

7th European Coke and Ironmaking Congress (ECIC 2016)

Linz, Austria
12 - 14 September 2016

Volume 1 of 2

ISBN: 978-1-5108-5176-4

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© (2016) by Austrian Society for Metallurgy and Materials (ASMET)
All rights reserved.

Printed by Curran Associates, Inc. (2018)

For permission requests, please contact Austrian Society for Metallurgy and Materials (ASMET)
at the address below.

Austrian Society for Metallurgy and Materials (ASMET)
Franz-Josef-Straße 18
8700 Leoben
Austria

Phone: +43 3842 402 2290

Fax: +43 3842 402 2202

asmet@asmet.at

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2633
Email: curran@proceedings.com
Web: www.proceedings.com

TABLE OF CONTENTS

VOLUME 1

KEYNOTES

THE BLAST FURNACE - FIT FOR THE FUTURE?	3
<i>P. Schmöle</i>	
EVALUATION OF THE CAPABILITIES OF DIRECT AND SMELTING REDUCTION PROCESSES TO ENHANCE THE ENERGY EFFICIENCY AND TO REDUCE THE CO ₂ EMISSION OF THE STEEL PRODUCTION IN EUROPE	13
<i>J. Schenk, H. Lingen</i>	
UPDATES ON THE FINEX®, A COMMERCIALY PROVEN ALTERNATIVE IRON-MAKING PROCESS.....	23
<i>S. Yi</i>	

BLAST FURNACE MODELLING

BLAST FURNACE HEARTH ASSESSMENT BY COMBINING AU-E AND THERMOCOUPLE DATA.....	33
<i>K. Chomyn, S. Phillips, H. Ghorbani</i>	
PREDICTION OF BURDEN DISTRIBUTION OF BLAST FURNACE BY USING DEM.....	43
<i>H. Mio, Y. Narita, A. Inayoshi, S. Matsuzaki, T. Orimoto</i>	
IRON ORE PELLET REDUCTION BEHAVIOR IN POTENTIAL LOW CO ₂ BLAST FURNACE SCENARIOS	53
<i>A. Kempainen, C. Wang, Elsayedmousa, J. Haapakangas, H. Suopajarvi, T. Fabritius</i>	
SINTER – NUT COKE INTERACTION AND BEHAVIOUR DURING CONVEYOR BELT TRANSPORTATION AND DISCHARGE: A DEM STUDY.....	63
<i>D. Chibwe, D. Pinson, P. Austin, M. Biasutti, S. Chew, B. Monaghan, G. Evans</i>	

BLAST FURNACE, DESIGN AND EXPERIMENT

LATEST DEVELOPMENT IN DRY AND WET BLAST FURNACE GAS CLEANING TECHNOLOGY	78
<i>P. Klut, W. Ewalts, R. Hink, E. Engel</i>	
INSTALLATION, COMMISSIONING AND RAMP-UP OF THE NEW PULVERIZED COAL INJECTION SYSTEM AT ARCELORMITTAL KRYVYI RIH BLAST FURNACE NO. 9	87
<i>P. Adrichem, P. Hubbeling, E. Engel, S. Deliamure</i>	
NEW BLAST FURNACE OPERATION PROSPECTS WITH THE G3 CHUTE TRANSMISSION GEARBOX	96
<i>P. Tockert, J. Brinckmann, J. Hollman</i>	
BLAST FURNACE RELINE IMPLEMENTATION STRATEGY	104
<i>J. Busser, B. Hyde, Y. Gordon, I. Cameron</i>	
ILTEC - METTOP'S REVOLUTIONARY COOLING SOLUTION FOR THE STEEL INDUSTRY	118
<i>M. Hanel, A. Filzwieser, I. Filzwieser, S. Ruhs</i>	
THE USE OF PLASMA TORCHES IN BLAST FURNACE IRONMAKING	128
<i>M. Sukhran, N. Patel, I. Cameron, V. Subramanyam, A. Gorodetsky</i>	
KÜTTNER'S PULVERIZED COAL INJECTION TECHNOLOGY – LATEST DEVELOPMENTS.....	138
<i>F. Reufer, R. Schott</i>	
LONG LIFE COPPER STAVE FOR BLAST FURNACE OF NIPPON STEEL & SUMIKIN ENGINEERING.....	154
<i>M. Goto</i>	
BLAST FURNACE MODERN DESIGN – MODULAR CONSTRUCTION	163
<i>R. Van laar, V. Van straat</i>	
EQUIPMENT FOR THE INJECTION OF TI-CONTAINING POWDERS INTO THE BLAST FURNACE TUYERES	174
<i>C. Wolf</i>	
BLAST FURNACE COOLING STAVE DESIGN.....	185
<i>M. Smith, J. Fletcher, R. Harvey, R. Horwood</i>	
DEVELOPMENT OF REACTION BONDED SiC BRICK WHICH HAVE HIGH THERMAL CONDUCTIVITY FOR BLAST FURNACE.....	194
<i>Y. Hong, S. Yun, H. Kang</i>	

BLAST FURNACE, OPERATIONS AND CONTROL

ENHANCING THE PRODUCTIVITY OF LARGE BLAST FURNACES AT HIGH SLAG RATES.....	201
<i>N. Singh, L. Singh, A. Singh, R. Anand, M. Ubayadullah</i>	
BLAST FURNACE OPERATION IN ROUGH TIMES	211
<i>R. Van opbergen, E. Engel, V. Van straat</i>	

EFFECT OF SMALL COKE RATE ON CONSUMPTION BEHAVIOR OF SMALL COKE IN BLAST FURNACE	221
<i>Y. Kashihara, Y. Iwai, A. Murao, K. Fukada, H. Matsuno</i>	
CHARACTERISATION OF FRACTURE MECHANISMS IN A BLAST FURNACE COKE	231
<i>R. Roest, H. Lomas, S. Gupta, R. Kanniala, M. Mahoney</i>	
MODULAR UPGRADES FOR EXISTING BLAST FURNACE AUTOMATION SYSTEMS	241
<i>R. Mijnen, F. Weegeenaar, P. Warren</i>	
CHARGING PRACTICE OF BLAST FURNACE OPERATED WITH 100% ACID PELLETS	248
<i>I. Shepetovsky, A. Shalygin, K. Myasnikov, R. Nuriev, P. Bermes, L. Hausemer</i>	
INNOVATIVE TOOLS FOR PROCESS OPTIMIZATION – BURDEN SURFACE SCANNING VIA BEAMFORMING RADAR AND MEASUREMENT OF THE TOP GAS TEMPERATURE DISTRIBUTION	257
<i>C. Feilmayr, S. Schuster, V. Ganglberger, B. Lackner, D. Zankl, L. Stegfellner</i>	
THE HIGHS AND LOWS OF THE FOURTH CAMPAIGN OF REDCAR BLAST FURNACE, SSI UK, APRIL 2012 – SEPTEMBER 2015	265
<i>P. Warren, D. Fisher</i>	
IMPACT ON COMBUSTION CONDITIONS FROM TUYERE INJECTION SETTINGS	275
<i>L. S ökvist, M. Ölund, D. Sandström, L. From, J. Alatalo</i>	
IDEAL BLAST FURNACE PROCESS	285
<i>S. Filatov, I. Kurunov, D. Tikhonov, D. Vorsina</i>	
RESERVES FOR RAISING THE EFFICIENCY OF BLAST FURNACE PROCESS	290
<i>S. Filatov, I. Kurunov, D. Tikhonov</i>	
STUDY ON EROSION OF LARGE BLAST FURNACE HEARTH AND TECHNIQUES TO PROLONG CAMPAIGN LIFE OF HEARTH	298
<i>W. Xu, X. Mao, W. Song, J. Hua</i>	
VAIRON BLAST FURNACE PROCESS OPTIMIZATION - 25 YEARS OF EXPERIENCE WITH CLOSED-LOOP EXPERT SYSTEMS	317
<i>D. Bettinger, H. Fritschek, T. Kronberger, M. Schaler, B. Schürz</i>	
BLAST FURNACE PERFORMANCE WITH HIGHER PELLET IN BURDEN	334
<i>G. Raut, A. Reddy, A. Kumar</i>	
STRUCTURAL ASSESSMENT OF BLAST FURNACE HEARTH REFRACTORY SYSTEM	340
<i>M. Maleki, N. Darivandi, C. Van der woude, K. Chomyn, G. Lee, S. Phillips, H. Ghorbani</i>	
DEVELOPMENT AND IMPLEMENTATION OF NEW MEASURING AND MONITORING SYSTEMS TO SUPPORT BF CONTROL	351
<i>L. Rongshan, H. Rausch, W. Hartig, L. Wu</i>	
CAREFUL CONTROL OF REFRACTORY LINING CONDITIONS ENSURES PROLONGED CAMPAIGN OF BLAST FURNACE	361
<i>E. Vinogradov, M. Karimov, A. Dmitriev, A. Sokolov, Y. Kosenkov, Y. Gordon, A. Sadri, W. Ying</i>	
ENERGY EFFICIENT TECHNOLOGY TO PRODUCE HOT METAL FROM TITANIA-MAGNETITE ORE	371
<i>S. Zagainov, S. Filatov, V. Filippov, Y. Gordon, L. Gileva, S. Jimoh, A. Lazovich</i>	
OPTIMAL DISTRIBUTION OF SUPPLEMENTAL FUEL AND OXYGEN AMONGST FURNACES IN BLAST FURNACE SHOP	380
<i>N. Spirin, V. Lavrov, Y. Gordon, I. Gurin, L. Lazic</i>	
ADVANCED SIGNAL PROCESSING OF TUYERE PRESSURE DATA TO DETECT REDUCED HOT WIND THROUGHPUT AND RACEWAY BLOCKAGES	388
<i>S. Puttinger, H. Stocker, E. Schuster, M. Lunglmayr, O. Lang, I. Kofler, S. Pirker</i>	
THE LONG WAY TO PCI IN LINZ – FIRST OPERATION EXPERIENCE	398
<i>B. Rummer, C. Thaler, C. Feilmayr</i>	
 <u>CO2 REDUCTION AND ENERGY SAVING</u>	
DRY BLAST FURNACE SLAG GRANULATION WITH WASTE HEAT RECOVERY	409
<i>A. Werner, I. Mcdonald, A. Fleischanderl</i>	
EFFICIENT SINTER COOLING WITH OPTIMIZED ENERGY RECOVERY, ENERGY SAVING AND EMISSION REDUCTION	419
<i>M. Boeberl, E. Fehringner</i>	
LOW CO₂ IRONMAKING IN THE BLAST FURNACE	426
<i>A. Morcel, L. Ökvist, J. Orre, B. Björkman, P. Lagerwall</i>	
DIRECT REDUCTION TECHNOLOGY AS A FLEXIBLE TOOL TO REDUCE THE CO₂ INTENSITY OF IRON AND STEELMAKING	436
<i>T. Buergler, I. Kofler</i>	
COMPARING THE CO₂ EMISSIONS OF DIFFERENT IRONMAKING ROUTES	444
<i>B. Rammer, R. Millner, C. Boehm</i>	
HELPING TO ADDRESS ENVIRONMENTAL CONTROL IN IRON ORE PROCESSING, IRON MAKING, AND COKE HANDLING OPERATIONS THROUGH THE USE OF COMPUTATIONAL FLUID DYNAMICS (CFD)	455
<i>J. Woloshyn, A. Blackmore, T. Plikas, W. Johnson</i>	
NEW IRONMAKING PROCESS TO ENHANCE THE FLEXIBILITY OF ENERGY SUPPLY AND USE OF LOW GRADE RESOURCES	466
<i>T. Nouchi, K. Takahashi, M. Sato</i>	

CO₂ ULTIMATE REDUCTION IN STEELMAKING PROCESS (COURSE50 PROJECT)	476
<i>S. Tonomura, N. Kikuchi, N. Ishiwata, S. Tomisaki, Y. Tomita</i>	
COKE DRY QUENCHING: A SOLUTION FOR ENVIRONMENTAL CONTROL AND ENERGY SAVING	486
<i>A. Esposito, R. Calcagno, A. Fabbri, F. Lambardi</i>	
THE CIRCULAR ECONOMY: CARBON RECYCLING AND THE IRON INDUSTRY	497
<i>A. Fleischanderl, T. Plattner, P. Nair, C. Wolf</i>	

COKEMAKING FUNDAMENTALS

THE EFFECT OF BINARY AND TERNARY MINERAL COMBINATIONS ON THE REACTIVITY OF A COKE ANALOGUE	509
<i>R. Longbottom, B. Monaghan, G. Zhang, A. Chowdhury, M. Mahoney, K. Hockings, M. Reid</i>	
NEW THEORY OF COAL BLENDING BASED ON NOVEL THERMOPLASTICITY MEASUREMENT; PERMEATION DISTANCE	519
<i>Y. Dohi, K. Fukada, T. Yamamoto, T. Matsui, H. Sumi, I. Shimoyama</i>	
EFFECTS OF BRIQUETTE BLEND ON PACKING STRUCTURE OF FINE COAL PART	529
<i>W. Masahiko, Y. Kubota, K. Uebo, S. Nomura</i>	
THE EFFECT OF BROWNCOAL ADDITION ON COKE STRENGTH	537
<i>T. Song, J. Zhang, G. Wang, R. Xu, S. Liu, H. Qian</i>	
APPLICATION OF SMALL ANGLE NEUTRON SCATTERING TO UNDERSTAND NANOPOROSITY OF COKES	545
<i>R. Sakurovs, M. Grigore, L. Koval, A. Sokolova, C. Rehm</i>	

COKEMAKING, DESIGN AND EQUIPMENT

DEVELOPMENT OF A VERTICAL CHAMBER COKING OVEN FOR UPGRADING LIGNITES OR SUB-BITUMINOUS COAL	555
<i>M. Spöttle, R. Kim, U. Tschirner</i>	
STUDIES ON MINERALOGICAL AND THERMO-MECHANICAL PROPERTIES OF DENSE SILICA BRICKS FOR COKE OVEN SOLE AND WALL LINING	560
<i>B. Panda, B. Prasad, S. Swain</i>	

VOLUME 2

REFRACTORIES FOR COKE OVEN WALL - OPERATOR'S PERSPECTIVE	568
<i>K. Andreev, M. V. Wijngaarden, P. Put, V. Tadaion, O. Oerlemans</i>	

COKEMAKING, OPERATION AND CONTROL

PID COMBUSTION – DEDICATED CONTROL FOR AIR ADMISSION IN A HEAT RECOVERY COKE OVEN AT TKCSA	581
<i>Y. Ferreira junqueira, N. Henrique, R. Coelho, L. De Andrade, C. Effgen Wernesbach, U. De oliveira pinto, G. De Sousa De Araujo, S. De Souza Azevedo, R. Pereira</i>	
OBTAINING DETAILED MINERAL AND MINERAL/MACERAL ASSOCIATION INFORMATION IN COKE OVEN FEED COAL SAMPLES BY OPTICAL IMAGE ANALYSIS	591
<i>P. Hapugoda, G. O'brien, G. Krahenbuhl, K. Warren</i>	
APPLICATION OF I₆₀₀ FROM THE CSR TEST AS A MEASURE OF PILOT OVEN COKE STRENGTH	601
<i>L. Koval, R. Sakurovs, K. Hockings, K. Vining</i>	
APPLICATION OF ORGANIC POLYMER IN COKE MAKING- TATA STEEL SCENARIO	608
<i>D. Nag, B. Das, P. Dash</i>	
COMMISSIONING OF 60 KG MOVABLE WALL OVEN AT THYSSENKRUPP STEEL EUROPE AG	616
<i>M. Schulten, V. Stiskala</i>	
THE NEW GERMAN PAH-REGULATIVE INFLUENCING COKEMAKING AT SCHWELGERN PLANT	625
<i>P. Liszio</i>	
OPTIMIZATION OF COAL PREPARATION PLANT IN LINZ	635
<i>T. Abfalterer</i>	
CHANGING BULK DENSITY IN CARBONISATION BLENDS	643
<i>R. Poultney</i>	

DIRECT REDUCTION

DRIpax™ – THE NEW GENERATION OF DR PLANT PROCESS OPTIMIZATION	652
<i>A. Klinger, A. Altendorfer, G. Hughes, D. Gupta</i>	
HIGH-CARBON DRI THE FEEDING MATERIAL TO IMPROVE PERFORMANCES AND DECREASE CO₂ EMISSIONS IN BOTH BF AND EAF	662
<i>D. Pauluzzi, A. Martinis, J. Martinez</i>	

APPLICATION OF MIDREX TECHNOLOGIES IN INTEGRATED STEEL PLANTS; POSSIBLE REDUCTION OF ENVIRONMENTAL IMPACT AND OPEX	676
<i>M. Perato, S. Magnani, T. Astoria, H. Michishita, L. Meier</i>	
SELECTION AND IMPLEMENTATION OF IRONMAKING TECHNOLOGY – EXPERIENCE, PRINCIPLES AND RISKS	686
<i>Y. Gordon, S. Kumar</i>	
EFFECT OF HEATING RATE ON THE PROPERTIES OF TWO NONCOKING COALS USED IN TUNNEL KILN DIRECT REDUCTION OF IRON PROCESS	696
<i>N. Toloue farrokh, T. Fabritius, M. Askari</i>	

IRONMAKING FUNDAMENTALS

MINERAL4/RECOGNITION4: A UNIVERSAL OPTICAL IMAGE ANALYSIS PACKAGE FOR IRON ORE, SINTER AND COKE CHARACTERIZATION	707
<i>E. Donskoi, A. Poliakov, K. Vining, S. Hapugoda</i>	
A STUDY ON THE METALLIZING SINTERING OF PELLETS OF IN-PLANT IRON-BEARING DUST AND MUD	718
<i>D. Zhu, Q. Zhang, Z. Guo, Q. Li</i>	
ADSORPTION CHARACTER OF SINTER ORE ON POTASSIUM VAPOR	729
<i>Z. Yan, J. Zhang, Z. Liu, X. Yuan, B. Gao, H. Zhang</i>	
A STUDY OF THE GASEOUS REDUCTION OF MAGNETITE ORE IN A FIXED-BED REACTOR AND USING IN-SITU HIGH-TEMPER	737
<i>Y. Kapelyushin, Y. Sasaki, J. Zhang, S. Jeong, O. Ostrovski</i>	
EXPERIMENTAL SIMULATION OF THE INTERACTION OF SLAG AND HOT METAL WITH COKE AT THE BOSH REGION OF BLAST FURNACE	747
<i>A. Bhattacharyya, J. Schenk, M. Jäger, H. Stocker, C. Thaler</i>	
QUANTIFICATION OF SINTER MINERAL PHASES WITH IMAGE PROCESSING	758
<i>B. Kain-bückner, H. Mali, S. Schadler, E. Schuster</i>	
ANALYSIS OF THE ALKALI DISTRIBUTION IN IRONMAKING REACTORS BY THERMOCHEMICAL MODELLING	761
<i>A. Pichler, J. Schenk, F. Hauzenberger, H. Stocker, C. Thaler</i>	
DISINTEGRATION MECHANISM OF CALCIUM FERRITE IN SINTER BY REDUCTION	772
<i>T. Murakami, D. Maruoka, E. Kasai</i>	
EFFECT OF COKES GASIFICATION WITH CO₂ AND H₂O ON THE POROSITY AND STRENGTH IN 1100-1500°C	779
<i>S. Shin, S. Jung</i>	
DEVELOPMENT OF SLAG FLUIDITY PREDICTION SYSTEM AND ITS APPLICATION FOR BLAST FURNACE	789
<i>S. Jia-shyan, L. Shih-hsien, H. Chung-ken</i>	
A MECHANISTIC MODEL OF THE SAPOZHNIKOV PLASTOMETER	799
<i>D. Jenkins, M. Mahoney</i>	
FORMATION OF IRON-ORE SINTER MINERALOGY AND MICROSTRUCTURE: TOWARDS A COMPREHENSIVE CONCEPTUAL MODEL OF THE FLAME FRONT	808
<i>J. Small, E. Zinngrebe, S. Melzer, V. Van Hinsberg</i>	
EFFECT OF VOLATILE MATTER OF COAL ON VOLUME CHANGE AND REDUCTION OF IRON ORE/COAL COMPOSITE PELLETS	818
<i>C. Hao-Hsun, C. In-Gann, L. Ke-Miao, L. Shih-Hsien</i>	
EXAMINATION OF COKE REACTIVITY USING MICRO-CT ANALYSIS	826
<i>D. Jenkins, M. Mahoney, A. Deev, J. Donnelly, R. Davidson, S. Mayo</i>	
TOWARDS PREDICTION OF COAL CONVERSION BEHAVIOUR IN THE BLAST FURNACE	835
<i>H. Ho, A. Babich, D. Senk, J. Frank</i>	
EFFECT OF SILICA ON THE REDUCTION KINETICS OF CaO-Fe₂O₃-SiO₂ SYSTEM	845
<i>C. Ding, X. Lv, S. Xuan, Y. Chen, K. Tang</i>	

PELLETISING

EFFECT OF FLUXING AGENTS ON THE QUALITY AND MICROSTRUCTURE OF HEMATITE PELLETS	858
<i>S. Dwarapudi, C. Sekhar, I. Paul, K. Modi, U. Chakraborty</i>	
INNOFREIGHT CONTAINER SYSTEMS - A NEW STANDARD IN RAILWAY TRANSPORT FOR VOESTALPINE	869
<i>L. Zeni, P. Wanek-Pusset, J. Zirngast, E. Schuster, J. Herzmaier</i>	
SIMULATION BASED PELLET-PLANT DESIGN	878
<i>M. Faller, B. Hiebl, M. Wirth, R. Redl</i>	
PELLETIZATION OF MALAYSIA MAGNETITE CONCENTRATES AND ITS PROPERTIES OF GAS-BASED DIRECT REDUCTION	888
<i>J. Pan, B. Bai, W. Huang, B. Shi</i>	
APPLICATION OF THE HYBRID FLOTATION IN IRON ORE - PNEUMATIC FLOTATION FOR REMOVAL OF SULFUR	898
<i>L. Petzold, J. Martens</i>	

EFFECT OF IRON ORE CHARACTERISTICS ON THE WATER –IRON ORE INTERACTION	908
<i>T. Higuchi, L. Lu</i>	
THE OXIDIZING PELLETIZATION OF MANGANESE ORE FINES AND ITS CONSOLIDATION MECHANISM	919
<i>D. Zhu, X. Hu, F. Zhang, Z. Li</i>	

POSTER

PHYSICAL MODELLING BASED ANALYSIS OF DRY SLAG GRANULATION	932
<i>P. Kali, D. Ravindra, K. Ajay, S. Pushpavanam</i>	
ANALYSIS OF NONSTATIONARY TRANSIENT PROCESSES IN BLAST FURNACE	942
<i>B. Bokovikov, Y. Gordon, V. Lavrov, V. Moikin, N. Spirin, V. Shvidkiy, Y. Yaroshenko</i>	
KINETIC ANALYSIS AND EFFECT OF BIOMASS ASH ON COMBUSTION CHARACTERISTIC OF PULVERIZED COAL	952
<i>S. Liu, J. Zhang, R. Xu, T. Song, H. Wang, H. Lin</i>	
EFFECTS OF MGO ON THE SINTERING LIQUID, THE PROPERTIES AND MINERALOGICAL MORPHOLOGY OF THE HIGH-BASICITY SINTER	961
<i>J. Zhang, D. Liu, Z. Liu, Y. Wang, Q. Kang, G. Wang, J. Yan, S. Feng</i>	
THE INFLUENCE OF ZINC VAPOR ON COMPOSITION AND PROPERTIES OF COKE	971
<i>J. Zhong, J. Zhang, K. Li, Z. Liu, G. Wang, R. Xu, D. Zhao</i>	
STUDY THE INFLUENCE MECHANISM OF POTASSIUM VAPOUR ON SINTER REDUCTION	979
<i>Z. Yan, J. Zhang, X. Yuan, B. Gao, H. Zhang</i>	
CHARACTERISTICS OF LITHIUM SILICATE PREPARED BY SOLID STATE REACTION AND THERMOGRAVIMETRIC ANALYSIS	989
<i>H. Wang, J. Zhang, G. Wang, J. Zhong, T. Song</i>	
STUDY ON THE MECHANISM OF CEO_2 AS COMBUSTION IMPROVER IN PCI	997
<i>S. Liu, Y. Sun, J. Li, Y. Qie, Q. Lv, X. Liu, L. Sun</i>	

RECYCLING OF IN-PLANT RESIDUES

CHARACTERISATION OF STEELPLANT BY-PRODUCTS TO REALISE THE VALUE OF FE AND ZN	1007
<i>R. Longbottom, B. Monaghan, G. Zhang, S. Chew, D. Pinson</i>	
FLOW SHEET MODELLING OF STEEL MAKING ROUTES IN A PROCESS INTEGRATION PLATFORM	1017
<i>B. Weiss, A. Spanlang, W. Wukovits</i>	

SINTERING, DESIGN AND EQUIPMENT

MODERN DESIGN OF SINTER COOLERS	1028
<i>H. Kassebaum</i>	
PROTECTING SINTERING PLANTS – DURABILITY, SUSTAINABILITY AND EFFICIENCY IN WEAR PROTECTION	1044
<i>J. Laskowski</i>	
TECHNOLOGIES FOR IMPROVEMENT OF SINTER PLANTS	1054
<i>M. Hoffmann, G. Kass, G. Nouaille-Degorce, T. Schwalm, A. Schulakow-Klass, P. Wurth</i>	
NEW TYPE OF PARTITION WALLS IN A PELLETIZING PLANT: A THERMO MECHANICAL ANALYSIS	1064
<i>H. Marschall, C. Nader, G. Hebenstreit, B. Wilhelmi</i>	

SINTERING, OPERATION AND CONTROL

COMBINED INJECTION TECHNOLOGY OF GAS FUEL AND OXYGEN IN IRON ORE SINTERING PROCESS	1073
<i>T. Hirosawa, Y. Iwami, T. Yamamoto, O. Nobuyuki, H. Matsuno</i>	
AUTOMATIC SAMPLING AND ANALYSIS OF GRANULATED SINTER FEED	1084
<i>J. Reidtschlaeger, D. Bettinger, A. Seiler, S. Muenkel, S. Schadler, E. Schuster, J. Zirngast</i>	
RECENT ADVANCES IN UNDERSTANDING SINTERING EMISSIONS AND THEIR MITIGATION TECHNOLOGIES	1094
<i>L. Lu</i>	

SMELTING REDUCTION

FINEX® - AN INNOVATIVE AND ENVIRONMENT FRIENDLY IRONMAKING PROCESS	1107
<i>J. Shibu, H. Ofner, N. Rein, S. Yi, S. Shin</i>	
COREX® - AN ALTERNATIVE FOR HOT METAL PRODUCTION IN A CHALLENGING ENVIRONMENT	1120
<i>C. Böhm, W. Sterrer, J. Wurm, B. Rammer</i>	
THE STUDY OF CORE-BORED TAPHOLE CLAY USED IN FINEX	1133
<i>J. M. Park, D. M. Choi, Y.J. Choi, J. H. Lee, C. H. Lee</i>	

Author Index