



**Proceedings of the
Iron & Steel Technology Conference
Volume I**

**6–9 May 2024
Columbus, Ohio
U.S.A.**



Ronald E. Ashburn, *Publisher*

Amanda L. Woods, *Publications Manager*

Jennifer M. Vergot, *Technical Editor*

Emily C. Williams, *Technical Editor*

Carolyn A. Trobaugh, *Graphic Designer*

Kyle McMullen, *Graphic Designer*

A Publication of the Association for Iron & Steel Technology

AISTech 2024
Iron & Steel Technology Conference Proceedings
Volume I

Copyright © 2024 by Association for Iron & Steel Technology or the authoring company(ies).
Contact AIST for specific information on reprinting or repurposing any part of this publication.

All rights reserved.
Printed in the U.S.A.

ISBN: 978-0-930767-25-9 (Print)
ISBN: 978-1-7138-9774-3 (CD-ROM)
ISSN: 1551-6997

Association for Iron & Steel Technology
186 Thorn Hill Road
Warrendale, PA 15086-7528
U.S.A.
Phone: +1.724.814.3000
Fax: +1.724.814.3001
memberservices@aist.org
AIST.org

The Association for Iron & Steel Technology is not responsible for statements or opinions
expressed in this publication.

In the development, submittal and presentation of material for publication for any of the Association for Iron & Steel Technology's (AIST's) media, AIST seeks to maintain the highest standard in its service to the industry. AIST expects its members, authors and presenters to adhere to these standards within any AIST function or forum. Plagiarism within submitted work will not be tolerated. Any responsibility for the thorough investigation of work submitted for publication in AIST media lies with the author or the author's employer prior to said submission. AIST shall not be liable for any outcome related to claims of plagiarism.

Papers delivered at AIST-sponsored forums are intended to be technical in nature, with solutions supported by verifiable data. Commercially motivated commentary or endorsement of specific brands or companies is not acceptable. Each paper will be reviewed by forum organizers to ensure compliance with this policy. If a paper is deemed to be in violation, the author(s) will be notified by the forum organizer(s) and given the opportunity to revise the content or to withdraw the paper/presentation. To preserve and protect the interests of AIST, forum organizers will have the authority and the responsibility to stop any paper presentation they determine to be in violation of this policy and/or withdraw the paper from publication in conference proceedings.

TABLE OF CONTENTS

AISTech® 2024

Volume 1

BRIMACOMBE MEMORIAL LECTURE

Brimacombe Memorial Lecture

Integrating Physics-Based Modeling and Artificial Intelligence for Smart Manufacturing	1
<i>Sunday Abraham</i>	

SAFETY & HEALTH

Safety & Health I

What Helmet Style and Classification Provides the Best Impact Protection?	21
<i>Michael Bottlang, Stanley Tsai, Connor Blankenau, Steven Madey</i>	
Hazard Recognition Scenario Builder for On-Site Customizable Virtual Training	30
<i>Sai Laya Mallineni, Kyle Toth, John Moreland, Xibin Zhou, Chenn Zhou, Michael Schwentor, Garrett Page</i>	
Heat Stress Prevention in Steel Manufacturing: A Review of Risk Factors and Applications of Wearable Sensing Devices.....	39
<i>Mehdi Torbat Esfahani, Ibukun Awolusi</i>	
A Hazard Recognition Training Intervention for Steel Manufacturing Workers and Supervisors.....	51
<i>Luz S. Marin, Majed Zreiqat, Wanda Minnick, Chloe Croft, Brook Endress, Julia Robins</i>	

Safety & Health II

Integrating Wearable Sensing Devices and Computer Vision for Safety Management in Steel Mills.....	61
<i>Roy Lan, Ibukun Awolusi</i>	
Advanced Guiding: How to Concurrently Improve Safety, Efficiency and Profitability	71
<i>Matthew Anderson</i>	

ENVIRONMENTAL

Environmental: Emission Controls & Regulations

The Integration of Quenching of EAF Fumes into the Dropout Box: Experiences and Alternatives to the Standard Solutions.....	76
<i>Marco Peter Cudicio, Massimo Bevilacqua</i>	
Fabric Filter Pressure Drop Problems in Blast Furnace Top Gas Applications — Identification, Solutions and Optimization	83
<i>Tyler Ty Leng, Xinxin Zhou, Tim Fisher</i>	

Environmental: Sustainability and Reporting

An Advanced Automation Package to Optimize Scarce Utilities	90
<i>Marcellino Fornasier, Lorenzo Marino, Francesco Fabris, Edi Tomat</i>	

Environmental: Water Treatment & Minimizing Water Waste

Microbiological Monitoring and On-Site Toxicant Evaluation in Critical Closed-Loop Cooling System	95
<i>James Gleason</i>	

COKEMAKING

Cokemaking

Three-Dimensional Shape Measurement of Coke Using a Medical X-Ray CT Scanner	99
<i>Shohei Matsuo, Yukihiko Kubota, Masahiko Watanabe, Masayuki Imba</i>	

IRONMAKING

Ironmaking: Blast Furnace Efficiency, Productivity & Maintenance I

BF Hearth Condition Monitoring and Hearth Repair/Reprofiling.....	107
<i>Ralf Allmannsdörfer, Stephan Bamberg, Markus Bierod, Volker Dulz, Martina Engelmann, Eric Schaub</i>	

Modern Blast Furnace Slag Granulation and Its Utilization.....	112
<i>Roger Bosman, Rob D'Arrigo, Joerg Brinckmann, Thiago Mazzeu</i>	

Ironmaking: Blast Furnace Efficiency, Productivity & Maintenance II

Spotlight on Na ₂ O and K ₂ O Behavior in Blast Furnace Operation	119
<i>Peter Warren, Maarten Geerdes</i>	

Toward the Future: First Steps Toward Achieving Autonomous Blast Furnace in Ternium Brasil	125
<i>Giuleano Goncalves, Carlos Emilio Carra Citeli, Ian Monteiro Werner, Thayron Riberiro Cremasco, Luciano Augusto Morais Maia, Bruno Pinheiro, Juraj Micak, Nicolas Schlesser, Bernardo Patto</i>	

Increase of Pulverized Coal Injection Rate at Blast Furnaces 1 and 2 of Ternium Brasil	134
<i>Tamoghna Mitra, Laurent Pasinetti, René Gaiola, Philipp Bermes, Raphael Lima, Rafael Colombo Baptista, Geovane Da Silva Viturino</i>	

Ironmaking: Digitalization & Modeling I

The Integrated Virtual Blast Furnace: Enabling Physics-Based Operational Guidance	143
<i>Tyamo Okosun, Ricardo Calix, Orlando Ugarte, Hong Wang, Kosta Leontaras, Joseph Morey, Jason Entwistle, Brian Rogers, Chenn Q. Zhou</i>	

Image-Based Casting Rate Estimation for Molten Iron Jet Released from Blast Furnace	152
<i>Weixiao Shang, Jun Chen, Tyamo Okosun, Chenn Q. Zhou, Kosta Leontaras, Joseph Morey, Jason Entwistle, Brian Rogers</i>	
A Friend in Need — a Friend Indeed: Successful AI Applications in Ironmaking by a Transparency Approach	159
<i>Dieter Bettinger, Harald Fritschek, Angelika Klinger, Petra Krahwinkel, Martin Schaler, Christian Tauber, Christoph Feilmayr, Clemens Staudinger, Magdalena Schatzl, Ross P. Goldberg</i>	

Ironmaking: Digitalization & Modeling II

Evaluating Auxiliary Reducing Agents in a Test Rig Under Raceway Conditions.....	167
<i>Thomas Nanz, Markus Boesnhofer, Johannes Rieger, Hugo Stocker, Christoph Feilmayer, Michael Harasek</i>	
Numerical Evaluation of the Suitability of Thermally Thick Alternative Reducing Agents in the Raceway Zone	176
<i>Matthias Kiss, Markus Boesnhofer, Eva-Maria Wartha, Franz Hauzenberger, Markus Gruber, Christoph Feilmayr, Hugo Stocker, Christine Gruber, Michael Harasek</i>	

Ironmaking: Low-Carbon Ironmaking

Development and Progress on Green and Low-Carbon Ironmaking Technology at Shougang.....	185
<i>Fuming Zhang, Yanbo Chen, Meng Xu, Xiangfeng Cheng</i>	

Ironmaking: Raw Material

Development of a Measurement Framework for Determining Sinter Phases and Their Influence on Sinter Plant Performance	195
<i>Janaina Solvelino Brum, Oliver Donnes, Bartosz Smaha, Alexandra Hirsch</i>	

DIRECT REDUCED IRON/DECARBONIZATION

Direct Reduced Iron/Decarbonization: Transformation

A Study on the Patented MIDREX Reformer and Its Adaptability to the H2 Economy	207
<i>Pei Yoong Koh, Paul Kazalski</i>	
High-Temperature Electrolysis Integrated with Direct Reduced Iron Process for Producing Low-Carbon Steel	215
<i>Romuald Coupan, Fabien Cens, Capella Festa, Arthur Delamare, Omar Navarro</i>	
Hydrogen-Based Direct Reduction of Industrial Hematite Pellets: Chemical Composition and Microstructural Evolution	220
<i>Ali Zakeri, Kenneth Coley, Leili Tafaghodi</i>	
Methanation as a Low-Risk and Low-Emission Pathway for the Integrated DRI-ESF-BOF Process Route — Part 2	228
<i>Kamal Joubarani, Takshi Sachdeva, Daysi Perez, Sa Ge, Ian Cameron, Richard Elliott</i>	

Characterization of Hydrogen DRI Samples from ZESTY Process	239
<i>Bintang A. Nuraeni, Isis R. Ignacio, Geoffrey Brooks, Deddy C. Nababan, M. Akbar Rhamdhani, Matte. Boot-Handford, Yun Xia, Tom Dusty, Mark G. Sceats</i>	

DIRECT REDUCED IRON

Direct Reduced Iron: Decarbonization

Copper Removal Methods from Steel — a Critical Assessment	251
<i>F. N. H. Schrama, R. Botinha Lopes Cancado, I. Hussain, N. Dogan, Y. Yang</i>	
Comparison of CO ₂ Capture Options at MIDREX Flex Plants	259
<i>Robert Millner, Hermann Voelkl, Johannes Rothberger, Vincent Chevrier, Todd Astoria</i>	
Ammonia Direct Reduction of Iron Oxides — Preliminary Assessment	270
<i>Tiara Triana, Geoffrey Brooks, M. Akbar Rhamdhani, Mark Pownceby</i>	

Direct Reduced Iron: Process Improvement

Effect of the Porosity Distribution on the Industrial-Scale DRI Reforming Process.....	278
<i>Sirisha Parvathaneni, Marcelo Andrade</i>	
DRI Advanced Process Control with Predictive Method and Virtual Assessment for Increased Plant Yield with Reduced OPEX and Emissions	288
<i>Dario Pauluzzi, Alberto Zugliano, Drius Andrea, Ashton Hertrich Giraldo, Mohab Mahmoud</i>	

Direct Reduced Iron: Reductants & Ores

Disintegration of Cold-Bonded Agglomerates of Iron-Bearing Materials in Blast Furnaces and DRI Shaft Furnaces	298
<i>Naiyang Ma</i>	
Carbon-Negative Ironmaking Using Fast Pyrolysis Bio-Oil Gasification.....	306
<i>Brian Jamieson, Jake Wilkins, Grace Connors, Subodh Adhikari, Victor Silva, Peter Reinhardt</i>	
Carbon Emissions Analysis of Pelletization Practices for Direct Reduced Iron.....	318
<i>Grant Kenny, Chris Pistorius</i>	

ELECTRIC STEELMAKING

Electric Steelmaking: EAF Efficiencies & Improvements I

CFD Modeling of the Refining Process in an Industry-Scale Electric Arc Furnace: Analysis of Decarburization Efficiency and Model Validation	327
<i>Orlando Ugarte, Neel Busa, Bikram Konar, Sathvika Kottapalli, Tyamo Okosun, Chenn Q. Zhou</i>	
How Offgas Analysis is a Fundamental Component for Achieving Dynamic EAF Control	341
<i>Armando Vazquez, Doug Zuliani</i>	
Approach for Efficient and Highly Productive EAF: Operational Results of a Reference Plant.....	353
<i>Andrea Grasselli, P. Stagnoli, B. B. Cheng, J. Chen</i>	

Electric Steelmaking: EAF Efficiencies & Improvements II

- The Effect of Arc Stability on EAF Performance 359
Nicolas Lugo, Steve Goulden, Paul Stafford, Rodrigo Corbari

- Nitrogen Control in Scrap-Based EAF Steelmaking 368
Fatih Goekce, Celal Adar, Mehmet Ali Tosun, Zirve Ik, Alp Eren Gürbüz

Electric Steelmaking: Electrical Projects/Upgrades to EAF

- New Multi-Level Converter System for Electric Arc Furnace Applications 376
Kevin Delsol, Duro Basic, Cyrille Baviere, Laurent Fahrner, Pierre-Louis Garmier, Nicolas Lapassat, Christof Sihler, Franck Terrien

- EAF Electrode Holder Replacement Via OEM, Remanufactured Design Or Additive Manufacturing Repair: Assessing the Carbon Footprint, Economic Viability, Lead Times and Tooling Life Span of Each Solution 385
Eric J. Bryan

- Active Power Feeder: The New Medium-Voltage Power Supply Solution with Huge Benefits in Power Quality and Electric Arc Furnace Regulation 394
Günther Winter, Thomas Matschullat, Daniel Dinkel, Ramazan Alishov, Sonal Bhatt, Hiranya Pathak, Magnus Geijer

- Operational Results of Swingdoor Installations at CMC Steel Texas and CMC Steel South Carolina 399
Tim Campa, Paul Shikhmetoff

Electric Steelmaking: Media Transport

- Stirring Efficiency Generated by Electromagnetic Stirring Vs. Bottom Gas Stirring for a Giant Electric Arc Furnace - Numerical Simulation Results 406
Lidong Teng, Hongliang Yang, Monika Zielinska, Zaeim Mehraban

- Models to Predict Carbon and Temperature in the Steelmaking Electric Furnace 415
Marcella Café, Gabriel Fonseca, Diego Santiago, João Aixer, Rosiane Faleiro, Bruno Mesquita

Electric Steelmaking: Refractory & Slag

- Study of Slag Properties in Steel Dephosphorization in the EAF 425
Diego Darry Moreira, Raphael Mariano De Souza, Karin Satie Komati, Kaylani Nobre Sperandio, Diego Dias Rodrigues, Jose Roberto De Oliveira

Electric Steelmaking: Robotics/Neural Network/Efficiencies

- Improved Monitoring of the Water-Cooled Upper Shell of an Electric Arc Furnace Using Fiber-Optic Sensors 435
Yeshwanth Reddy Mekala, Rony Kumer Saha, Ogbole C. Inalegwu, Muhammad Roman, Farhan Mumtaz, Rex E. Gerald Ii, Jeffrey D. Smith, Jie Huang, Ronald J. O'malley

Electric Steelmaking: Scrap

A New On-Line Scrap Quality Prediction System for Improved Raw Material Optimization During EAF Steelmaking	444
<i>Stefan Griesser, Robert Pierer, Sebastian Michelic, Robert Michelic, Jan Piskernik</i>	

Development of an Application for Scrap Metallic Management in Electric Steelmaking	453
<i>Amanda Cristina Lima Da Fonseca, Laurent Chesseret, Bruna Borba De Carvalho, Beatriz Medanha Reis, Andrew Gonzaga De Souza, Paulo Henrique Santos, Carla De Barros Hermeto</i>	

OXYGEN STEELMAKING

Oxygen Steelmaking: Automation & Technological Advancements

Improving Acoustic-Based Slag Foam Control Systems in the BOF	464
<i>Jason Heenatimulla, Geoffrey A. Brooks, Michelle Dunn, David Sly, Rod Snashall, Wang Leung</i>	

BOF Advanced Slop Detection Warning and Mitigation Results at ArcelorMittal South Africa	470
<i>Stephan Van Der Walt, Marshall Khan, Sergio Micelli, Elena Uchiteleva, Vittorio Scipolo</i>	

Sublance 2.0 — Fully Automated Measuring Solutions in Converter Steelmaking.....	482
<i>Bernhard Voraberger, Jakub Szcech, Franz Hartl, Elberth Menezes, Gerald Wimmer</i>	

Increase in BOF Productivity Through the Implementation of a New Tuyere Design for Combined Blow	491
<i>Haysler Lima, Vladnilson Ramos, Douglas Galesi, Hamilton Guimarães, Isaque Granuzzio</i>	

Oxygen Steelmaking: Decarbonization

Gerdau Ouro Branco's Steel Shop at the Forefront of Reducing Carbon Emissions Through Face Post-Combustion Technology.....	500
<i>Amilton Carlos Pinheiro Cardoso Filho, Eric Novaes De Almeida, Gilberson Mendonça Storck De Melo, Breno Totti Maia, Lucas Moreira Duarte, João Paulo Mafort Santos, Wellington Morais De Andrade, Leandro Rocha Lemos</i>	

Oxygen Steelmaking: Practices

Dephosphorization Revisited: A Niche for BOF Steelmaking	512
<i>Jilai Zhang, Mariam Sidawi, Feng Liu, Ian Cameron, Rainer Huesken, Richard Elliott</i>	

Oxygen Steelmaking: Process Modeling

Influence of Geometry on Flow Patterns and Metal Accumulation at the Lance Tip in BOF Converters	524
<i>Ayrton Cavallini Zottelle, Pedro Francelino Garcia, Renato Do Nascimento Siqueira, João Paulo Barbosa, José Roberto De Oliveira, Breno Totti Maia</i>	

Three-Dimensional Simulation of Supersonic Nozzle Start-Up Structures and Their Consequences on the BOF Steelmaking Process	537
---	-----

Pedro Francelino Garcia, Ayrton Cavallini Zottelle, Renato Do Nascimento Siqueira, João Paulo Barbosa, José Roberto De Oliveira, Breno Totti Maia

On (%FeO)–[%C] Correlation During Primary Steelmaking.....	548
--	-----

Deepoo Kumar, Nurni N. Viswanathan, M. P. Gururajan, P. Chris Pistorius

SPECIALTY ALLOY & FOUNDRY

Specialty Alloy & Foundry: Melting & Casting

Modeling Helium Heat Transfer in VAR with Accommodation Coefficients: Examination of Their Uncertainty and Effect on Modeling Predictions	555
---	-----

Richard Smith

Mastering the Challenges to Produce Automotive Exposed Grade Via EAF Steelmaking Route.....	574
---	-----

Andreas Viertauer, Bernd Linzer, Stefan Mühlböck, Hagen Fuchs, Willi Bühler, Zafer Cetin, Naci Ibrahim Arun, Hans Jörg Krassnig

Specialty Alloy & Foundry: Processing & Analysis

LIBS-Based Fast Elemental Analysis of Ferroalloys and Process Slag for Immediate Decision-Making Followed by Efficient Resource Consumption, Smaller Process Window and Increased Yield - Case Study of a Forging Plant	583
---	-----

Amit Ahsan, Marko Hornschu, Christian Bohling, Marco Thielemann

Artificial Intelligence Developments for Stainless Steel Production in Aperam Genk	588
--	-----

Matthias Schops, Bastien Soete, Thierry Koeger, Guillermo Fernandez, Saul Gonzalez

LADLE & SECONDARY REFINING

Ladle & Secondary Refining: Improvements in Ladle Processing

Optimized Instrument Settings for Faster Automated Inclusion Analysis	592
---	-----

Panwen Su, P. Chris Pistorius, Bryan A. Webler

Maximization of Steel Ladle Free Open Rate by Using Shop-Specific Production Parameters	599
---	-----

Daniel Holmes, James Lash, Todd Albring

Post-Taphole Ladle Refining of a CRISP+ ESF Hot Metal to Produce High-Quality Green Metallics	605
---	-----

Rainer Hüskens, Sa Ge, Anastasiya Mitsui, Simon Faux

Ladle & Secondary Refining: Modeling & Machine Learning

Study of the Vacuum Degassing Process Using the Effective Equilibrium Reaction Zone Model	612
---	-----

Bikram Konar, Keyan Miao, Noah Quintana, Ziyi Wang

A CFD Study of Refractory Brick Erosion and Corrosion in Ladle Metallurgy Furnace.....	627
--	-----

Xipeng Guo, Mohammed Abdul Razzak, Syed Imran, Nicholas Walla, Steve Ryan, Chenn Zhou

Updated Experience with IR Imaging and Process Control Software for VTD Operations Coupled with Specialized Infrared Camera	635
<i>Charles S. Krcmaric, Thomas J. Connors, John D. Lewis, Randall Stone</i>	

Ladle & Secondary Refining: Modeling & Technology Innovations

Simulation of Secondary Metallurgical Processes by Using Computational Thermodynamics and Comprehensive Statistical Learning Methods	644
<i>Daniel Kavi, Michael Bernhard, Roman Rössler, Christian Bernhard</i>	

Characterization of Inclusions During Ladle Refining of a Resulfurized Steel Grade (38MnSiVS5) Using Lollipop Samples	658
<i>Bansode Krushna, Soorya Prakash Jayaraj, M. P. Gururajan, Nurni Vishwanathan, Deepoo Kumar</i>	

Modeling on the Three-Dimensional Distribution of Inclusions in the Molten Steel of an Argon-Stirred Ladle	667
<i>Zhentong Liu, Jujin Wang, Lifeng Zhang</i>	

Ladle & Secondary Refining: Slag & Process Optimization

Quality Steel Needs Quality Vacuum	673
<i>Derek Corcoran</i>	

The Design of Sound Cavities for Microphone Sensors in Steelmaking.....	676
<i>Jaefer Yenus, Geoffrey Brooks, Michelle Dunn, David Sly, Alister King</i>	

Study of the Efficiency of the Slag Formed in Steel Tapping in Desulfurization and Refractory Wear.....	687
<i>Jose Roberto De Oliveira, Victor Barcellos Oval, Victor Dagostini</i>	

The Deoxidizing Effect of Metallurgical Silicon Carbide at Tapping into the Ladle and Its Influences on the Following Desulfurization Stage for a Steel Produced by EAF Route.....	698
<i>Ricardo Abrahão Júnior, Isabela De Fátima Silva Vidal, Gabriel Fonseca Silva, Telmo Sumak Alves Diana, Klebson Luiz Silva, Victor Dos Santos Dagostini, Raphael Mariano De Souza, Victor Barcellos Oval, Emanuel Vailant De Nazareth, Felipe Fardin Grillo, José Roberto De Oliveira</i>	

CONTINUOUS CASTING/METALLURGY - STEELMAKING & CASTING

Continuous Casting/Metallurgy - Steelmaking & Casting: Impact of Mold & Tundish Flux on Caster Operation

Innovative Non-Radioactive Steel Level Control for Open-Stream Casting.....	708
<i>Simone Cicutto, Isabella Mazza, Giovanni Schiavon, Stefano Spagnul</i>	

Continuous Casting/Metallurgy – Steelmaking & Casting: Mold Flux Design & Optimization I

Suppressing Aluminum/Silica Exchange Reaction Between High-Aluminum Steel and Mold Flux Using Dopant Additions	713
<i>Kuanysh Yermukhanbetov, Ronald O'Malley, Yijia Gu, Todd Sander, Darrell Sturgill, Thinium Natarajan, Kris Phillips, Matthew Nosbush, Christopher Rakers, Nathan Gillespie</i>	

Continuous Casting/Metallurgy – Steelmaking & Casting: Mold Flux Design & Optimization II

Casting Powder Developments for Medium-Thickness High-Speed Slab Caster at Nucor Steel Gallatin	726
<i>Neil Sutcliffe</i>	
Decarbonization of Mold Flux: Contributing to Carbon Footprint Reduction	740
<i>José Augusto Cardoso Ferreira, Jeferson L. Klug</i>	
Influence of Crystallization Behavior in Slag Film on Mold Thermocouple Temperature Deviation	749
<i>Satoshi Yamasaki, Junya Ito, Masanori Okada, Jim Gilmore</i>	

Volume 2

Mold Powder Feeding for Submerged Casting Machines: Technology and Applications.....	758
<i>Simone Cicutto, Isabella Mazza, Giovanni Schiavon, Stefano Spagnul</i>	

CONTINUOUS CASTING

Continuous Casting: Caster Process Improvement

A Machine-Learning Approach with Few-Shot Counting (FAMNet) to Count Bubbles in a Full-Scale Continuous Casting Mold.....	765
<i>Eric Wang, Alexander W. Olson, Jackie Leung, Markus Bussmann</i>	
Smart Robotics Applied to Caster Operations	775
<i>Ion Rusu, Anna Zoppirolli, Gianluca Maccani</i>	
Smart Products for High-Quality Steel Production with Billet Or Bloom Continuous Caster	779
<i>Steve Muench, Nicholas Klipa, Vincent Duport, Raul Santagostini</i>	
AI-Driven Temperature Control in Secondary Metallurgy Based on Continuous Temperature Measurement	788
<i>Murat Gunerdi, Talip Küçük, B. Burç Gündoğan, Güven Atatepe, M. Evren Arıkan, Isa Keskin, Hüseyin Özçalan, Dilara Boynueyri, Otmar Jannasch, Marcus Bahn</i>	

Continuous Casting: Caster Technology

A Novel Approach to Simulate and Evaluate Submerged-Entry Nozzle Clogging Evolution Using the Full-Scale Physical Twin of a Continuous Casting Mold	797
<i>Jackie Leung, Donghui Li, Joydeep Sengupta, Markus Bussmann</i>	
A Lab-Scale Mold Simulator Employing an Optical-Fiber-Instrumented Mold to Characterize Initial Steel Shell Growth Phenomena.....	807
<i>Muhammad A. Nazim, Rony Kumer Saha, Mario Buchely, Ronald O'Malley, Jie Huang, Arezoo Emdadi</i>	
Automated, Scalable AI for Real-Time Monitoring of Steel Continuous Casting System	819
<i>Joe Porter, Keval Bhanushali, Shreebhooshan B., Suhas Mehta, Nikunj Mehta</i>	
Striving for Operational Excellence in Continuous Casting – Development of a Continuous Casting Simulator Using a Mixed Reality Approach.....	830
<i>Franz Ramstorfer, Vinicius Teixeira De Morais, Marcio Neves De Oliveira, Felipe Nazário</i>	

Continuous Casting: Casting Quality

Effect of Atmosphere on Scale Evolution in Continuous Casting	841
<i>Tochukwu Princewill Ojiako, Jon Austin Hatcher Jr., Robin Brost, Ryan Barrette, Richard Osei, Tony Bader, Mario Buchely, Simon Lekakh, Ronald O'malley</i>	
Development of a System for Caster Segments Mileage Tracking at SSAB Iowa.....	852
<i>Yufeng Wang, Sunday Abraham, Dallas Brown, John Fraley, Randy Petty</i>	

Continuous Casting: New Caster Developments

The Caster for Green Steel	861
<i>Michael Riedler, Alja Vila, Denijel Burzic, Thomas Lengauer, Gerald Hrazdera, Andreas Jungbauer</i>	
Mechanical Soft Reduction Technology for Increased Quality Demands in the Future Long Product Market	870
<i>Giovanni Cairoli, Steve Munch, Stephan Feldhaus</i>	
Digital Aspects on the Way to a Fully Automated Continuous Caster.....	880
<i>Reinhold Leitner, Christoph Aigner, Rainer Kaltseis</i>	

Continuous Casting: Submerged Nozzle Design

Study of Submerged Nozzle Designs to Reduce Potential Stickers in a Slab Caster	887
<i>Pavan Shivaram, Lidia Yakovleva, Gernot Hackl, Wolfgang Fellner, Yong Tang</i>	
Development of New ZrO ₂ -CaO-C Material for High-Performance Anti-Clogging Nozzle.....	898
<i>Akinari Sasaki, Ling Li, Shigefumi Matsumoto, Katsumi Morikawa, Kiyoshi Goto</i>	

PLATE ROLLING

Hot Sheet Rolling/Energy & Utilities

Operation of Reheating Furnace with 100% Green Hydrogen	909
<i>Itsaso Auzmendi, Julen Garmendia-Toledo, Juan Blanco-requesens, Joaquin De Diego Rincon, Eider Del Molino Duran, Juan Palacios Taubmann, Borja Peña</i>	

HOT SHEET ROLLING/ENERGY & UTILITIES

Scale-Free Furnace: A Step Toward Decarbonization	917
<i>Elisa Salamone, Andrea Biliotti, Narayan Raut, Alessandro Venanzini</i>	
Temperature Measurements of Slabs in Reheating Furnaces from Radar Measurements	925
<i>Patrik Ottosson, Jonas Engdahl</i>	

Hot Sheet Rolling/Energy & Utilities: Reheat Furnaces

Performance Modules – Milestones on the Way to a Carbon-Neutral Hot Rolling Process.....	940
<i>Georg Padberg, Jennifer Grzyb</i>	

Reduced CO ₂ Emissions by Productivity Increase in Hot Strip Mills	947
<i>Kai Grybel, Klaus Pronold, Philipp Raming, Jörn Sieghart</i>	

Improve Energy Efficiency by Defining the Operating Parameters of a Reheating Furnace Using State-Of-The-Art Digital Solutions	952
<i>Kássio Nogueira Cançado, Paula Pomaro, Ana Carolina Rocha, Giovanna Guzella, Lis Nunes Soares</i>	

HOT SHEET ROLLING

Hot Sheet Rolling: Digitalization

Modeling of Thin-Slab Hot Rolling Technologies	966
<i>Evgueni Nikitenko</i>	

Sophisticated State-Aware Roll Force Prediction.....	974
<i>Susanne Sparrer, Jens Frenzel</i>	

Combined On-Line Flatness, Profile and Wedge Control — Finite Element Simulation-Based Design and Commissioning Results	985
<i>Klaus Loehe, Peter Gruber, Niklas Petrasch, Sebastian Kallabis, Martin Mucha</i>	

Numerical Hot Rolling Simulations for Improvements in Flatness and Profile Control	995
<i>Jônatas Barbosa, Bruno Resende, Cristovão Giacomin</i>	

Hot Sheet Rolling: New Installations/Upgrades

Commissioning of the New 4.6 Mt/Y Direct Slab Rolling Plant of Yunan Yukun Steel	1008
<i>Andrea Colombini</i>	

New Established Mexican Hot Rolling Facility: ArcelorMittal Mexico Commences Operation of Its New Hot Rolling and Processing Facility	1017
<i>Lukas Pichler, Martin Bergmann, Franz X. Schmoller, Konrad Krimpelstaetter, Jorge Nieto, Everardo Aceves</i>	

Nucor Steel Gallatin Compact Casting-Rolling Plant Successful Modernization	1027
<i>Luca Faralli</i>	

Criteria for Slab Cooling After Continuous Casting.....	1034
<i>Franz Ramstorfer, Allana Rodrigues Pavão, Marcos Delane De Souza</i>	

Hot Sheet Rolling: Process Improvements

Automotive Exposed Steel Via Direct Casting Rolling Line.....	1041
<i>Riccardo Conte, Alessandro Pigani</i>	

Automotive Exposed Steel Production on Arvedi ESP	1045
<i>Simon Grosseiber, Gero Schwarz, Elmira Montazerozohour, Lukas Preuler, Andreas Jungbauer, Juergen Scholler</i>	

Bringing Key Advantages Together: The Nexus Concept	1051
<i>Cosimo Cecere, Ken Sharer, B. Kintscher, Tristan Töpfer-Bergner, C. Hassel</i>	

Work Roll Speed Drop Compensation for Hot Strip Mills Reduces Drivetrain Wear and Increases the Strip Quality	1059
<i>Klaus Loehe, Johannes Reinhard, Niklas Petrasch, Sebastian Kallabis, Knut Graichen, Martin Mucha</i>	

COLD SHEET ROLLING

Cold Sheet Rolling: Innovation & Modernization

Strip Transport Digital Twins	1071
<i>Paul Schaeffer, Brian Braho</i>	
Optimizing for Mill Housing Deflection with Analytical Equations.....	1081
<i>Colin Gardner, Paul Schaeffer</i>	

Cold Sheet Rolling: Optimization & Performance

Outline of Super Hybrid Leveler/Slitter Line for High-Performance Metal Plate/Sheet.....	1090
<i>Ryuta Kumagai, Tomoyuki Shimamura, Tomohiro Ishido, Keizo Abe</i>	

Cold Sheet Rolling: Ultrahigh-Strength Steels

Advanced Technologies of Cold Complex for Advanced High-Strength Steel (Tandem Cold Mill and Continuous Galvanizing Line).....	1098
<i>Takanori Nagai, Keiji Mizuta, Toru Nakayama</i>	
Green Steel in Cold Rolling and Processing Lines.....	1107
<i>Dmitriy Voitekhovskii</i>	
Discrete Techniques of Cold Rolling Ultrathin Strip.....	1112
<i>Navneet Singh, Aseem Gill, Navit Gill</i>	
Latest Technology of Tension Leveler for Ultrahigh-Strength Steel	1121
<i>Takuya Kameyama, Tomoyuki Shimamura, Keizo Abe</i>	

GALVANIZING

Galvanizing: Line Challenges

Novel Digital Solutions to Optimize OPEX and Quality for Galvanizing Furnaces	1129
<i>Sébastien Roche, Maxime Monnoyer</i>	
Smart Approach to Design a Hybrid/Full Electric Furnace for Galvanizing Line.....	1135
<i>Filippo De Santi, Alessandro Venanzini, Matteo Volpato</i>	
Consumption Reduction and Product Mix Expansion Toward AHSS Grades with CGL Furnace Revamping: A Technical and Erection Challenge	1139
<i>Giovanni Carozzo, Alessandro Venanzini</i>	

Galvanizing: New Materials & Testing

- Zn-Bath Corrosion Behavior of the Martensitic Stainless Steels (1.4095-Type) After Variation of the Si and Cr Content in Comparison to the Ferrite-Free 316L Type (1.4409.01).....1147
Tobias Simon, Frank Wischnowski

- Managing the Effects of Passline and Strip Shape on Metal Coatings1157
Ivan Marincic, Owen Pearcey, Joel Tham

PLATE ROLLING

Plate Rolling: I

- Thermal Expansion and Temperature Evolution on Work Rolls of Plate Mills.....1165
Qiulin Yu, Scott Beavers, Anthony Jones, Keith Dailey, Logan Schoppert

- Value-Added Plate Production with Heat Treatment Technology1178
Manfred Dingenotto, Georg Padberg, Bernd Bohnenkamp, Christian Sprung, Andreas Mnich

- Alloy Design and Processing of Low-Cost Structural Steel Plates Using Low-Mn and Micro-Nb Additions1189
T. Ros-Yanez, M. Kapustin, I. Cayetano, L. Brantingham, B. Mee, L. F. Simoes, M. Moritugui, C. I. Garcia

- Comprehensive Modernization of the 166-Inch Plate Mill at Algoma Steel 1202
Tom Katagis, Matteo Bulfone, Illya Synelnykov, Marco Mossutti

Plate Rolling: II

- Effect of M/A on the Mechanical Properties of Microalloyed Steels1211
Dengqi Bai, Jacob Ecklund

- Nucor Brandenburg MultiPlate: The Most Advanced Plate Mill of America 1224
Antonio Comelli, Lorenzo Lusina, Marco Mossutti

- Smart Hot Rolling Process Based on Real-Time Work Hardening Evaluation and Incremental Plasticity Theory1238
Lorenzo Ferraiuolo, Alessandro Ferraiuolo

LONG PRODUCTS

Long Products: Rebar/Wire Rod

- Continuous Mill Technology for Efficient Production of Long Products.....1248
Carlo Cascino, Marco Abram, Andrea Lanari, Filippo Verlezza, Mario Fabro

- Defect Detection and Trimming in Wire Rod Mills Driven by Robotics and Computer Vision Technology1257
Enrico Piceni, Matteo Sandri, Simone Ambrosio, Manuel Martin

- Laboratory Simulation and Characterization of Duplex Laying Head Pipe Thermal Distortions 1264
Gabriela Madeira, Ricardo Nolasco, Clélia Oliveira, Cynthia Castro

Long Products: Rolling Mill Data

Numerical Calculation of Roll Pass Designs for 3-Roll Rolling Mills.....	1271
<i>Christian Overhagen</i>	
ProcessExpert – Digitalization Foundation and System Integration of Long Rolling Plants	1284
<i>Lukasz Rzepa</i>	
Integrated Platform for Process Design, Mill Operation and Thermometallurgical Simulation.....	1294
<i>Dario Magni, Alberto Nardini</i>	
The Virtual Sensor Digital Application in Long Products Rolling Mills.....	1305
<i>Alberto Nardini, Dario Magni</i>	

Long Products: Rolling Technology

Automatic Gap Control Function Applied to a Long Products Rolling Mill for Sections.....	1314
<i>Alberto Nardini</i>	
Application of Asymmetric Hydraulic AGC to Shifting Reverse Mill	1327
<i>Rikizo Nakatani, Yasuhiko Maruyama, Keizo Abe</i>	

ROLLS

Rolls: Equipment/Quality

A Team Effort to Solve Strip Surface Quality Issues from Hot Rolling Critical Applications	1336
<i>Michael Aigner, Danny Beentjes, Henk Bolt, Sébastien Flament, Armin Paar, Leonel Elizondo</i>	

Rolls: Properties/Performance

Cemented Carbide Rolls Having Higher Yield Strength for Cold Steel Sheet Rolling	1348
<i>Takumi Ohata, Yuki Yamauchi, Shunji Matsumoto, Shinya Shufumoto, Masahiro Soeta</i>	

METALLURGY - STEELMAKING AND CASTING

Metallurgy – Steelmaking & Casting: Cleanliness/Inclusion Quantification

Development of an Improved Inclusion Assessment Approach for Steels	1356
<i>Amrita Bag, Bikram Konar, Keyan Miao, Michael J. Gaudet</i>	
Steel Cleanliness Quantifications in Molten Steel, Slabs and Coils for Process Optimizations.....	1371
<i>Ricardo V. R. A. Martins, Alanderson Batista O., Pablo J. Huazano, Bruno Pinheiro S.</i>	

Metallurgy – Steelmaking & Casting: Impact of Crack & Segregation

Inhibition Mechanism of Microscale Complex MnS Precipitation on Spot Segregation in GCr15SiMn Steel Ingots	1378
<i>Guolei Zhang, Guoguang Cheng, Tao Zhang, Wenjun Sheng, Hongsheng Sheng, Xu Zhang</i>	

Formation, Deformation and Oxidation Behavior of Small-Sized and Irregular-Morphological Surface Crack on the Hot-Rolled Thick Plate of HSLA Steel	1389
<i>Wenjun Shen, Guoguang Cheng, Chuangju Zhang, Shisong Pan</i>	

Metallurgy – Steelmaking & Casting: Inclusion Engineering in Bearing Steel

Automated Strand Quality Assessment Using Quality Indices in Continuous Casting	1400
<i>Rainer Kaltseis, Susanne Hahn, Franz Ramstorfer</i>	
Inclusion Engineering for Clogging-Free Continuous Casting of Case-Hardened Bearing Steels.....	1406
<i>Sakkiah Dharmar, Sethu Prasanth Shanmugam, Eswarakrishnan Ramamurthy, Rajesh Durairaj</i>	
Characteristics of Large-Size Ds-Type Inclusions in Ultrahigh Clean Bearing Steel.....	1410
<i>Guanbo Wang, Guoguang Cheng, Yanling Zhang, Lie Chen, Lei Hui, Qiang Wang, Honghan Cai</i>	

Metallurgy – Steelmaking & Casting: Inclusion in Continuous Casting

Growing Mechanism Model Applied for Non-Metallic Inclusion Evolution in Molten Steel	1420
<i>Leandro P. Prandi, Marcello A. P. Batalha, Luiz F. Z. W. Guimarães, Demetrius R. Ruy, Estefano A. Vieira</i>	
Effect of Casting Speed on the Inclusion Distribution in a LCAK Steel Sheet Produced by the MCCR Process	1431
<i>Tianxiang Yuan, Wen Yang, Lifeng Zhang, Jingang Liu</i>	

Metallurgy – Steelmaking & Casting: Metallurgy of Steel

Peritectic Prediction Model Development.....	1439
<i>Sarah A. Pfeffer, Thinium T. Natarajan, Scott R. Story</i>	
Effects of Si and Al on the Microstructures and Cracking Behavior of As-Cast Advanced High-Strength Steels.....	1454
<i>Nhu Ngo, Bryan Webler, P. Chris Pistorius</i>	
Effect of Ti on Phase Transformation and Grain Evolution in Nb/V Microalloyed Steel	1470
<i>Barshan Saha, Henry Haffner, Mario Buchely, Simon Lekakh, K. Chandrashekara, Ronald O'malley</i>	

Metallurgy – Steelmaking & Casting: Steelmaking Process Analysis

Investigation of Non-Metallic Inclusions During Vacuum Induction Melting	1479
<i>Zhikai Liu, Bryan Webler</i>	
Variation of Ladle Eye Size Using Image Analysis.....	1489
<i>Jaefer Yenus, Geoffrey Brooks, Michelle Dunn, David Sly, Alister King</i>	

METALLURGY - PROCESSING, PRODUCTS & APPLICATIONS

Metallurgy – Processing, Products & Applications: Alloying & Microstructure

Development of Nanoprecipitation-Strengthened Cold-Rolled Batch-Annealed HSLA Coated and Uncoated Sheet Steels (>550 MPa Yield Strength) with Superior Formability.....	1495
<i>Siddhartha Biswas, Shobhit Bhartiya, William Williams, V. S. Yashwanth Injeti, Amar K. De</i>	

Metallurgy - Processing, Products & Applications: Heat Treatment & Characterization I

Metallurgical Studies of Quench-And-Self-Tempered-Produced Rebar	1503
<i>Ignatius C. Okafor, Benjamin W. Lovell, Douglas Ferreira Ambrosio, Camilo Rodrigo Florentino Da Silva, Augusto Donelli</i>	

Metallurgy - Processing, Products & Applications: Heat Treatment & Characterization II

Evaluation of Austenitizing Parameters on Coating Evolution, Microstructure and Mechanical Response of a Press-Harden 22MnB5 Steel Grade.....	1515
<i>Eliseo Hernandez, Patrick Cleaver, Koushik Balasubramanian, Sobhan Nazari, Panagiotis Makrygiannis</i>	

Volume 3

Effect of Heating Rate on the Kinetics of Intercritical Austenitizing in a Commercial C-Mn-Si Steel for Automotive Application	1524
<i>Eduardo Antônio Laia Da Silva, Geraldo Lício De Faria</i>	

Effect of Calcium Content on the Transformation of Inclusions During Heating Process in a Ultralow-Sulfur Steel.....	1536
<i>Xiqing Zhao, Weijian Wang, Lifeng Zhang</i>	

Metallurgy - Processing, Products & Applications: Steel Cleanliness

Cleanliness Evaluation and Control During API 5L X70 Slab Steel Production.....	1541
<i>Jakeline Lima, Wagner Viana Bielefeldt, Ismael Flores</i>	

Improvements in Process Practices with a Focus on Reduction of Slivers in Ultralow-Carbon Automotive Exposed Application Grades at Ternium Brasil.....	1550
<i>Laryssa De Jesus Ramos, Thaisa Franco Silva, Bruno Suveges Cerchiari, Luisa Saisse De Melo, Jakeline Paula De Lima, Ricardo Vieira Regis De Almeida Martins</i>	

Comparison of the Level of Inclusion in High-Carbon Steel Wire Rod Produced from Scrap-Based and Ore-Based Billets.....	1559
<i>Cagkan Eraydin, Hüssam Batu, Tuçe Motugan, Ümit Karata, Sedat Tarakç</i>	

Metallurgy – Processing, Products & Applications: Technology Simulations & Modeling

Developing an Intelligent Process-Properties Simulator for Predicting Magnetic Properties of Electrical Steels Through Synthesis of Operational Data.....	1567
<i>John Caleb Somasundaram, Menghan Gu, Codrick Martis, Ted Hill</i>	

Is MicroXRF Technology the Missing Link in Standard Metallurgical and Failure Analyses of Ferrous-Based Components?	1574
<i>Ben Ruchte</i>	

DECARBONIZATION

Decarbonization: Blast Furnace

Simulation-Aided Evaluation of Alternative Reducing Agent Conversion Experiments	1591
<i>Makus Bösenhofer, Thomas Nanz, Matthias Kiss, Christine Gruber, Johannes Rieger, Hugo Stocker, Christoph Feilmayr, Michael Harasek</i>	

Decarbonization: Carbon Capture, Usage & Storage

Methanation – an Opportunity to Recycle Carbon and More Efficiently Introduce Hydrogen to the Blast Furnace?	1602
<i>Nicholas Aubry, Megan Estabrooks, Feng Liu, Daysi Perez, Richard Elliott, Mitren Sukhram, Pauli Baumann, Ian Cameron</i>	

Carbon-Negative Ironmaking – Carbon Dioxide Removal and Fossil-Free Iron Units	1614
<i>Brian Jamieson, Edward Young, Peter Reinhardt</i>	

Decarbonization: Challenges

Decarbonization in the Steel Industry.....	1623
<i>Joseph Maiale, Douglas Ferrante, Benny Nyberg</i>	

What is an Optimal Route for Green Steelmaking?	1626
<i>Suvi Rannantie, Aleksi Laukka, Petri Palovaara, Jussi Niemelä, Matti Sakaranaho, Virpi Leinonen, Janne Tikka</i>	

From Green Electron to Green Iron – Challenges and Opportunities.....	1637
<i>Thomas Germershausen, Guido Kleinschmidt, Momchil Amautski, Kanstantin-Kiril Stanchin, Bobby Pecotic</i>	

Defossilization of Integrated Plants — Benefits and Challenges of Different EAF Designs	1647
<i>Felix Firsbach, Per Lueckhoff, Ralf Schweikle, Andrea Pezza, Patrick Hansert, Peter Van Der Velden, Marcus Krause</i>	

Decarbonization: Iron Ore Quality Challenges

Electric Smelting Technology Implementation Road Map.....	1660
<i>Kyle Chomyn, Sa Ge, Terry Koehler, Chris Walker, David Rudge</i>	

Methanation as a Low-Risk, Low-Emission Pathway for the Integrated DRI-ESF-BOF Process Route — Part 1	1671
<i>Takshi Sachdeva, Kamal Joubarani, Daysi Perez, Sa Ge, Ian Cameron, Richard Elliott</i>	

Smelter – Green Steelmaking Using Low-Grade DRI	1681
<i>Gerald Wimmer, Bernhard Voraberger, Johannes Rosner, Andreas Pfeiffer</i>	

Decarbonization: Technology Makers

Derisking of Iron and Steelmaking Decarbonization Projects	1689
<i>Richard Elliott, Sa Ge, T. Sachdeva, A. Abazarpoor, Stefanie Vo, David Zybko</i>	
Options for Reducing CO ₂ for Iron and Steel Plants and Energy Efficiency Considerations	1698
<i>Sunil Kumar, Yakov Gordon, Paul Krawchuk, Ricardo Maia</i>	
Hydrogen Flame Behavior in High Temperature Steelmaking Environment	1706
<i>Gopal Pandey, Geoffrey Brooks, Jamal Naser, Daniel Liang</i>	

ENERGY & UTILITIES

Energy & Utilities: Combustion Gases & Applications

Recovery of Residual Process Heat from Fume Exhausts and Conversion into Electrical Energy	1715
<i>Michele Chiappa</i>	
The Combustion Characteristics of Hydrogen-Rich Fuels Injected into the Blast Furnace	1719
<i>Jyun-Hao Huang, Dai-qui Vo, Sheng-yen Hsu, Bo-jhih Lin, Chien-hsiung Tsai, Tsung-yen Huang</i>	

Energy & Utilities: Electrical Based Heating Systems

Induction Heating – a Contribution on the Way to CO ₂ Neutrality in Rolling Mills	1727
<i>Marco Rische, Axel Walther, Martin Ennen, David Decker</i>	
Evaluation of Combined DC/AC Inductive Heating of Steel Billet	1734
<i>Tharindu Siyambalapitiya, Geoffrey Brooks, M. Akbar Rhamdhani, Alister King</i>	
Unavoidable CO ₂ Emissions from the EAF — a Solution for Net Zero.....	1741
<i>Ali Nehme, Marco Lapasin, Antonio Sgrò</i>	

Energy & Utilities: Energy Management, Combustion & Injection Applications

Harnessing Energy Independence.....	1749
<i>Remington Schieffer</i>	
Decarbonization Through Proven Energy-Efficiency Solutions and Use of Hydrogen in Reheat Furnaces	1755
<i>Joachim Von Scheele, Hamzah Alshawarghi, Jim E. Murphy, Patrick Diggins, Oscar Salvador</i>	
Utilization of a Digital Tool to Assess the H ₂ High Concentration Event in Blast Furnace Gas	1762
<i>Giovanna Guzella, Kassio Cancado, Lis Nunes Soares</i>	
Demonstration Plant for Producing High-Purity Hydrogen from Blast Furnace Gas.....	1771
<i>Michael Iannelli, Jasmeer Ramlal, Ken Grieshaber</i>	

Energy & Utilities: Process Modeling & Production Upgrades

An Off-Line Model to Design RHF Processes	1778
<i>Domenico Garassino, Fabio Merlo, Paolo Spagnolo</i>	

Scale Thickness Prediction for Steel Reheating	1791
<i>Misbahuddin Husaini Syed, Abhishek Kalakotla, Nicholas J. Walla, Armin K. Silaen, Kurt Johnson, Lawrence Fabina, Chenn Zhou</i>	

Producing Value Out of Exhaust Gas Energy Content, Improving Furnace's Energy Efficiency	1803
<i>Gabriele Guastaferro, Ali Nehme, Antonio Sgrò</i>	

ELECTRICAL APPLICATIONS

Electrical Applications: Design, Applications & Maintenance

Solving Transformer Supply Chain Issues with Key Transformer Maintenance Procedures and Tactics.....	1822
<i>Dominic Pollaro</i>	

Automatic Assessment of Electrical Load Impact and Strategies for Mitigation of Voltage Sags	1830
<i>Daniel Sabin, Jon Bickel, Sreemant Roy</i>	

Electrical Applications: Production & Digital

AI-Controlled Product Changes at Cold Rolling Mills Significantly Improves Performance.....	1840
<i>Jörn Sieghart, Klaus Pronold, Christian Pfeifer, Rachid Barkouta</i>	

Improved Hot Strip Mill Operation by Centerline Control — Latest Application Toward Fully Automatic Flat Rolling.....	1845
<i>Klaus Pronold, Alexander Kofler, Christian Mengel, Tim Oliver Heinz, Guido Eicher</i>	

DIGITALIZATION APPLICATIONS

Digitalization Applications: AI & Digital Twins

Modern Order Dressing: From Catalog-Based to Rule-Based	1853
<i>Eric Meta, Gunther Schober, Kurt Pressberger, Carlos Olmos, Scott Miller</i>	

Leveraging Industrial AI to Increase Throughput in Steel Manufacturing	1858
<i>Venkatesh Muthusamy, John Murdoch</i>	

Optimizing Supply Chain Scheduling in Steel Mills: An Algorithm Leveraging Digital Twin Technology	1861
<i>Pedro Henrique Feres Campos, Fabricio Schiavon Kolberg, Matheus Henrique Lemes Faria, Matheus De Oliveira Mendonça, Geraldo José Duarte, Milton Carlos Abel Pires, Wiliam Lopes Santos, Luiz Fabio Lobato Notini, Bruno Alvares, Bruno Da Silva Breder</i>	

Generative AI for Process Modeling in the Steel Industry	1869
<i>Richard Marquez, Esnardo Morales, Alex Alvarez</i>	

Digitalization Applications: Energy & Environmental Applications I

Leveraging High-Speed Data, Analytics and AI at Plant Scale to Deliver Business Value in Steel Production	1878
<i>Eric Snyder, Ashis Khan, Shreebhoooshan B.</i>	

Digitalization Applications: Energy & Environmental Applications II

- Enabling Digital Transformation in the Steel Sector: An Interpretive Structural Modelling of Adoption Barriers and Strategies to Overcome Them 1889
Aitana Ucles Fuensanta, Taoseeq Ibn-Mohammed, Neeraj Bhanot, Temidayo Akenroye, Mehmet Chakkol
- Detailed Tracking of Product CO₂ Footprint in Steel Industry to Drive Emissions to Net Zero 1901
Martin Schlaudmann, Heinz-josef Ponten

Digitalization Applications: Primary Steelmaking I

- Saving Energy by the Application of Artificial Intelligence to the Hot Metal Ladle Logistics 1908
Maria Gabriela Garcia Campos, Bruno Luchini, Paul Van Der Beurden, Sido Sinnema
- Real-Time Optimized Torpedo Cars Schedule: Increasing Pig Iron Usage Efficiency 1913
Pedro Henrique Feres Campos, Matheus Botelho M. Dos Santos, Guilherme Cristiano Fraga, Renan Da Silva Santos, Matheus De Oliveira Mendonça, Gustavo Rodrigues Lacerda Silva, Douglas Alexandre Gomes Vieira, Rewber Guilherme Dos Reis, Bruno Alvares, Bruno Da Silva Breder
- Real-Time Hot Metal Rate Optimization in Steel Mills Through Innovative Digital Twin Technology 1921
Pedro Henrique Feres Campos, Fabricio Schiavon Kolberg, Thales Henrique Silveira Pinto, Matheus De Oliveira Mendonça, Gustavo Rodrigues Lacerda Silva, Douglas Alexandre Gomes Vieira, Geraldo José Duarte, Fabiano Martins Gomes De Lima, Bruno Alvares, Bruno Da Silva Breder

Digitalization Applications: Primary Steelmaking II

- Prioritized Anomaly Management in Steel Production Using Self-Supervised AI 1928
Rishabh Shah, Suhas Mehta
- Bucket Hooking Identification System Driven by Computer Vision and AI Technology 1939
Loris Busolini, Luigi Mariotto, Nicol Miculan, Francesco Maria Rapolla, Matteo Sandri
- Enhancing Steelmaking Plant Safety: Robotic Operations in Continuous Casting with Fine-Kinney Method for Risk Reduction 1944
Pedro Cardoso, Giovani Delfim, Lucio Mascarenhas, Eduardo Duarte, Moises Miranda, Paulo Teixeira, Victor Aramayo, Douglas Lilge, Igor Guimaraes, Juliano Silva

Digitalization Applications: Primary Steelmaking III

- Process and Profitability Improvements Made Possible by Digital Solutions: Acciai Speciali Di Terni Case Study 1952
Arnaud Ollagnier, Gian-Piero Ruello, Maxime Monnoyer, Sébastien Roche, Gabriel Viot
- Unlock the Sustainable Value Path for Metals Industry Challenges 1958
Bertrand Orsal
- Advanced Strategies for Capacity Planning and Production Occupation: Marginal Cost and Productivity Optimization in the S&OP 1963
Anderson Tzitas, João Victor Sá, Rubens David Machado, Henrique Milagres

SENSORS

Sensors: Applications for Steelmaking & Foundry Industry

- Enhanced Bottom Anode Monitoring in DC Electric Arc Furnaces Using Fiber-Optic Sensors..... 1971
Yeshwanth Reddy Mekala, Ogbole C. Inalegwu, Rony Kumer Saha, Farhan Mumtaz, Rex E. Gerald Ii, Jeffrey D. Smith, Jie Huang, Ronald J. O'malley
- Femtosecond Laser Inscribed Fiber Bragg Grating Sensors: Enabling Distributed High-Temperature Measurements and Strain Monitoring in Steelmaking and Foundry Applications 1979
Ogbole Collins Inalegwu, Yeshwanth Reddy Mekala, Rony Kumer Saha, Farhan Mumtaz, Dinesh Reddy Alla, Deva Prasad Neelakandan, Jeff Smith, Ronald J. O'Malley, Rex E. Gerald Ii, Jie Huang
- Development of a New On-Line Sensor for Steel Contamination..... 1989
David Egner, Thomas Gossuin, Will Smailes

PROJECT & CONSTRUCTION MANAGEMENT

Project & Construction Management

- Best Practices for Planning and Executing Brownfield Projects 1997
Neil Tannyan, Nick Olds, Edward Natali, Christian Thomason
- Successful Start-Up of 2-Stand HYPER UCM Reversing Cold Mill at TKSE Bochum..... 2005
Konrad Krimpelstaetter, Paul Rassbach, Martin Bergmann, Josef Hofbauer

MAINTENANCE & RELIABILITY

Maintenance & Reliability: Lubrication/Industry 4.0

- Greases for Water-Intense Applications..... 2017
Tim-Oliver Mattern, Dustin Greiner
- Application of Lubricant to the Backup Rolls with New Design and Comparison with Work Roll Gap Lubrication Method in a Hot Strip Mill 2023
Yusuf Özkul, Hayrettin Sultan, Muharrem Koçak, Cihat Karada

Maintenance & Reliability: Maintenance

- Bearing Selection to Improve Gearbox Reliability..... 2030
Cory Langhoff
- Razor-Sharp Equipment for Best-In-Class Cutting Experiences 2040
Paolo Durigon, Federico Croatto

Maintenance & Reliability: Signal Analysis

- What Can Digital Condition Monitoring Practices Help to Achieve? 2047
Vijay Anand Venkateswaran, Christophe Begot

Intelligent Oil Film Bearing Monitoring System for Flat Product Rolling Mills	2053
<i>Enrico Veronesi, Matteo Nobile, Michal Zawadzki</i>	

REFRACTORY SYSTEMS

Refractory Systems: Digitalization & Sensors

Data-Driven Ladle Reliability Monitoring	2059
<i>Yakup Bayram, Suat Bayram, Hande Alp, Elif Rana Dama, Oncel Turer, Neal Sullivan, Tyler Richards, Edward Puskar, Steven Asseff, Ruth Engel</i>	
Radar Technology for Refractory Monitoring in Steelmaking	2065
<i>Alexander Ruege, Yakup Bayram, Neal Sullivan, Tyler Richards, Jeffrey Haeberle, Eric Marshall, Paulo Souza</i>	

Refractory Systems: Refractory Selection & Design I

Development of Dry Gunning Refractory with No Necessity of Drying Process	2072
<i>Atsushi Tokutomi, Masanori Koga, Takashi Matsunaga, Takashi Nishi, Kouji Ide</i>	

Refractory Systems: Refractory Selection & Design II

Multiple-Use Basic Slidgate Plate for Corrosive Steel Casting.....	2080
<i>Alireza Valipourberenjestanaki, Keisuke Inukai, Naohide Hamamoto, Hiroyasu Niitsuma</i>	
Increase in BOF Productivity at Usiminas Steel Shop #2 Through Thermal Insulation of the Converter	2088
<i>Haysler Lima, Douglas Galesi, Lucas Alvarenga, Vladnilson Ramos, Magno Mendes, Ronaldo Borges, Marcio Verissimo, Matheus Santos</i>	

Refractory Systems: Steel Ladles & Impact Pad

Measured Ladle Energy Savings with Microporous Silica Insulation for Carbon Footprint Reduction in Steelmaking Meltshops	2097
<i>Robert Doty</i>	
Improvement of Steel Ladle's Refractory Performance Through Thermomechanical Numerical Analysis.....	2105
<i>Pedro M. Domingos, Jean C. De Oliveira, Rodrigo L Mariz</i>	
Challenges for BOF Impact Pad: Redesign Flexible Binder for Improving Performance.....	2116
<i>Carlos Pagliosa, Haylander Coelho Avila, Leandro Rocha Martins, Walter Cassete</i>	
Improvements of the Lifetime of Purging Plugs	2125
<i>Takafumi Imaeda, Kimihiro Yasui, Tomomi Soeda</i>	

MATERIAL HANDLING/TRANSPORTATION & LOGISTICS

Material Handling/Transportation & Logistics: Optimization

Using High-Tech Dual-Purpose Drives to Upgrade Steel Handling Motion System in Meltshops.....	2132
<i>Bernardo Sainz, Rommel Villarreal, Eric Martinez</i>	

Optimization of the Slab Cooling Process After Continuous Casting Using Numerical Simulation..... 2141
Franz Ramstorfer

Digital Transformation for Coil Handling and Packing Logistics 2153
Juha Suksi, Jagannathan Rajagopalan, Juha Luhtala

Solution for Compact and Efficient Vertical Storage 2169
Lorenzo Bacchetti, Sami Koivuluoma

Material Handling/Transportation & Logistics: Tracking

A Tool to Help Production Tracking by Using Computer Vision Technology..... 2173
Mauro Olivotto, Raffaele Treu

Products Identification Driven by Computer Vision and AI Technology 2177
Davide Armellini, Luigi Mariotto, Francesco Maria Rapolla, Matteo Sandri, Cahit Haluk Sumen

CRANES

Cranes I

Fitness-For-Service Assessment and Life Extensions of Meltshop Cranes 2181
Michael Ross, Christopher Long, Majid Maleki, Lucio Santos, Chad Van Der Woude, Robert Busic, Robert MacCrimmon, Rogerio Castro, Hamid Ghorbani

Cranes II

On-Line Condition Monitoring Systems in the Hoisting and Bridge Traveling Equipment of Cranes in the Iron and Steel Industry 2190
Serkan Ozsu, Mesut Kotesli

ELECTRICAL APPLICATIONS

Design, Applications & Maintenance

Grid Forming Control Implementation in a STATCOM for Electrical Arc Furnace Compensation in a U.K. Steel Plant 2202
Jon Rasmussen, Tony Bertilsson, Carl-johan Elm

Production & Digital

Upgrading SVC Firing Circuitry at JSW Steel Ohio Boosts EAF Performance 2212
Eric Martinez Mora

IRONMAKING

Low-Carbon Ironmaking

Research and Development on Low-Carbon Technologies of Modern Blast Furnace Ironmaking..... 2221
Fuming Zhang

COKEMAKING

Cokemaking

- Using Artificial Intelligence and Machine Learning for Coke Production Optimization 2232
Lloyd Dewey Lee Jr., Richard W. Westbrook, Wayne D. Ferguson

OXYGEN STEELMAKING

Decarbonization

- Jet Over Water Penetration and Equations — 04 Nozzle Variations 2243
Amilton Carlos Pinheiro Cardoso Filho, Ana Luiza Lisboa Barbosa, Breno Totti Maia, Eric Novaes De Almeida, Juan Pedro Pereira Sales Gargano, Ketlen Lorraine Martins Maciel Da Silva, Leandro Rocha Lemos, Romulo Avelino Da Costa Viana, Rafaela Cardoso Da Silva

Automation & Technological Advancements

- Start-Up of the Sublance Skull Cleaning Device in Ternium Brasil 2256
Rubia Teodoro Silva, Antonio Augusto De Rezende Martins, Klinger De Lima Alexandre, Fernando Assuncao Da Cruz, Hugo Leonardo Oliveira Cardoso, Renan Izar Ganezini, Danilo Dias Rodrigues, Evanildo Bernabe Soares

LADLE & SECONDARY REFINING

Improvements in Ladle Processing

- The Future Role of Ladle Furnaces in Integrated Steel Plants 2265
Stefan Kraskes, Frank Ahrenhold, Helge Mees

Author Index