Energy System for Thar Coal in Pakistan, Farid A. Malik, FC College, A Chartered University, Ferozepur Road, Lahore Pakistan

14:45 Slipstream Testing of Amine-Based Solvents at a Low-Rank Coal-Fired Power Plant, Joshua Strege, Jason Laumb, John Kay, and John Oleksik, University of North Dakota Energy & Environmental Research Center, Grand Forks, ND, USA

15:05 ODYSSEUS - Coal-to-Liquids Supply Chain Integration in View of Operational, Economic and Environmental Risk Assessments Under Unfavorable Geological Settings, Thomas Kempka, Natalie Nakaten, Christopher Otto, GFZ German Research Centre for Geosciences, Telegrafenberg, GERMANY; Friedemann Mehlhose, Technische Universität Bergakademie Freiberg, Freiberg, GERMANY; Torsten Gorka, Stephan Peters, DMT GmbH & Co., Essen, GERMANY; Vasiliki Gemeni, Pavlos Krassakis, Konstantina Pyrgaki, Nikolaos Koukouzas, Centre for Research and Technology, Hellas (CERTH), Marousi, GREECE; Aikaterini Kapsampeli, Georgios Louloudis, Christos Roumpos, Public Power Corporation of Greece, Athens, GREECE; Mária Hámor-Vidó, University of Pécs, Department of Geology and Meteorology, Pécs, HUNGARY; István Kalmár, Calamites Ltd., Nagymanyok, HUNGARY; Krzysztof Kapusta, Marian Wiatowski, Główny Instytut Górnictwa (GIG), Plac Gwarków, Katowice, POLAND; Sam Parsons, Vasilis Sarhosis, University of Leeds, Leeds, UNITED KINGDOM

15:25 Design and Performance Considerations for the FEED Study of an Advanced Pressurized Fluidized Bed Combustion Power Plant with Carbon Dioxide Capture and Storage, Stephen E. Winter, Daniel P. Connell, Jacqueline M. Fidler, CONSOL Energy Inc., Canonsburg, PA, USA

15:45 Flameless Pressurized Oxy-Fuel (FPO) Technology Update & Commercialization Objectives, Massimo Malavasi, Richard A. Horner, School of Energy Resources, University of Wyoming, USA

16:05 Combustion Related Considerations in the Retrofit of a Pulverized Coal Fired Boiler Utilizing Oxy-Coal Technology, Andrew P. Chiodo, Kevin A. Davis, Brydger Van Otten, Reaction Engineering International, Midvale, UT, USA, and Steve Krimsky, Jupiter Oxygen Corporation, Des Plaines, IL, USA

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