CCC’ 04

The Third International Conference on Continuous Casting of Steel in Developing Countries
(Sept. 14-17, 2004, Beijing, China)

Sponsored and Organized by
The Chinese Society for Metals

Co-sponsored by
- ABM-Brazilian Metallurgy & Materials Society
- AIMM-The Australasian Institute of Mining and Metallurgy
- IAS-Instituto Argentino de Siderurgia (Argentina)
- IIM-The Indian Institute of Metals
- ISS-Iron and Steel Institute of Japan
- ISIJ-Iron and Steel Society (USA)
- KIM-The Korean Institute of Metals and Materials
- VDEh-Verein Deutscher Eisenhuttenleute (Germany)

Supported by
VOEST-ALPINE Industrieanlagenbau GmbH & Co.
SMS Demag AG
DANIEL
CONTENTS

Invited Papers and State-of-the Art

Rapid Development of Continuous Casting in China ............................................ YIN Ruiyu 1
Driving Forces for Innovation in Continuous Casting .......................................... Karl Schwaha 9
New Technologies and Products Based on CSP® .............................................. Dieter Rosenthal Wolfgang Hennig 15
Technological Development of Steel and Continuous Casting in the 21st Century .... Jean-Pierre Birat Christian Marchionni 29
Development and Achievement of Casting Technologies ...................................... Dario Fabro 36
Melt Flow Control in Tundish and Mold—a Key to Quality in Continuous Casting ... Yogeshwar Sahai 41
Topics in Continuous Casting Science and Technology ....................................... Tooru Matsumiya 47
Process Improvements at ISPAT Mexicana to Supply Quality Slabs for the World Market ... H. Thomas Tsai Raul Torres 54
Recent Progress on Commercialization of CASTRIP® Direct Strip Casting Technology at Nucor ........................................................................................................................................................................... Peter Campbell Wal Blejde Rama Mahapatra et al. 61
Continuous Casting Scenario in India .................................................................... Supriya Das Gupta Subrata Mitra 67
Innovation as a Key Factor for the Ongoing Success of VAI Continuous-Casting Technology .............................................................. K. Mörwald A. Flick C. Chimani et al. 72
Review and Prospects on Continuous Casting Production & Technology of WISCO ................................................................................................................. YU Zhixiang XIAO Zhongmin YU Chenghuan et al. 77
The Present Status and Future Development of Baosteel CC Technology .......... ZHANG Li KANG Fu XU Rongjun 84
Development and Application of Continuous Casting Yielded Heavy Rail Steel in Baogang ........................................................................................................ LI Chunlong LIU Ping ZHI Jianguo 92

Refining Aspects

Process Application of Continuous Casting Clean Steel ...................................... XUE Wenhui SONG Mantang 95
Study on the Ultra Low S Steel Treated with LF in AISC .................................... GUAN Yong JIA Hongming WU Yuqiang et al. 100
Research on Calcium Treatment of Feeding Si-Ca Wire into Liquid Steel during Refining Process ................................................................. REN Ziping SUN Qun 104
Aspects of Variant RH Plant Design .................................................................... Rainer Teworte Volker Wiegmann Andreas Kubbe 112
Biogenic Silica – the Ideal Thermal Insulating Covering Agent for Ladle and Tundish ................................................................................................................. Rainer Gaebel Wolfgang Koslowski 117
Inclusion Composition Influence in Castability Effect of Marginal Steel Composition Changes

Philippe Guillo Jose Simões 122

Billet, Bloom and Round Casting

Electromagnetic Stirring of Billets and Blooms

S. Kunstreich 128

Acciaierie Valbruna’s New Conticaster for Stainless Steel, Italy

D. Lestani W. Ruzza A. Miconi 132

ABS “LUNA” ECR® Plant: Latest Developments and Results after the Third Year of Operation

F. Alzetta F. Toschi 140

6-Strand Bloom Caster with VAI DynaGap Soft Reduction Technology

D. Zhang J. Li Z. Li et al. 150

The Successful Establishment of DIAMOLD and DYNAFLEX Technology in Billet Casting Plants Worldwide

Josef Fuchshuber Gerald Zederbauer 156

VAI Pomini’s High Performance Billet Casters at Xingtai Iron and Steel Co. and Maanshan Iron and Steel Co., Ltd.

Josef Fuchshuber Gerald Zederbauer Udo Pappitsch 161

Improvement of Quality of Cast Billet at Tata Steel Using an Upgraded Billet Caster

I. Chakrabarti Anup Kumar A. Khullar et al. 166

Ceramic-Lined Compound Copper Pipe Using in Tubular Billet Crystallizer Prepared by SHS

FU Hanguang FU Hanfeng 173

Study on F-EMS of Billet Continues Casting

ZHANG Senlin FENG Jun Chen Weiqing et al. 178

Mathematical Heat Transfer and Dynamic Control Method for the Secondary Cooling in Bloom Casting

LI Donghui QIU Yiqing LIU Xianghua et al. 182

Practice and Optimization on Secondary Cooling System of Continuous Casting Bloom

CAO Liguo DONG Daxi HAO Yanying 187

Revamping of 8-Strand Billet Caster in Shougang No.2 Steelworks

DONG Chengmao DONG Aihua TAN Changxiang et al. 192

Bloom Casting for Quality Steels

DONG Chengmao WANG Guorui CUI Xinchao et al. 197

Producing Process and Quality Control of Railway Steels with Bloom Continuous Caster at Pangang

XUE Xun 201

The Secondary Cooling Technology of Billet during High-efficiency Continuous Casting

CHEN Dengfu ZENG Dingding PAN Yanhua et al. 206

Modelling Study on Fluid Flow, Heat Transfer and Inclusion Removal in Tundish of 6-Strand Bloom Caster

ZHU Mingmei WEN Guanghua ZHANG Lifeng et al. 214

Production Technology of Rail for High Speed Railway

ZHI Jianguo LI Chunlong CHEN Jianjun et al. 221

Continuous Casting Production of Quality Steel

ZHANG Yongzang WANG Minghe HU Lining et al. 225

Reform for No.2 Billet Device Water System at Linggang

BIAN Lingtao GAO Yanhong 229
Dynamic Soft Reduction Technology and Its Operational Results at Pangang Bloom Continuous Casting

Theory and Practical Application of High-efficient Improvement in the Billet Continuous Caster

EMS Applied in Shougang Continuous Casting Production

The Process Control for SGIS ROKOP Caster

Exploration and Practice of the Process for Soft Pressing on Billet

Studies on Service Life of Mould Oscillation Table of Round Continuous Caster

Practice of Rectangular Bloom Continuous Casting of Steel for Locomotive Brake Beam

Prevention of Metering Nozzle Clogging in Casting EAF Aluminium Killed Molten Steel

Study and Application of Efficient Continuous Casting Process in Laigang Steelmaking Plant

Development of High Quality Round Bloom Continuous Casting Technology in Masteel

Process and Quality of Al-Killed Cold-Heading Steel with Low Carbon Silicon Content by BOF-LF-CC Route

The Secondary Cooling System for Alloy Steels and Its Application

The Mold Electromagnetic Stirring Technology for Special Steel Continuous Casting

Integrated Technology of Segregation Control for 200mmx200mm High Carbon Bloom

Slab Casting

Danieli Slab Caster at Sidmar Plant (Arcelor), Belgium

Study on the Centerline Segregation and the Inclusion Distribution in the Cross Section of Slab with Different Drawing Speeds

Study on Centerline Segregation of Ship Steel Plate

Benchmarks in Slab Casting Technology

On-line Profile Measurement of Slab Edges

Effect of Centre Line Segregation on Sulphide Stress Cracking of Line Pipe Steel

III
VAI Competence in Wide Slab Casting

................................. T. Reynolds 334

New Technology to Prevent Periodical Level Fluctuation in Continuous Casting (Development of Variable Pitch Segment) ........................ Toshihiko Murakami Masayuki Kawamoto Hiroshi Kitada et al. 338

Controlled Cooling in Continuous Casting

................................. Miroslav Raudensky Jaroslav Horsky Petr Kotrbacek 342

Breakout Prevention by Mold Heat Flux Control in Thin Slab Caster

................................. Seung-Hyun Baek Chul-Min Kim Young-Bae Kim et al. 347

Improvement of High Grade Sheets with Nippon Steel In-mold electro-magnetic Stirrer

................................. Setsuo KITAKA Kunio WATANABE Toyohiko KANKI et al. 351

Implementation of Modern Secondary Cooling Technology in Existing Casters

................................. Ray Boyle Juergen Frick QIU Wengguang 355

Strand Cooling and Drive Concepts for Slab Caster

................................. Christian Geerkens Martin Becker Axel Weyer et al. 360

Recent Improvement of Continuous Casting Practice for High Quality Free Surface Defect Slab Product of Gas Cylinders Application

................................. Adri Muluk Muchtadien Asqar Muhammad Shodiq et al. 365

Improvement of Slab Centerline Segregation by the Soft Reduction

................................. Jemin Park Hong-gu Ryu Seung-kwan Baek et al. 369

Experiment and Study on Increasing Temperature of CC Slab in DHCR Process

................................. ZHOU Youyu MA Qinxue SHENG Xisong et al. 373

The Influence of CC Slab Internal Cracks on Strip Quality

................................. HUANG Jianfeng 378

Production Practice of Ultra-Low Carbon Steel in Angang No.2 Steel Plant

................................. REN Ziping SUN Qun 383

Design Features of 250mmx1600mm Slab Caster in Shaogang

................................. CHEN Weiqiang XU Hongwei 387

Design Features of No.1 Slab Caster of (Converter) Steelmaking Project, Xinyu Iron and Steel Company

................................. ZHU Xiaoyong 392

The Internal Quality Improvement of C.C. Slab at No.2 Smp of WISCO

................................. LI Fengxi LI Juzhong YU Chenghuan 395

DYNACS Model in the Secondary Cooling System of Slab CCM

................................. BAI Han KONG Decai 401

Practice and Investigation on Strand Straightening with Liquid Core on a Single-point Straightening Continuous Casting Machine

................................. CHEN Nailiang WANG Hongfeng 405

The Influence of the Uneven Cooling along the Width of Continuously Cast Slabs in Secondary Cooling Zone on Internal Quality

................................. ZHANG Fuqiang JIANG Zhensheng MENG Jinsong et al. 410

Analysis and Prevention of Steel Leakage at KISCO’s Straight-and-Curved Continuous Slab Caster

................................. ZHOU Kaicheng CAO Yang LI Jinzhu et al. 416

Study on Continuous Casting Process and Slab Quality at No.2 Slab Caster in Pangang

................................. GU Wuan XIAO Mingfu YANG Subo et al. 421

Mould—the Heart of Slab Continuous Caster

................................. JIANG Zhongkuan CHENG Nailiang ZOU Junsu 427
Improvement on Slab Surface Quality of Nb Microalloyed Steels at No. 2 Steelmaking Plant WISCO

LI Fengxi  YU Chenghuan  ZHANG Wenhui et al.  431

Integrated and Optimized Application of New Technology in Slab

WANG Yumin  SUN Fengxiao  LI Dianming et al.  435

Research on Surface Crack of Plate and Slab

PENG Shengtang  LI Guobin  CHENG Fangwu et al.  440

Analyse of Low Breakout Ratio on Bengang Continuous Caster

XU Jiayan  JIANG Xuefeng  446

The Production Practice of the Continuous Casting Machine in Bengang and the Study for Quality of Slab

XU Jiayan  JIANG Xuefeng  451

Application of Dynamic Soft Reduction for Slab Casting in Meishan Steel

CHEN Zhiping  CHENG Nailiang  CUI Lixin et al.  457

The Start-up and Operation Results within the First 6 Months of the New Wide Slab Caster at No.3 Steelmaking Plant of WISCO

YU Zhixiang  ZHENG Wan  YANG Yunchao et al.  461

**Thin Slab, Middle Thickness Slab, Strip and Beam Blank Castings**

Thin Slab Caster at Tangshan Iron & Steel Group, P. R. of China

R. Borsi  A. Carboni  468

Nucor Hertford Medium Slab Caster and Plate Mill Complex, USA

B. Di Giusto  472

The New EZZ Flat Steel Minimill for Flat Products, Egypt

F. Stella  R. Borsi  478

Effects of Level Magnetic Field and Flow Control Electro Magnetic Brake on Fluid Flow in Thin Slab Continuous Casting Mold

WANG Lei  SHEN Houfa  486

Thin Slab Continuous Casting and Rolling and Silicon Steel Grades Production

LI Yongquan  491

The Development of Thin Slab Casting and Rolling (TSCR) Technologies in China

WANG Zhongbing  496

Hot Strip Production of Value Added Steel Grade in the MPS.Dolvi Plant of Ispat Industries Ltd. in Dolvi, India

Fritz-Peter Pleschitschnigg  Vilas Vishnu Jamnis  Sukhdev Raj Talwar et al.  506

Advanced CSP® Casting Technology for High-Quality Steel Grades

Wolfgang Hennig  Carsten Lippold  Jürgen Müller  514

VAl Near-Net-Shape Beam-Blank Casting Technology

Franz Leingruber  Christian Chimani  Franz Wimmer  519

Technological Development for CSP Thin Slab Caster and Rolling Mills as Source of Common Mechanics, Electrics and Automation Design

Hans Esau Klassen  Michael Reiner Jansen  Hermann Wolters  525

Precipitation Mechanisms of Nano-Scale Copper Sulfides in Strip Casting Low Carbon Steel

LIU Zhongzhu  Kobayashi Yoshinao  Nagai Kotobu  530

Central Bearing Failures Analysis at CST Continuous Casting Machine 02

Sérgio Mattedi  Fábio de Borba Sanchotene  Jose Carlos Passos et al.  534

The Development of HSLC Plates for Automobile Frames Produced

MAO Xipping  WANG Zhongbing  LIN Zhenyuan et al.  537
Study on Interfacial Heat Transfer in Strip Casting Process

YU Yan FANG Yuan QIN Bo et al. 542

Exploratory Research on Industrialization of Twin-Roll Strip Continuous Casting Technology

SHI Hongjia 546

Technology of Twin-Roll Casting at RAL

QIU Yiqing DI Hongshuang LIU Xianghua et al. 550

Study on Heat Transfer Behavior of Mould in Thin Slab Continuous Casting

YANG Xiaojiang YANG Chunzheng ZHANG Hongbo 554

Cleanliness Controlling of Q235B Steel Yielded by Baosteel CSP Process

ZHII Jianguo SI Yongtao LI Chunlong et al. 560

Development and Application of Non-Sinus Oscillation Curve in Thin Slab Caster

ZHOU Yingchao WEI Zukang ZHANG Ruizhong et al. 564

Investigation on Non-metallic Inclusions in Low Carbon Al-killed Steel in CSP Process

WEI Jun ZHAO Guoyuan CAI Kake et al. 568

Commissioning and Production at Masteel CSP Caster

JIANG Haitao Bob Kowalewski 573

Process Research on the Production of Steel Plate of Container with CSP Caster

HONG Binxiong ZHANG Guoguang 578

Research on Nb Subperitectic Steel Beam Blank Continuous Casting Process

SUN Wei WANG Kaizhong QI Yinyin 582

Research on Product Quality of Tangsteel Flexible Thin Slab Caster

YANG Chunzheng LIANG Hongbing HAO Huaqiang et al. 587

Products Advantages of Arvedi Steel Technology Performed in Arvedi Steel Plant Cremona – Italy

Giovanni Arvedi Luciano Manini Andrea Bianchi et al. 592

Theoretical Aspects and Simulations

An Aspect of Evolution on Meniscus Control in Continuous Casting Process of Steel

Wataru Ohashi Takehiko Toh Tooru Matsumiya 601

Advanced Applications of Electromagnetic Force to Clean Metal Production

Shoji Taniguchi Kazuyuki Ueno Koichi Takahashi et al. 605

Design and Enhancement of Casters for Improved Cast Semi Quality

Brian Barber Brian Patrick Adrian Normanto et al. 609

Water Modeling Experimental Study of the Tundish Flow Field in the Various Flow Control Devices

LIU Jingang WANG Xinhua YAN Huicheng et al. 613

Significant Thermo-Physical Properties Associated with Accuracy of Transport Model for Continuous Casting

FENG Ke CHEN Dengfu JIANG Bin 620

Optimization of Tundish Configuration in Slab Continuous Casting and Its Application

LI Liying ZHONG Liangcai ZHU Yingxiong et al. 626

A Kind Secondary Cooling Mode of the Dynamic Control

LI Chunyuan LI Bailian 630

Characteristics of Titanium Oxide Precipitation during Solidification of Low Carbon Steel Containing Titanium

WANG Minglin QIU Shengtao CHENG Guoguang et al. 635
Numerical Simulation on Fluid Flow and Inclusion Motion in Continuous Casting Tundish
ZHANG Lifeng  WANG Yong  ZHOU Deguang et al.  641

Water Model Experiment on Sequence Casting of Different Grades in No.2 Continuous Caster at Baosteel
LI Yugang  DONG Jingang  LI Gang et al.  647

Experimental Study on Mould Oscillation-Less Continuous Casting Process under High Frequency Amplitude-Modulated Magnetic Field
LEI Zuosheng  REN Zhongming  DENG Kang et al.  651

Optimizing Magnetic Field Design for Billet Electro-Magnetic Stirrers
LI Jin  MAO Bin  657

The Numerical Analysis of Electro Magnetic Stirring Assembled in Mould/Foot Section
MA Yonglin  WANG Baofeng  LI Baowei et al.  662

A Combination Model of the Breakout Prediction
LI Wenbing  667

Modeling of Solidified Grain Structure of Continuously Cast Steel
HU Kuntai  QIU Shengtao  ZHANG Hui et al.  672

Study on the Effects of Physical Fields on Metal Crystal Structure
CANG Daqiang  CUI Heng  ZHANG Rong et al.  676

Mathematical Simulation of Flux Film Lubrication in Gap between Mould and Solidified Shell
ZHU Liguang  WANG Shuoming  ZHANG Yuwen  680

Mass Flow Simulation System for a Continuous Casting Applied Distributed Simulation
JI Yang  BI Yingjie  LI Wenbing et al.  684

Prediction Model of Metallurgical Length and Centerline Macro-Segregation in Continuous Casting Steel Billet
LIN Guoqiang  CHEN Yuanyuan  LI Baokuan et al.  690

Optimization of the Water Rate in Secondary Cooling Zone of Continuous Casting Billet
WU Rongyang  MENG Hongji  MEI Guohui et al.  695

Research on Stainless Steel Continuous Casting Processing
WU Wei  LIU Liu  HAN Zhijun  699

Mechanical Analysis of Soft Reduction Practices for Slab Continuous Casting
CUI Lixin  ZHANG Jiaquan  CHEN Zhiping et al.  706

Analysis of Temperature Profiles in Slab Casting Moulds with a Coupling Thermal Model
CUI Lixin  ZHANG Jiaquan  CHEN Zhiping et al.  710

Equipment, Automation and Process Control

Technological Packages (TP) for Continuous Casting Machines
Maurizio Passoni  715

Winning Concepts in Continuous Casting Automation and Process Control
Luigi Morsut  727

A Major Step ahead in Caster Safety with Extensive Use of Robotics in Continuous-Casting Technology
F. Wimmer  J. Lanschützer  H. Resch et al.  733

“Connect & Cast” with VAI Casting Technology
H. Wahl  K. Herzog  C. Federstien et al.  738

Development on Spray Cooling Sensor and Its Application in Continuous Casting Process
YUAN Weixia  Jeon Jaeyoung  Choi Jongsoo  748
New Slag Detection System Improves Availability

High Speed Cutting and Efficient Deburring of Slabs and Blooms

Prediction of Abnormality Mould Friction on Slab Caster Based on Neural Network

Surface Quality Prediction Expert System of Slab Continuous Casting

The Principle Analysis of the Forecast System of the Mold Breakout

The Mechanical Non-sinusoidal Oscillation Technique of Mold

Improvement for Universal Drive Shaft of the Continuous Casting Machine

Development and Application of Mould Non-sinusoidal Oscillation System

Analysis and Optimization of the Blackbody Cavity-based Continuous Temperature Measurement System for Liquid Steel

Application of Artificial Intelligence for Molten Steel Level Control of Twin Roll Strip Casting Process

Development and Application of Automatic Mould-Powder Feeder

Consumables and Auxiliary Technology

Improvements in Continuous Casting Mold Technology - the First Fully Ceramic Coated Molds

Development New Sliding Plate Material for Making It Longer Life

Investigation on Crystallization Temperature of Continuous Casting Mould Fluxes

Development of Silica and Carbon-Free SEN for Cleaning-Steel Continuous Casting

Study on Magnesia-Calcia Coating in Tundish

Study and Application of Prefused Mould Fluxes for Continuous Casting of Rare Earth Treating Steel

Development of Carbon-Free and Anti-Clogging SEN

Study on Anti-clogging SEN for Special Alloy Steel Continuous Casting