

# **Greenhouse Gas Management**

**Topical Conference at the 2010 AIChE Spring Meeting  
and 6th Global Congress on Process Safety**

**San Antonio, Texas, USA  
21 – 25 March 2010**

**ISBN: 978-1-61738-438-7**

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© (2010) by AIChE  
All rights reserved.

Printed by Curran Associates, Inc. (2010)

For permission requests, please contact AIChE  
at the address below.

AIChE  
3 Park Avenue  
New York, NY 10016-5991

Phone: (203) 702-7660  
Fax: (203) 775-5177

[www.aiche.org](http://www.aiche.org)

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2634  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

## TABLE OF CONTENTS

<b>Impact of Carbon Cap and Trade On Refinery Conservation Economics .....</b>	1
<i>Ian M. Glasgow, Stan Polcar, Earl Davis, Tram Nguyen, Raj Subbiah, Jerry Price, Chris Stuecheli, R.E. (Ed) Palmer</i>	
<b>Reduction of CO<sub>2</sub> Emissions in a Refinery.....</b>	12
<i>Jason L. Stahlman, Richard Isherwood</i>	
<b>Update on Carbon Capture Technology .....</b>	13
<i>Robert G. Hilton</i>	
<b>Aim for Autothermal Operation in Diesel Production .....</b>	50
<i>Francois R. Reverdy</i>	
<b>Screening CHP Configurations for Improved Performance and CO<sub>2</sub> Reduction: Revisiting the R-Curves.....</b>	51
<i>Oscar Aguilar</i>	
<b>CO<sub>2</sub> Footprinting in the Chemical Industry .....</b>	52
<i>Russell Heinen</i>	
<b>Progression of GHG Emissions Benchmarking.....</b>	72
<i>Claire Cagnolatti, Kevin Henke</i>	
<b>Carbon Capture in Cracking Furnaces .....</b>	78
<i>Gunther Schmidt, Markus Weikl</i>	
<b>Carbon Capture and Storage - Can CCS Be A Viable Business.....</b>	88
<i>Ray Hattenbach</i>	
<b>GHG Emission Reporting Rule .....</b>	102
<i>Mary Ellen Ternes, David M. Winfrey, Kristine D. Baranski, Deanne Hughes</i>	
<b>Workshop: CO<sub>2</sub> Emission Reporting in Ethylene Plants - Part I .....</b>	115
<i>David M. Winfrey, Kristine D. Baranski, Mary Ellen Ternes, Deanne Hughes</i>	
<b>Workshop: CO<sub>2</sub>e Emission Reporting in Ethylene Plants - Part II .....</b>	128
<i>David M. Winfrey, Kristine D. Baranski, Mary Ellen Ternes, Deanne Hughes</i>	
<b>Novel Polymer Membrane Process for Pre-Combustion CO<sub>2</sub> Capture From Coal-Fired Syngas .....</b>	129
<i>Timothy C. Merkel, Meijuan Zhou, Sylvie Thomas, Haiqing Lin, Adrain Serbanescu</i>	
<b>Evaluation of the Technical and Economic Performance of the Calcium Looping Process for CO<sub>2</sub> and H<sub>2</sub>s Capture From Coal-Derived Synthesis Gas.....</b>	130
<i>Daniel P. Connell, Shwetha Ramkumar, L. S. Fan, Robert M. Statnick</i>	
<b>Development of Freeze Granulated Oxygen Carriers for Chemical Looping Combustion of Solid Fuels.....</b>	132
<i>Yi Zhang, Aurora M. Rubel, Kunlei Liu, James K. Neathery, Joseph E. Remias</i>	
<b>Pulverized Coal Pyrolysis &amp; Gasification in N<sub>2</sub>/O<sub>2</sub>/CO<sub>2</sub> Atmospheres by Thermo-Gravimetric Analysis.....</b>	141
<i>Muhammad Faisal Irfan</i>	
<b>Future Feedstocks for Petroleum and Petrochemical Industries.....</b>	142
<i>D. P. Lal</i>	
<b>Greenhouse Gas Legislation, Regulation and Litigation .....</b>	152
<i>Mary Ellen Ternes, David M. Winfrey</i>	
<b>IP Strategy Options for Emerging Technologies in the Low-Carbon Energy Space .....</b>	153
<i>Mark C. Meyer, Ilian Iliev</i>	
<b>Complying with the EPA Mandatory GHG Reporting Rule, 40 C.F.R. Part 98 .....</b>	163
<i>Mary Ellen Ternes, David M. Winfrey, Glen A. Capra</i>	
<b>Analysis of Greenhouse Gas (GHG) Regulation Impacts to the U.S. Refining Industry .....</b>	164
<i>Ian M. Glasgow, Stan Polcar, R.E. (Ed) Palmer</i>	
<b>High Capacity Regenerable Sorbent for Pre-Combustion CO<sub>2</sub> Capture .....</b>	165
<i>Gökhan Alptekin, Ambalavanan Jayaraman, Steve Dietz, Margarita Dubivik, Lauren Brickner</i>	
<b>The Third C in CCS - Compression .....</b>	167
<i>Dipanjan Bhattacharya, Ramachandra P. Tekumalla, David Messersmith, Lee Schmoe, Tomas Maramba</i>	
<b>Catalytic Dehydrogenation of Methylecyclohexane for the On-Board Hydrogen Storage and Supply .....</b>	168
<i>Muhammad R. Usman, David L. Cresswell, Arthur A. Garforth</i>	
<b>Molecular Simulations and Predictions of Pure and Mixed CO<sub>2</sub>/H<sub>2</sub> Gas Absorption Into Some Ionic Liquids .....</b>	169
<i>Wei Shi, Dan C. Sorescu</i>	

<b>Elastic Layered Metal-Organic Framework Absorbents for Carbon Dioxide Capture .....</b>	170
<i>Christian M. Lastoskie, Tran D. Trinh</i>	
<b>A Solid-Gas Ideal Gibbs Reactor Model for Natural Gas Reforming in the Presence of CaO .....</b>	172
<i>Jorge Pena Lopez, Vasilios I. Manousiouthakis</i>	
<b>Hydrogen Fill-Up Pressure and Temperature Modeling.....</b>	180
<i>Fernando Olmos, Sophia Munoz, Carlos Garcia, Aurora Garcia, Marcos Pantoja, Justin Garrett, Vasilios I. Manousiouthakis</i>	
<b>Post-Combustion Carbon Capture Research Progress through the DOE/NETL Existing Plants Program.....</b>	186
<i>Timothy E. Fout, Jared Ciferno, Lynn Brickett</i>	
<b>Vapor-Liquid Equilibrium (VLE) Study of CO<sub>2</sub> with MEA and Ammonia Solvents .....</b>	187
<i>Donald Johnson, Zhe Lu, Joseph E. Remias, Kunlei Liu, James K. Neathery</i>	
<b>Stripper Configurations for CO<sub>2</sub> Capture by Aqueous Amines .....</b>	188
<i>David H. Van Wagenen, Gary T. Rochelle</i>	
<b>Enhancing Post-Combustion CO<sub>2</sub> Capture in Power Plant – A Catalytic Approach.....</b>	196
<i>Reynolds A. Frimpong, Quanzhen Huang, Joseph E. Remias, James K. Neathery, Kunlei Liu</i>	
<b>Design of a Continuous Foam-Bed Reactor System for CO<sub>2</sub> Removal From Power-Plant Exhausts .....</b>	197
<i>Amit A. Gaikwad, Ashok N. Bhaskarwar</i>	
<b>An Incremental, Multi-Technology Approach to Retrofitting Existing Pulverized Coal Power Plants for Carbon Capture.....</b>	201
<i>David C. Miller</i>	
<b>A Two-Tiered Approach to Managing Greenhouse Gas Emissions in US Petroleum Refineries .....</b>	202
<i>Abhishek Pednekar, Dennis Aguirre</i>	
<b>Effects of Nitrogen Ions Concentration On South African Fresh Water High CO<sub>2</sub> Tolerant Microalgae Growth.....</b>	204
<i>Edmore Kativu, Tonderayi Matambo, Diane Hildebrandt, David Glasser, Karl Rumbold</i>	
<b>Using and Measuring the Combined Heat and Power Advantage .....</b>	206
<i>Tommy John</i>	
<b>Design of Ultra-Low NO<sub>x</sub> Critical Furnaces .....</b>	213
<i>Marco W.M. Van Goethem, I. J. Risseeuw, Simon Barendregt, Alessio Frassoldati</i>	
<b>Improving Combustion and Oxidation Reactions: When to Use Oxygen.....</b>	222
<i>Reed J. Hendershot, Timothy D Lebrecht, Nancy C Easterbrook</i>	
<b>Status Report: Process Technology Improvements in Supercritical Water Oxidation (C.L.E.A.N. Tech) .....</b>	231
<i>Carol A. Blaney</i>	
<b>Measurements of Carbon Dioxide Capture in Various Amines-Ionic Liquids-Water Systems .....</b>	232
<i>Yansong Zhao, Xiangping Zhang, Haifeng Dong, Suojiang Zhang</i>	
<b>Hybrid Membrane Absorption Process for Post Combustion CO<sub>2</sub> Capture .....</b>	234
<i>S. James Zhou, Howard S. Meyer, Benjamin Bikson, Yong Ding</i>	
<b>Post-Combustion CO<sub>2</sub> Capture Using An Efficient Membrane Process .....</b>	243
<i>Xiaotong Wei, Timothy C. Merkel, Haiqing Lin, Bilgen Firat, Jenny He, Karl D. Amo, Richard Baker</i>	
<b>Characterization of Coal Flame Impacts Under Oxy-Combustion .....</b>	245
<i>Bradley Adams, Andrew Fry</i>	
<b>Equilibrium and Kinetic Studies Carbon Dioxide Capturing On Ca-Based Sorbents .....</b>	248
<i>Jorge Pena Lopez, Panagiotis (Peter) Smirniotis, Vasilios I. Manousiouthakis</i>	
<b>Metal-Adeninate Porous Materials for Selective CO<sub>2</sub> Capture.....</b>	249
<i>Nathaniel L. Rosi</i>	
<b>Theoretical Screening Good Sorbents for CO<sub>2</sub> Separation .....</b>	250
<i>Yuhua Duan</i>	
<b>Utilization of Carbon Dioxide Towards Control/Suppression of Underground Coal Fires .....</b>	261
<i>Ali S. Rangwala, Evan J. Granite</i>	
<b>Possible Use for CO<sub>2</sub> Captured from Coal Derived Flue Gas: Reforming of Methane in Electric Discharge Plasma.....</b>	267
<i>Erik C. Rupp, Evan J. Granite</i>	
<b>Survey of Potential Uses for Carbon Dioxide Captured From Coal-Burning Power Plants.....</b>	269
<i>Evan J. Granite, Erik C. Rupp, Bryan D. Morreale, Henry W. Pennline, Dirk Link, David Luebke, Todd H. Gardner</i>	
<b>Study On Flare Minimization During Ethylene Plant Upsets.....</b>	271
<i>Xiongtao Yang, Qiang Xu, Kuyen Li</i>	
<b>Simulating Industrial Ethylene Flares .....</b>	272
<i>Hitesh Vaid, Anjan Tula, Kanwar Devesh Singh, Daniel H. Chen, Helen H. Lou, Kuyen Li, Xianchang Li, Christopher Martin</i>	

<b>Proactive Flare Minimization During Chemical Plant Startups.....</b>	273
<i>Chaowei Liu, Xiongtao Yang, Qiang Xu, Kuyen Li</i>	
<b>Modeling and Optimization of a Packed-Bed Tubular Reactor for Eco-Friendly Epichlorohydrin Production.....</b>	274
<i>Woohyun Kim, Choamun Yun, Young Kim, Jeongho Park, Sunwon Park, Ki Taek Jung, Kyoung Sup Woo, Yong Hwa Lee, Sae Heon Kim</i>	
<b>Synthesis of <math>\alpha</math>-Hydroxy Dodecanoic Acid by Hydrolysis of <math>\alpha</math> -Chlorine Dodecanoic Acid.....</b>	276
<i>Wenfu Chen, Yun Fang</i>	
<b>Author Index</b>	