

Edited by

Guangxi Yue
Hai Zhang
Changsui Zhao
Zhongyang Luo

**Proceedings of
the 20th International Conference on
Fluidized Bed
Combustion**

(I)



Tsinghua University Press



Springer

Proceedings of
the 20th International Conference on
**Fluidized Bed
Combustion**

(I)

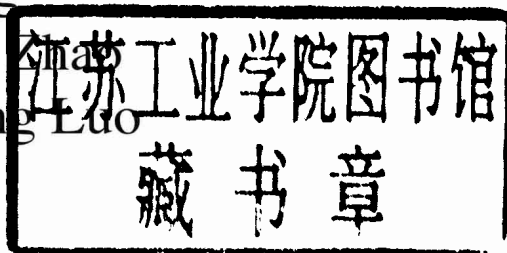
Edited by

Guangxi Yue

Hai Zhang

Changsui Ma

Zhongyang Luo



Tsinghua University Press
Beijing



Springer

版权所有，侵权必究。侵权举报电话：010-62782989 13701121993

图书在版编目(CIP)数据

第20届国际流化床燃烧会议论文集 = Proceedings of the 20th International Conference on Fluidized Bed Combustion: 英文/岳光溪, 张海, 赵长遂, 骆仲泱主编. —北京: 清华大学出版社, 2009. 5

ISBN 978-7-302-20146-5

I. 第… II. ①岳… ②张… ③赵… ④骆… III. 流化床—循环锅炉—锅炉燃烧—国际学术会议—文集—英文 IV. TK229.5-53

中国版本图书馆CIP数据核字(2009)第064479号

责任编辑: 张占奎

责任校对: 王淑云 赵丽敏 刘玉霞

责任印制: 孟凡玉

出版发行: 清华大学出版社

<http://www.tup.com.cn>

社总机: 010-62770175

投稿与读者服务: 010-62776969, c-service@tup.tsinghua.edu.cn

质量反馈: 010-62772015, zhiliang@tup.tsinghua.edu.cn

地址: 北京清华大学学研大厦A座

邮编: 100084

邮购: 010-62786544

印刷者: 北京密云胶印厂

装订者: 北京市密云县京文制本装订厂

经销: 全国新华书店

开本: 210×297 总印张: 76

总字数: 1769千字

版次: 2009年5月第1版

印次: 2009年5月第1次印刷

印数: 1~700

定价: 298.00元(I、II)

本书如存在文字不清、漏印、缺页、倒页、脱页等印装质量问题, 请与清华大学出版社出版部联系调换。联系电话: 010-62770177 转 3103 产品编号: 031955-01

PREFACE

The Proceedings of the 20th International Conference on Fluidized Bed Combustion (FBC) collect 9 plenary lectures and 175 peer-reviewed technical papers presented in the conference held in Xi'an China in May 18-21, 2009. The conference was the 20th conference in a series, covering the latest fundamental research results, as well as the application experience from pilot plants, demonstrations and industrial units regarding to the FBC science and technology. It was co-hosted by Tsinghua University, Southeast University, Zhejiang University, China Electricity Council and Chinese Machinery Industry Federation.

A particular feature of the proceedings is the balance between the papers submitted by experts from industry and the papers submitted by academic researchers, aiming to bring academic knowledge to application as well as to define new areas for research.

The authors of the proceedings are the most active researchers, technology developers, experienced and representative facility operators and manufacturers. They presented the latest research results, state-of-the-art development and projects, and the useful experience.

The proceedings are divided into following sections:

- CFB Boiler Technology, Operation and Design
- *Fundamental Research on Fluidization and Fluidized Combustion*
- CO₂ Capture and Chemical Looping
- Gasification
- Modeling and Simulation on FBC Technology
- Environments and Pollutant Control
- Sustainable Fuels

The proceedings can be served as idea references for researchers, engineers, academia and graduate students, plant operators, boiler manufacturers, component suppliers, and technical managers who work on FBC fundamental research, technology development and industrial application.

The editors would like to take this opportunity to thank our FBC colleagues around the world who devoted much of their time to review the manuscripts to keep the scientific standard of the proceedings.

Xi'an, China
May 2009
Guangxi YUE
Hai ZHANG
Changsui ZHAO
Zhongyang LUO

Steering Committee Members:

Anthony, J. Edward	CETC-O,Natural Resources, Canada
Basu, Prabir	Dalhousie University, Canada
Bonk, L. Donald	National Energy Technology Laboratory, USA
Bulewicz, M. Elzbieta.	Cracow University of Technology, Poland
Cabanillas, Andres	CIEMAT, Spain
Chen, Hanping	Huazhong Science and Technology University, China
Chyang, Chien-Song	Chung Yuan Christian University, Taiwan, China
DeLallo, R. Michael	Parsons Infrastructure & Technology Group,Inc., USA
Grace, John	University of British Columbia, Canada
Gulyurtlu, Ibrahim	INETI, Portugal
Horio, Masayuki	Tokyo University of Agriculture & Technology, Japan
Hotta, Arto	Foster Wheeler Power Group, Inc., Finland
Hrdlicka, Frantisek	CVUT Prague, Czech Republic
Hupa, Mikko	Abo Akademi University, Finland
Jaud, Philippe	R&D Division EDF, France
Jia, Lufei	CETC-O,Natural Resources, Canada
Kim, Sang Done	Korea Advanced Institute of Science and Technology, South Korea
Leckner, Bo	Chalmers University of Technology, Sweden
Luo, Zhongyang	ZhejiangUniversity, China
Maryamchik, Mikhail	Babcock & Wilcox, USA
Miccio, Michele	University of Salerno, Italy
Mustonen, John	Stone & Webster Consultants, USA
Newby, A. Richard	Siemens-Westinghouse Power Corp., USA
Nowak Wojciech	Czestochowa University of Technology , Poland
Pham, Hoang Luong	Hanoi Univeristy of Technology, Vietnam
Preto, Fernando	CETC-O,Natural Resources, Canada
Rozelle, Peter	Department of Energy, USA
Rubow, N. Lynn	Parsons Energy and Chemicals Group, USA
Selcuk, Nevin	Middle East Technical University, Turkey
Skowrya, Richard	Alstom Power, USA
Wedel, von George	Lurgi Energie und Entsorgung, Germany
Werther, Joachim	Technical University Hamburg-Harburg, Germany
Wietzke, L. Donald	Babcock & Wilcock Company, USA
Winter, Franz	Vienna University of Technology, Austria
Yue, Guangxi	Tsinghua University, China
Zhao, Changsui	Southeast University, China

Sponsors

China National Machinery & Equipment Import & Export Corporation



China Power Investment Corporation



Dongfang Electric Corporation



Foster Wheeler Corporation



Harbin Electric Corporation



National Nature Science Foundation of China



Shanghai Electric Corporation



Qingdao Songling Power Environmental Equipment Co., Ltd



Taiyuan Boiler Works



Wuxi Boiler Works



Yixin High Alumina Bricks Company

CONTENTS

Keynotes

LATEST DEVELOPMENT OF CFB BOILERS IN CHINA	G. X. Yue, H. R. Yang, J. F. Lu, H. Zhang	3
GASIFICATION OF BIOMASS IN FLUIDISED BED: REVIEW OF MODELLING	A. Gómez-Barea, B. Leckner	13
POTENTIALS OF BIOMASS CO-COMBUSTION IN COAL-FIRED BOILERS	J. Werther	27
Formation and Reduction of Pollutants in CFBC: From Heavy Metals, Particulates, Alkali, NO _x , N ₂ O, SO _x , HCl	Franz Winter	43
LATEST EVOLUTION OF OXY-FUEL COMBUSTION TECHNOLOGY IN CIRCULATING FLUIDIZED BED	C .S. Zhao, L. B. Duan, X .P. Chen, C. Liang	49
FOSTER WHEELER'S SOLUTIONS FOR LARGE SCALE CFB BOILER TECHNOLOGY: FEATURES AND OPERATIONAL PERFORMANCE OF ŁAGISZA 460 MWe CFB BOILER	Arto Hotta	59
FLUIDIZED COMBUSTION OF LIQUID FUELS: PIONEERING WORKS, PAST APPLICATIONS, TODAY'S KNOWLEDGE AND OPPORTUNITIES	M. Miccio, F. Miccio	71
DIRECT NUMERICAL SIMULATION OF VERTICAL PARTICULATE CHANNEL FLOW IN THE TURBULENT REGIME	M. Uhlmann, A. Pinelli	83
GASIFICATION IN FLUIDIZED BEDS – PRESENT STATUS & DESIGN	Prabir Basu, Bishnu Acharya, Animesh Dutta	97

CFB Boiler Technology, Operation and Design

RESEARCH AND DEVELOPMENT OF LARGE CAPACITY CFB BOILERS IN TPRI	Sun Xianbin, Jiang Minhua	107
EXPERIENCE FROM THE 300 MWe CFB DEMONSTRATION PLANT IN CHINA	P. Gauvillé, J.-C. Semedard, S. Darling	113
PROJECT MAXAU – FIRST APPLICATION OF HYBRID CFB TECHNOLOGY BY AUSTRIAN ENERGY & ENVIRONMENT	Kurt Kaufmann, Herbert Köberl, Thomas Zotter	121
1300°F 800 MWe USC CFB BOILER DESIGN STUDY	Archie Robertson, Steve Goidich, Zhen Fan	125
STRUCTURE AND PERFORMANCE OF A 600MWe SUPERCRITICAL CFB BOILER WITH WATER COOLED PANELS	Y. Li, L. Nie, X. K. Hu, G. X. Yue, W. K. Li, Y.X. Wu, J. F. Lu, D. F. Che	132
STARTUP, COMMISSIONING AND OPERATION OF FENYI 100MW CFB BOILER	Zhiwei Wang, Wugao Yu, Shi Bo	137
DESIGN AND OPERATION OF LARGE SIZE CIRCULATING FLUIDIZED BED BOILER FIRED SLURRY AND GANGUE	Zhang Man, Bie Rushan, Wang Fengjun	143
PERFORMANCE IMPROVEMENT OF 235 MWe AND 260 MWe CIRCULATING FLUIDIZED BED BOILERS	W. Nowak, R. Walkowiak, T. Ozimowski, J. Jablonski, T. Trybala S.	151
B&W IR-CFB: OPERATING EXPERIENCE AND NEW DEVELOPMENTS	M. Maryamchik, D.L. Wietzke	157
NO _x EMISSION REDUCTION BY THE OPTIMIZATION OF THE PRIMARY AIR DISTRIBUTION IN THE 235MWe CFB BOILER	P. Mirek, T. Czakiert, W. Nowak	162

HEAT TRANSFER COEFFICIENT DISTRIBUTION IN THE FURNACE OF A 300MWe CFB BOILER P. Zhang, J. F. Lu, H. R. Yang, J. S. Zhang, H. Zhang, G. X. Yue	167
CALCULATION AND ANALYSIS OF HEAT TRANSFER COEFFICIENTS IN A CIRCULATING FLUIDIZED BED BOILER FURNACE Zhiwei Wang, Jianhua Yang, Qinghai Li	172
RESEARCH ON THE HYDRAULIC CHARACTERISTICS OF A 600MW SUPERCRITICAL PRESSURE CFB BOILER D. Yang, J. Pan, Q. C. Bi, Y. J. Zhang, X. G. Jiang, L. Yu	180
STUDY OF NOX EMISSION CHARACTERISTICS OF A 1025t/h COAL-FIRED CIRCULATING FLUIDIZED BED BOILER Q.Y. Li, Z.D. Mi, Q.F. Zhang	186
MERCURY EMISSION AND REMOVAL OF A 135 MW CFB UTILITY BOILER Y.F. Duan, Y.Q. Zhuo, Y.J. Wang, L. Zhang, L.G. Yang, C.S. Zhao	189
NOVEL CFB BOILER TECHNOLOGY WITH RECONSTRUCTION OF ITS FLUIDIZATION STATE H. R. Yang, H. Zhang, J. F. Lu, Q. Liu, Y. X. Wu, G. X. Yue, J. SU, Z. P. Fu	195
DEVELOPMENT OF FLEXI-BURN™ CFB POWER PLANT TO MEET THE CHALLENGE OF CLIMATE CHANGE Horst Hack, Zhen Fan, Andrew Seltzer, Arto Hotta, Timo Eriksson, Ossi Sipu	200
DESIGN AND APPLICATION OF NOVEL HORIZONTAL CIRCULATING FLUIDIZED BED BOILER Q. H. Li, Y. G. Zhang, A. H. Meng	206
DESIGN AND OPERATION OF CFB BOILERS WITH LOW BED INVENTORY Jun Su, Xiaoxing Zhao, Jianchun Zhang, Aicheng Liu, Hairui Yang, Guangxi Yue, Zhiping Fu	212
OPERATIONAL STATUS OF 135MWe CFB BOILERS IN CHINA J.F. Li, S. Yang, J. H. Hao, J. H. Mi, J. F. Lu, H. M. Ji, H. T. Huang, H. R. Yang, G. X. Yue	219
IN DEVELOPPING A BENCH-SCALE CIRCULATING FLUIDIZED BED COMBUSTOR TO BURN HIGH ASH BRAZILIAN COAL-DOLOMITE MIXTURES Jhon Jairo Ramírez Behainne, Rogério Ishikawa Hory, Leonardo Goldstein Jr, Araújo Augusta Bernárdez Pécora	224
INDUSTRIAL APPLICATION STUDY ON NEW-TYPE MIXED-FLOW FLUIDIZED BED BOTTOM ASH COOLER B.Zeng, X.F.Lu, H.Z.Liu	231
OPERATION EXPERIENCE AND PERFORMANCE OF THE FIRST 300MWe CFB BOILER DEVELOPED BY DBC IN CHINA Q. Guo, X.S. Zheng, Q. Zhou, L. Nie, T.S. Liu, X.K. Hu, J.F. Lu	237
OPERATIONAL STATUS OF 300MWe CFB BOILER IN CHINA J.F. Li, J. H. Mi, J. H. Hao, S. Yang, H. T. Huang, H. M. Ji, J. F. Lu, G. X. Yue	243
ADVANCED REFRACTORY AND ANTI-WEARING TECHNOLOGY OF CYCLONE SEPARATOR IN CFB BOILER H. P. Chen, Y. Q. Shen X. H. Wang.X. M. Dai H. Y. Xue D. C. Liu	247
ABRASION-RESISTANT TECHNOLOGY AND ITS PROSPECT FOR CFB BOILERS H. Zheng, Y. J. Li, L. J. Wang, S. H. Liu, Q. R. Dou	250
COMPARION OF MERCURY EMISSIONS BETWEEN CIRCULATING FLUIDIZED BED BOILER AND PULVERIZED COAL BOILER Y. J. Wang, Y. F. Duan, C. S. Zhao	256
CO-COMBUSTION OF REFUSE DERIVED FUEL WITH ANTHRACITES IN A CFB BOILER Dong-Won Kim, Jong-Min Lee, Jae-Sung Kim	262
COMBUSTION OF POULTRY-DERIVED FUEL IN A CFBC Lufei Jia and Edward J. Anthony	271
THERMAL EFFECTS BY FIRING OIL SHALE FUEL IN CFB BOILERS D. Neshumayev, A. Ots, T. Parve, T. Pihu, K. Plamus, A. Prikk	277
ECONOMICAL COMPORISON PC AND CFB BOILERS FOR RETROFIT AND NEW POWER PLANTS IN RUSSIA G. A. Ryabov	282

Fundamental Research on Fluidization and Fluidized Combustion

CHARACTERIZATION OF FINE POWDERS	
..... Matthew Krantz, Hui Zhang, Jesse Zhu	291
VELOCITY OF COMPLETE FLUIDIZATION OF A POLYDISPERSE MIXTURE OF VARIOUS FUELS	
..... Yu. S. Teplitskii, V. I. Kovenskii, V. A. Borodulya	298
EFFECTS OF TEMPERATURE AND PARTICLE SIZE ON MINIMUM FLUIDIZATION AND TRANSPORT VELOCITIES IN A DUAL FLUIDIZED BED	
..... J. H. Goo, M. W. Seo, S. D. Kim, B. H. Song	305
FLUIDIZATION CHARACTERISTICS OF STALK-SHAPED BIOMASS IN BINARY PARTICLE SYSTEM	
..... Y. Zhang, B. S. Jin, W. Q. Zhong	311
BOTTOM ZONE FLOW PROPERTIES OF A SQUARE CIRCULATING FLUIDIZED BED WITH AIR STAGING	
..... Zhengyang Wang, Shaozeng Sun, Xiangbin Qin, Qigang Deng, Shaohua Wu	317
EXPERIMENTAL STUDY ON PARTICLE FEEDING AND MIXING IN THE BOTTOM ZONE OF A CIRCULATING FLUIDIZED BED	
..... X. P. Chen, D. Y. Liu, Z. D. Chen, C. S. Zhao	324
AN EXPERIMENTAL INVESTIGATION INTO THE FRAGMENTATION OF COAL PARTICLES IN A FLUIDIZED-BED COMBUSTOR	
..... Monika Kosowska-Galachowska, Adam Luckos	330
AXIAL AND RADIAL SOLIDS HOLDUP MODELING OF CIRCULATING FLUIDIZED BED RISERS	
..... Q. Miao, J. Zhu, S. Barghi, C. Wang, X. L. Yin, C. Z. Wu	335
RESEARCH ON FLOW NON-UNIFORMITY IN MAIN CIRCULATION LOOP OF A CFB BOILER WITH MULTIPLE CYCLONES	
..... S. Yang, H. R. Yang, Q. Liu, H. Zhang, Y. X. Wu, G. X. Yue, Y. Z. Wang	341
FLOW REGIME STUDY IN A CIRCULATING FLUIDIZED BED RISER WITH AN ABRUPT EXIT: FULLY DEVELOPED FLOW IN CFB RISER	
..... J. S. Mei, G. T. Lee, S. M. Seachman, J. Spenik	345
HEAT TRANSFER AT A LONG ELECTRICALLY-SIMULATED WATER WALL IN A CIRCULATING FLUIDISED BED	
..... R. Sundaresan, Ajit Kumar Kolar	350
DESIGN AND OPERATION OF EXPERIMENTAL SYSTEM FOR STUDYING HEAT TRANSFER IN A SMOOTH TUBE AT NEAR- AND SUPER CRITICAL PRESSURE	
..... W. K. Li, Y. X. Wu, Y. Li, J. F. Lu, H. Zhang	357
EXPERIMENTAL AND MODELING INVESTIGATION OF LIGNITE DRYING IN A FLUIDIZED BED DRYER	
..... K. Zhang, C. F. You	361
EXPERIMENTAL RESEARCH ON GAS-SOLID FLOW IN AN EXTERNAL HEAT EXCHANGER WITH DOUBLE OUTLETS	
..... H. Z. Liu, X. F. Lu	367
THE EXPERIMENTAL STUDY ON HEAT TRANSFER CHARACTERISTICS OF THE EXTERNAL HEAT EXCHANGER	
..... X. Y. Ji, X. F. Lu, L. Yang, H. Z. Liu	373
EXPERIMENTAL STUDY ON MASS AND HEAT TRANSFER CHARACTERISTICS IN A HORIZONTAL CIRCULATING DIVISIONAL FLUIDIZED BED	
..... P. Lu, R. ZHANG, J. Pu, C. S. Bu, W. P. Pan	379
EXPERIMENTAL STUDY OF GAS SOLID FLOW CHARACTERISTICS IN CYCLONE INLET DUCTS OF A 300MWE CFB BOILER	
..... J. Y. Tang, X. F. Lu, J. Lai, H. Z. Liu	386
EXPERIMENTAL RESEARCH ON GAS-SOLID FLOW IN A SQUARE CYCLONE SEPARATOR WITH DOUBLE INLETS	
..... B. Xiong, X. F. Lu, R. S. Amano, C. Shu	393
GAS-PHASE COMBUSTION IN THE FREEBOARD OF A FLUIDIZED BED-FREEBOARD CHARACTERIZATION	
..... Jean-Philippe Laviolette, Gregory S. Patience and Jamal Chaouki	398

CHARACTERISTICS OF PYROLYTIC TOPPING IN FLUIDIZED BED FOR DIFFERENT VOLATILE COALS	
.....R. Xiong, L. Dong, G. W. Xu	404
FLUIDISED BED COMBUSTION OF TWO SPECIES OF ENERGY CROPS	
.....P. Abelha, C. Franco, H. Lopes, I. Gulyurtlu, I. Cabrita	410
PREDICTION OF AGGLOMERATION, FOULING, AND CORROSION TENDENCY OF FUELS IN CFB CO-COMBUSTION	
..... Vesna Barišić, Edgardo Coda Zabetta, Juha Sarkki	416
ENVIRONMENTAL IMPACT OF ESTONIAN OIL SHALE CFB FIRING	
..... J. Loosaar, T. Parve, A. Konist	422
STUDY ON COMBUSTION CHARACTERISTICS OF LIGNITE IN A CFB BOILER	
.....J. Leng, T. S. Zou, J. X. Wu, C. Jiang, J. L. Gao, J. Wu, D. Su, D. Y. Song	429
STUDY OF HEAVY METALS CONDENSATION BY CONSIDERING VARIANT CONDITIONS OF INCINERATOR COOLING ZONE	
.....Yi Cheng, Atsushi Sato, Yoshihiko Ninomiya	434
DUAL-FUEL FLUIDIZED BED COMBUSTOR PROTOTYPE FOR RESIDENTIAL HEATING: STEADY-STATE AND DYNAMIC BEHAVIOR	
.....Antonio Cammarota, Riccardo Chirone, Michele Miccio, Roberto Solimene1, Massimo Urciuolo	441
EXPERIMENTAL STUDY ON GAS-SOLID FLOW CHARACTERISTICS IN A CFB RISER OF 54m IN HEIGHT	
.....N. Hu, H. R. Yang, H. Zhang, R. Q. Zhang, J. N. Cao, Q. Liu, J. F. Lu, G. X. Yue	448
STUDY OF AIR JET PENETRATION IN A FLUIDIZED BED	
.....X. L. Zhou, L. M. Cheng, Q. H. Wang, M. X. Fang, Z. Y. Luo, K. F. Cen	453
SOLIDS MIXING IN THE BOTTOM ZONE OF FLUIDIZED BEDS	
.....D. Y. Liu, X. P. Chen, C. Liang, C. S. Zhao	459
EFFECT OF RISER GEOMETRY STRUCTURE ON LOCAL FLOW PATTERN IN A RECTANGULAR CIRCULATING FLUIDIZED BED	
.... Chen Tian, Qinhui Wang, Zhongyang Luo, Ximei Zhang, Leming Cheng, Mingjiang Ni, Kefa Cen	464
EXPERIMENTAL STUDY ON COAL FEEDING PROPERTY OF 600MW CFB BOILER	
.....H. P. Chen, L. N. Tian, Q. Du, H. P. Yang, X. H. Wang, K. Zhou, S. H. Zhang	471
THE HEAT RELEASE RATIO AND PERFORMANCE TEST AT A SMALL-SCALE RDF-5 BUBBLING FLUIDIZED BED BOILER	
.....Hou-Peng Wan, Chien-Song Chyang, Chyh-Sen Yang, Ching-I Juch, Kuo-Chao Lo, Hom-Ti Lee	475
INTEGRATED USE OF FLUIDIZED BED TECHNOLOGY FOR OIL PRODUCTION FROM OIL SHALE	
..... Andres Siirde, Ants Martins	481
THE INFLUENCE OF SORBENT PROPERTIES AND REACTION CONDITIONS ON ATTRITION OF LIMESTONE BY IMPACT LOADING IN FLUIDIZED BEDS	
.....Fabrizio Scala, Piero Salatino	486
CHARACTERISTICS OF A MODIFIED BELL JAR NOZZLE DESIGNED FOR CFB BOILERS	
.....Z. M. Huang, H.R. Yang, Q. Liu, Y. Wang, J. F. Lu, G. X. Yue	492
HEAT BALANCE ANALYSIS OF BAIMA'S 300 MWe CFB BOILER IN CHINA	
.....J. Y. Lu, X. F. Lu, G. Yin, H. Z. Liu	496

CO₂ Capture and Chemical Looping

DIFFERENT METHODS OF MANUFACTURING FE-BASED OXYGEN CARRIER PARTICLES FOR REFORMING VIA CHEMICAL LOOPING, AND THEIR EFFECT ON PERFORMANCE	
.....J.P.E. Cleeton, C.D. Bohn, C.R. Müller, J.S. Dennis, S.A. Scott	505
KINETICS OF OXIDATION OF A REDUCED FORM OF THE Cu-BASED OXYGEN-CARRIER FOR USE IN CHEMICAL-LOOPING COMBUSTION	
.....S.Y. Chuang, J.S. Dennis, A.N. Hayhurst, S.A. Scott	512
REDUCTION KINETICS OF A CaSO ₄ BASED OXYGEN CARRIER FOR CHEMICAL-LOOPING COMBUSTION	
.....R. Xiao, Q. L. Song, W. G. Zheng, Z. Y. Deng, L. H. Shen, M. Y. Zhang	519
INVESTIGATION OF COAL FUELED CHEMICAL LOOPING COMBUSTION USING Fe ₃ O ₄ AS OXYGEN CARRIER	
.....Wenguo Xiang, Xiaoyan Sun, Sha Wang, Wendong Tian, Xiang Xu, Yanji Xu, Yunhan Xiao	527

DESIGN AND COLD MODE EXPERIMENT OF DUAL BUBBLING FLUIDIZED BED REACTORS FOR MULTIPLE CCR CYCLES	F. Fang, Z. S. Li, N. S. Cai	533
ROLE OF THE WATER-GAS SHIFT REACTION IN CO ₂ CAPTURE FROM GASIFICATION SYNGAS USING LIMESTONES	D. Y. Lu, R. T. Symonds, R. W. Hughes and E. J. Anthony	540
POSTCOMBUSTION CAPTURE OF CO ₂ WITH CAO IN A CIRCULATING FLUIDIZED BED CARBONATOR	M. Alonso, N. Rodriguez, B. González, G. Grasa, R. Murillo, J. C. Abanades	549
MEASURING THE KINETICS OF THE REDUCTION OF IRON OXIDE WITH CARBON MONOXIDE IN A FLUIDIZED BED	C. D. Bohn, J. P. Cleeton, C. M. Müller, S. A. Scott, J. S. Dennis	555
CO ₂ CAPTURE USING DRY POTASSIUM-BASED SORBENTS IN A BUBBLING FLUIDIZED-BED REACTOR	C. W. Zhao, X. P. Chen, C. S. Zhao	562
HYDRATION AND PELLETIZATION OF CaCO ₃ -DERIVED SORBENTS FOR <i>IN-SITU</i> CO ₂ CAPTURE	Dennis Y. Lu, Robin W. Hughes, Tiffany Reid and Edward J. Anthony	569
Ni/γ-Al ₂ O ₃ CATALYST FOR CO ₂ REFORMING OF BENZENE AS A MODEL COMPOUND OF BIOMASS GASIFICATION TAR: PROMOTIONAL EFFECT OF ULTRASONIC TREATMENT ON CATALYTIC PERFORMANCE	B. Li, H. P. Chen, H. P. Yang, G. L. Yang, X. H. Wang, S. H. Zhang	576
PARAMETRIC STUDY ON THE CO ₂ CAPTURE EFFICIENCY OF THE CARBONATE LOOPING PROCESS IN A 10 kW DUAL FLUIDIZED BED	Charitos, C. Hawthorne, A. R. Bidwe, H. Holz, T. Pfeifer, A. Schulze, D. Schlegel, A. Schuster, G. Scheffknecht	583
EXPERIMENTAL INVESTIGATION OF TWO MODIFIED CHEMICAL LOOPING COMBUSTION CYCLES USING SYNGAS FROM CYLINDERS AND THE GASIFICATION OF SOLID FUELS	C. R. Müller, T. A. Brown, C. D. Bohn, S. Y. Chuang, J. P. E. Cleeton, S. A. Scott and J. S. Dennis	590
DEVELOPMENT OF FLY ASH-BASED SORBENT TO CAPTURE CO ₂ FROM FLUE GAS	I. Majchrzak-Kucęba, W. Nowak	596
CHEMICAL LOOPING AUTOTHERMAL REFORMING AT A 120 kW PILOT RIG	Johannes Bolhär-Nordenkamp, Tobias Pröll, Philipp Kolbitsch and Hermann Hofbauer	603
EFFECTS OF STEAM AND CO ₂ IN THE FLUIDIZING GAS WHEN USING BITUMINOUS COAL IN CHEMICAL-LOOPING COMBUSTION	H. Leion, A. Lyngfelt, T. Mattisson	608
EXPERIMENTAL RESEARCH OF THE OXYGEN-ENRICHED COMBUSTION OF SEWAGE SLUDGE AND COAL IN CFB	S. W. Xin, X. F. Lu, H. Z. Liu	612
KINETICS OF COAL CHAR COMBUSTION IN OXYGEN-ENRICHED ENVIRONMENT	T. Czakiert, W. Nowak	618
COMBUSTION OF COAL CHAR PARTICLES UNDER FLUIDIZED BED OXYFIRING CONDITIONS	Fabrizio Scala, Riccardo Chirone	624

Gasification

OPTIMIZATION OF BIOMASS GASIFICATION PROCESS FOR F-T BIO-DIESEL SYNTHESIS	Jae Hun Song, Yeon Kyung Sung, Tae U Yu, Young Tae Choi, Uen Do Lee	633
CHEMICAL LOOPING GASIFICATION OF BIOMASS FOR HYDROGEN ENRICHED GAS PRODUCTION WITH IN-PROCESS CARBON-DIOXIDE CAPTURE	Animesh Dutta, Bishnu Acharya, Prabir Basu	636
THE THERMAL CRACKING EXPERIMENT RESEARCH OF TAR FROM RICE HULL GASIFICATION FOR POWER GENERATION	Z. S. Wu, T. Mi, Q. X. Wu, Y. F. Chen, X. H. Li	642
CATALYTIC PYROLYSIS OF COTTON STRAW BY ZEOLITES AND METAL OXIDES	X. X. Cao, B. X. Shen, F. Lu, Y. Yao	648

EXPERIMENTAL STUDY ON ASH-RETURNED REACTOR OF CFB ATMOSPHERIC AIR GASIFIER	
.....Zhang Shihong, Tian Luning, Zhou Xianrong, Chen Hanping, Yang Haiping, Wang Xianhua	653
FIRST EXPERIENCES WITH THE NEW CHALMERS GASIFIER	
.....H. Thunman, M. C. Seemann	659
A HYDRODYNAMIC CHARACTERISTIC OF A DUAL FLUIDIZED BED GASIFICATION	
.....Yeon Kyung Sung, Jae Hun Song, Byung Ryeul Bang, Tae U Yu, Uen Do Lee	664
THE CRACKING EXPERIMENT RESEARCH OF TAR BY CAO CATALYST	
.....X. H Li, T. Mi, Z. S. Wu, Y. F. Chen, Q. X. Wu	669
EXPERIMENT INVESTIGATION OF THE INFLUENCING FACTORS ON BED AGGLOMERATION DURING FLUIDIZED-BED GASIFICATION OF BIOMASS FUELS	
.....Y. Q. Chen, H. P. Chen, H. P. Yang, X. H. Wang, S. H. Zhang	675
FLOW REGIME DISTINGUISH IN A CIRCULATING FLUIDIZED BED GASIFIER BASED ON WAVELET MODULUS MAXIMA*	
.....F. Duan, Y.J. Huang, B.S. Jin, B. Li, M.Y. Zhang	680
WOOD GASIFICATION IN A LAB-SCALE BUBBLING FLUIDIZED BED: EXPERIMENT AND SIMULATION	
.....L. He, E. Schotte, S. Thomas, A. Schlinkert, A. Herrmann, V. Mosch, V. Rajendran, S. Heinrich	686
A COMPARATIVE STUDY OF EULER-EULER AND EULER-LAGRANGE MODELLING OF WOOD GASIFICATION IN A DENSE FLUIDIZED BED	
.....S. Gerber, F. Behrendt, M. Oevermann	693
BED MATERIAL AND PARAMETER VARIATION FOR A PRESSURIZED BIOMASS FLUIDIZED BED PROCESS	
.....Bernhard Puchner, Christoph Pfeifer, Hermann Hofbauer	700
PROCESS ANALYSIS OF LIGNITE CIRCULATING FLUIDIZED BED BOILER COUPLED WITH PYROLYSIS TOPPING	
.....Baoqun Wang, Li Dong, Yin Wang, Y. Matsuzawa, Guangwen Xu	706
APPLICATION OF CAO-BASED BED MATERIAL FOR DUAL FLUIDIZED BED STEAM BIOMASS GASIFICATION	
.....S. Koppatz, C. Pfeifer, A. Kreuzeder, G. Soukup, H. Hofbauer	712
FAST PYROLYSIS OF AGRICULTURAL WASTES IN A FLUIDIZED BED REACTOR	
.....X. H. Wang, H. P. Chen, H. P. Yang, X. M. Dai, S. H. Zhang	719
HYDRATION REACTIVATION OF CaO-BASED SORBENT FOR CYCLIC CALCINATION- CARBONATION REACTIONS	
.....Long Han, Qinhui Wang*, Qiang Ma, Jian Guan, Zhongyang Luo, Kefa Cen	726
CHARACTERISTICS OF CATALYTIC GASIFICATION OF NATURAL COKE WITH H ₂ O IN A FLUIDIZED BED	
.....L.S. Lin, C.S. Zhao, S. Wang, G. Zhu, W.G. Xiang	732
NOVEL APPROACH TO TAR REMOVAL FROM BIOMASS PRODUCER GAS BY MEANS OF A NICKEL-BASED CATALYST	
.....M. Vosecký, P. Kameníková, M. Pohořelý, S. Skoblja, M. Punčochář	740
DEVELOPMENT OF CATALYTIC TAR DECOMPOSITION IN AN INTERNALLY CIRCULATING FLUIDIZED-BED GASIFIER	
.....Xianbin Xiao, Duc Dung LE, Kayoko Morishita, Liuyun LI, Takayuki Takarada	747

Modling and Simulation

DEVELOPMENT AND VALIDATION OF A 3-DIMENSIONAL CFB FURNACE MODEL	
.....Ari Vepsäläinen, Kari Myöhänen, Timo Hyppänen, Timo Leino, Antti Tourunen	757
A SIMPLIFIED MODEL FOR THE BEHAVIOR OF LARGE BIOMASS PARTICLES IN THE SPLASHING ZONE OF A BUBBLING BED	
.....Anders Brink, Oskar Karlström, Mikko Hupa	764
HYDRODYNAMIC MODEL WITH BINARY PARTICLE DIAMETERS TO PREDICT AXIAL VOIDAGE PROFILE IN A CFB COMBUSTOR	
.....J. J. Li, H. Zhang, H. R. Yang, Y. X. Wu, J. F. Lu, G. X. Yue	768

3D-SIMULATION OF CONCENTRATION DISTRIBUTIONS INSIDE LARGE-SCALE CIRCULATING FLUIDIZED BED COMBUSTORS	
.....R. Wischniewski, L. Ratschow, E. U. Hartge, J. Werther	774
THREE-DIMENSIONAL SIMULATION OF TEMPERATURE DISTRIBUTIONS IN LARGE-SCALE CIRCULATING FLUIDIZED BED COMBUSTORS	
.....L. Ratschow, R. Wischniewski, E. U. Hartge, J. Werther	780
NUMERICAL CALCULATION OF HEAT TRANSFER DISTRIBUTION IN A 600MWe SUPERCRITICAL CIRCULATING FLUIDIZED BED BOILER	
.....Y. Li, W. K. Li, Y. X. Wu, H. R. Yang, L. Nie, S. S. Huo	786
IMPROVEMENT OF CFD METHODS FOR MODELING FULL SCALE CIRCULATING FLUIDIZED BED COMBUSTION SYSTEMS	
.....Srujal Shah, Marcin Klajny, Kari Myöhänen, Timo Hyppänen	792
EXPERIMENTAL STUDY AND CFD SIMULATION OF A 2D CIRCULATING FLUIDIZED BED	
.....S. Kallio, M. Guldén, A. Hermanson	799
3D NUMERICAL PREDICTION OF GAS-SOLID FLOW BEHAVIOR IN CFB RISERS FOR GELDART A AND B PARTICLES	
.....A. Özel, P. Fede, O. Simonin	805
NUMERICAL SIMULATION OF SLUDGE DRYNESS UNDER FLUE GAS ATMOSPHERE IN THE RISER OF A FLUIDIZED BED	
.....H. M. Xiao, X. Q. Ma, K. Liu, Z. S. Yu	812
APPLICATION OF MULTIVARIABLE MODEL PREDICTIVE ADVANCED CONTROL FOR A 2×310T/H CFB BOILER UNIT	
.....Zhao Weijie, Dai Zongliao, Gou Rong, Gong Wengang	817
COMBUSTION MODEL FOR A CFB BOILER WITH CONSIDERATION OF POST-COMBUSTION IN THE CYCLONE	
.....S. H. Li, H. R. Yang, H. Zhang, Y. X. Wu, J. F. Lu, G. X. Yue	824
NUMERICAL SIMULATION IN A SUPERCIRITICAL CFB BOILER	
.....YanJun Zhang, Xiang Gao, Zhongyang Luo, Xiaoguo Jiang	829
STUDY OF CFB SIMULATION MODEL WITH COINCIDENCE AT MULTI-WORKING CONDITION	
.....Z. Wang, F. He, Z. W. Yang, Z. Li, W. D. Ni	833
NUMERICAL INVESTIGATION OF 3-D TRANSIENT COMBUSTING FLOW IN A 1.2MwTH PILOT POWER PLANT	
.....A. Nikolopoulos, I. Rampidis, N. Nikolopoulos, P. Grammelis, and E. Kakaras	839
DYNAMICAL MODELING OF THE GAS PHASE IN FLUIDIZED BED COMBUSTION-ACCOUNTING FOR FLUCTUATIONS	
.....D. Pallarès, F. Johnsson	845
CFD MODELLING OF PARTICLE MIXTURES IN A 2D CFB	
.....M. Seppälä, S. Kallio	851
CFD ANALYSIS OF BUBBLING FLUIDIZED BED USING RICE HUSK	
.....Ravi Inder Singh, S.K.Mohapatra, D.Gangacharyulu	857
HYDRODYNAMIC SIMULATION OF GAS-SOLID BUBBLING FLUIDIZED BED CONTAINING HORIZONTAL TUBES	
.....Teklay Weldeabzgi Asegehegn, Hans Joachim Krautz	864
MATHEMATICAL DESCRIPTION OF THE HYDRODYNAMIC REGIMES OF AN ASYMPTOTIC MODEL FOR TWO-PHASE FLOW ARISING IN PFBC BOILERS	
.....S. de Vicente, G. Galiano, J. Velasco, J.M. Aróstegui	870
COMBUSTION CHARACTERISTICS OF SEWAGE SLUDGE USING A PRESSURIZED FLUIDIZED BED INCINERATOR WITH TURBOCHARGER	
.....T. Murakami, A. Kitajima, Y. Suzuki, H. Nagasawa, T. Yamamoto, T. Koseki, H, Hirose, S. Okamoto	877
NUMERICAL SIMULATION ON HYDRODYNAMICS AND COMBUSTION IN A CIRCULATING FLUIDIZED BED UNDER O ₂ /CO ₂ AND AIR ATMOSPHERES	
.....W. Zhou, C. S. Zhao, L. B. Duan, C. R. Qu, J. Y. Lu, X. P. Chen	883
MODELLING OF CO ₂ ADSORPTION FROM EXHAUST GASES	
.....Marcin Panowski, Roman Klainy, Karol Sztékler	889

Environmentals and Pollution Control

NO _x REDUCTION IN A FLUIDIZED BED REACTOR WITH Fe/ZSM-5 CATALYST AND PROPYLENE AS REDUCTANT	Terris Yang and Xiaotao Bi	897
THE IMPACT OF ZEOLITES DURING CO-COMBUSTION OF MUNICIPAL SEWAGE SLUDGE WITH ALKALI AND CHLORINE RICH FUELS	A Pettersson, A-L Elled, A Möller, B-M Steenari, L-E Åmand	902
EMISSIONS DURING CO-FIRING OF RDF-5 WITH COAL IN A 22 t/h STEAM BUBBLING FLUIDIZED BED BOILER	Hou-Peng Wan, Jia-Yuan Chen, Ching-I Juch, Ying-Hsi Chang, and Hom-Ti Lee	910
MERCURY EMISSION FROM CO-COMBUSTION OF SLUDGE AND COAL IN A CFB INCINERATOR	Y. F. Duan, C.S. Zhao, C.J. Wu, Y.J. Wang	916
CO-FIRING OF SEWAGE SLUDGE WITH BARK IN A BENCH-SCALE BUBBLING FLUIDIZED BED-A STUDY OF DEPOSITS AND EMISSIONS	Patrik Yrjas, Martti Aho, Maria Zevenhoven, Raili Taipale, Jaani Silvennoinen, and Mikko Hupa	922
NH ₃ ABATEMENT IN FLUIDIZED BED CO-GASIFICATION OF RDF AND COAL	I. Gulyurtlu, Filomena Pinto, Mário Dias, Helena Lopes, Rui Neto André, I. Cabrita	930
EFFECT OF OPERATING CONDITIONS ON SO ₂ AND NO _x EMISSIONS IN OXY-FUEL MINI-CFB COMBUSTION TESTS	L. Jia, Y. Tan and E.J. Anthony	936
DESULFURIZATION CHARACTERISTICS OF FLY ASH RECIRCULATION AND COMBUSTION IN THE CIRCULATING FLUIDIZED BED BOILER	S. F. Li, M. X. Fang, B. Yu, Q. H. Wang, Z. Y. Luo	941
NITRIC OXIDE REDUCTION OVER SEWAGE SLUDGE AND COAL CHARs AT CONDITIONS RELEVANT TO STAGED FLUIDIZED BED COMBUSTION	P. Salatino, R. Solimene, R. Chirone	947
DESTRUCTION OF N ₂ O OVER DIFFERENT BED MATERIALS	M. Pilawska, H. Zhang, X. S. Hou, Q. Liu, J. F. Lu, G. X. Yue	953
SIMULTANEOUS REDUCTION OF SO _x AND FINE ASH PARTICLES DURING COMBUSTION OF COALS ADDED WITH ADDITIVES	Yoshihiko Ninomiya, Shuyin Xu, Qunying Wang, Yi Cheng, Isao Awaya	960
SORBENT INVENTORY AND PARTICLE SIZE DISTRIBUTION IN AIR-BLOWN CIRCULATING FLUIDIZED BED COMBUSTORS: THE INFLUENCE OF PARTICLE ATTRITION AND FRAGMENTATION	Fabio Montagnaro, Piero Salatino, Fabrizio Scala, Massimo Urciuolo	966
THE PERFORMANCE OF A NOVEL SYNTHETIC CA-BASED SOLID SORBENT SUITABLE FOR THE REMOVAL OF CO ₂ AND SO ₂ FROM FLUE GASES IN A FLUIDISED BED	R. Pacciani, C.R. Müller, J.F. Davidson, J.S. Dennis, A.N. Hayhurst	972
FATE OF PHOSPHORUS DURING CO-COMBUSTION OF RAPESEED CAKE WITH WOOD	P. Piotrowska, M. Zevenhoven, M. Hupa, K. Davidsson, L.E. Åmand, E. C. Zabetta, V. Barišić	979
SULPHATION OF CaO-BASED SORBENT MODIFIED IN CO ₂ LOOPING CYCLES	Vasilije Manovic, Edward J. Anthony, Davor Loncarevic	987
MODELING OF NITROGEN OXIDES EMISSIONS FROM CFB COMBUSTION	S. Kallio, M. Keinonen	993
STUDY OF NO EMISSION FROM A PILOT SCALE VORTEXING FLUIDIZED BED COMBUSTOR USING RESPONSE SURFACE METHODOLOGY	F. P. Qian, C. S. Chyang, W. S. Yen	999
A TRIAL TO SEPARATE FORMATION AND REDUCTION PROCESS DURING NO EMISSION IN FLUIDIZED BED COAL COMBUSTION	T. Murakami, Y. Suzuki, A. K. Durrani	1005
EXPERIMENTAL STUDY OF NITROGEN OXIDE EMISSIONS IN A CIRCULATING FLUIDIZED BED	R. W. Liu, Q. L. Zhou, S. E. Hui, T. M. Xu	1011
EFFECT OF METAL OXIDE ON THE EMISSION OF N ₂ O AND NO IN FLUIDIZED BED TEMPERATURE RANGE USING PYRIDINE AS A NITROGENOUS MODEL FUEL	X. B. Wang, H. Z. Tan, C. L. Wang, Q. X. Zhao, T. M. Xu, S. E. Hui	1017

WASTE TO ENERGY IFBC-PLANT IN FRANKFURT, GERMANY	
..... Dipl. Ing. Paul Ludwig	1022
OPTIMIZATION OF LIMESTONE FEED SIZE OF A PRESSURIZED FLUIDIZED BED COMBUSTOR	
..... Tadaaki Shimizu, Jaakko Saastamoinen	1028
ZERO EMISSIONS HYDROGEN PRODUCTION BY FLUIDIZED BED CATALYTIC DECOMPOSITION OF METHANE	
..... Ammendola P., Chirone R., Ruoppolo G., Russo G.	1035
CHARACTERIZATIONS OF DEPOSITED ASH DURING CO-FIRING OF WHITE PINE AND LIGNITE IN FLUIDIZED BED COMBUSTOR	
..... Yuanyuan Shao, Jesse Zhu, Fernando Preto, Guy Tourigny, Jinsheng Wang, Chadi Badour, Hanning Li, Chunbao (Charles) Xu	1041
THE EMISSIONS OF PAHS AND HEAVY METALS FROM CO-COMBUSTION OF PETROCHEMICAL SLUDGE WITH COAL IN CFB INCINERATOR	
..... Ge Zhu, Changsui Zhao, Huichao Chen, Xiaoping Chen, Cai Liang	1048
COMPARISON OF ASH FROM PF AND CFB BOILERS AND BEHAVIOUR OF ASH IN ASH FIELDS	
..... H. Arro, T. Pihu, A. Prikk, R. Rootamm, A. Konist	1054
BROMINE AND CHLORINE IN AEROSOLS AND FLY ASH WHEN CO-FIRING SOLID RECOVERED FUEL, SPRUCE BARK AND PAPER MILL SLUDGE IN A 80MWth BFB BOILER	
..... P. Vainikka, J. Silvennoinen, P. Yrjas, A. Frantsi, L. Hietanen, M. Hupa, R. Taipale	1061
REBURNING CHARACTERISTICS OF RESIDUAL CARBON IN FLY ASH FROM CFB BOILERS	
..... S.H. Zhang, H.H. Luo, H.P. Chen, H.P. Yang, X.H. Wang	1067
USE OF FLUIDIZED BED COMBUSTION ASH AND OTHER INDUSTRIAL WASTES AS RAW MATERIALS FOR THE MANUFACTURE OF CALCIUM SULPHOALUMINATE CEMENTS	
..... M. Marroccoli, F. Montagnaro, M. L. Pace, A. Telesca, G. L. Valenti	1072
EFFECT OF THE ADDITIVES ON THE DESULPHURIZATION RATE OF FLASH HYDRATED AND AGGLOMERATED CFB FLY ASH	
..... D. X. Li, H. L. Li, M. Xu, J. F. Lu, Q. Liu, J. S. Zhang, G. X. Yue	1078
EXPERIMENTAL STUDY ON PM ₁₀ FEATURE DURING CAOL COMBUSTION	
..... Y.G. Du, J.C. Sui, G.Z. Yin	1082
STUDY ON THE CHARACTERISTICS OF GASEOUS POLLUTANT ABSORBED BY A MOVING LIQUID AEROSOL	
..... Y.G. Du, J.J. Deng, F. He, Y. Yu	1088

Sustainable Fuels-Combustion and New Concept

CHARACTERIZATION OF COMBUSTION AND EMISSION OF SEVERAL KINDS OF HERBACEOUS BIOMASS PELLETS IN A CIRCULATING FLUIDIZED BED COMBUSTOR	
..... S.Y. Li, H. P. Teng, W. H. Jiao, L. L. Shang, Q. G. Lu	1095
CHEMICAL CHARACTERIZATION OF BED MATERIAL COATINGS BY LA-ICP-MS AND SEM-EDS	
..... M. H. Piispanen, A. J. Mustonen, M. S. Tiainen, R. S. Laitinen	1103
INVESTIGATION ON AGROPELLET COMBUSTION IN THE FLUIDIZED BED	
..... Isemin R.L., Konayahin V.V., Kuzmin S.N., Zorin A.T., Mikhalev A.V.	1109
CHEMICAL CHARACTERIZATION OF WASTE FUEL FOR FLUIDIZED BED COMBUSTION	
..... F. Claesson, B-J. Skrifvars, A-L. Elled, A. Johansson	1116
CO ₂ REBINDING BY OIL SHALE CFBC ASHES: EFFECT OF PRE-TREATMENT	
..... Andres Trikkell, Merli Keelmann, Aljona Aranson, Rein Kuusik	1123
THE SUITABILITY OF THE FUEL MIXTURE OF HORSE MANURE AND BEDDING MATERIALS FOR COMBUSTION	
..... Sanna K. Tyni, Minna S. Tiainen, Risto S. Laitinen	1130
FUEL-NITROGEN EVOLUTION DURING FLUIDIZED BED OXY-COAL COMBUSTION	
..... Astrid Sanchez, Fanor Mondragon, Eric G. Eddings	1136
THE STUDY OF SAWDUST COMBUSTION IN A VORTEXING FLUIDIZED BED COMBUSTOR	
..... Chien-Song Chyang, Kuo-Chao Lo, Kuan-Chang Su, Keng-Tung Wu	1141
EXPERIMENTAL STUDY ON HEAT TRANSFER IN A ROLLING ASH COOLER USED IN TEE CFB BOILER	
..... W. Wang, J. J. Li, S. Yang, X. D. Si, H. R. Yang, J. F. Lu, G. X. Yue	1147

3D UNSTEADY MULTIPHASE SIMULATION OF URANIUM TETRAFLUORIDE PARTICLE FLUORINATION IN FLUIDIZED BED PILOT	
..... N. A. Konan, H. Neau, O. Simonin, M. Dupoizat, T. Le Goaziou	1152
AN IDEA OF STAGED AND LARGE VELOCITY DIFFERENTIAL SECONDARY AIR FOR WATERWALL EROSION PROTECTION AND OXYGEN COMPLEMENTARITY	
..... B. Q. Liu, X.H. Zhang	1159
CFD MODELLING APPLIED TO THE CO-COMBUSTION OF PAPER SLUDGE AND COAL IN A 130 T/H CFB BOILER	
..... Z. S. Yu, X. Q. Ma, Z. Y. Lai, H. M. Xiao	1165
A NEW DRY FLUE GAS DESULFURIZATION PROCESS-UNDERFEED CIRCULATING SPOUTED BED	
..... M. Tao, B. S. Jin, Y. P. Yang	1171
Authors Index	1178

Keynotes