Agenda

August 18, 2011

Continuous Casting Consortium Annual Meeting 2011

Brian G. Thomas, Director

Department of Mechanical Science & Engineering
University of Illinois at Urbana-Champaign

Objectives

- To develop computational models of continuous casting of steel and related processes
- To apply these models to problems of practical interest to the steel industry

Attendees

ABB	*Hongliang Yang, & Christer Carlsson*
Arcelor-Mittal:	*Hongbin Yin, Rich Gass, Ken Blazek, Key Robertson, Rajat Bathla, Yi Chen, Joydeep Sengupta, & Stephen Chung.*
Baosteel:	
Magnesita Refractories:	*Rob Nunnington, Steve Mangin, Shane Cox, & Bruno Ribeiro*
Nippon Steel:	*Hideaki Yamamura, Akihito Kiyose, & Akira Usami*
Nucor Steel:	*Ron O'Malley, (Decatur, AL), Curtis Glenn (Kankakee, IL), Steve Wigman, Dean Burke, & Ray Decard (Crawfordsville, IN).*
POSCO:	*Jun-kil Park, & Sang Woo Han*
Postech:	*Seon-Hyo Kim, Seong-Mook Cho, & Hyoung-Jun Lee*
SSAB	*Xiaoxu Zhou, & Sunday Abraham*
Tata Steel:	*Gert Abbel & Begoña Santillana*
Goodrich*:*	*Bill Sheldon & Steve Lonn*
Severstal	*Ron Radzilowski, Yuwei Wang, S. Bandyopadhyay & Mark Pole*
Ansys / Fluent Inc.:	*Ashwini Kumar*
University of Illinois:	Brian G. Thomas, Joseph Bentsman, Pratap Vanka, Bryan Petrus, Kun Xu, Lance Hibbeler, Yonghui Li, Seid Koric, Rui Liu, Chuanbo Ji, Vivek Natarajan, Pete Srisuk, Inwho Hwang, Roger Yang.
Other CCC researchers:	Seong-Mook Cho*, Hyung-jun Lee*, Eric Badger,
New CCC Researchers:	A.S.M. Jonayat, Kai Jin, Ramnik Singh, Jeng-Won Woo, Lejun Zhou, *Zengjie Fan*.

Day 1: Morning Session

8:00am Breakfast & Introductions 2005 Mech. Eng. Lab. (Deere Pavilion)

8:10	B.G. Thomas:	Overview of Projects
8:20	R. Liu	Model of Argon Flow through the Upper-Tundish Nozzle Refractory and Bubble Size Estimation
8:50	S.-M. Cho	Transient Flow, Vortex Formation, and Slag Entrainment in the Mold with Water Models and URANS Modeling
9:20	C. Ji	Mold Flow with Local EMBr and Evaluation using Nailboard and Oscillation-mark Measurements
9:40	R. Chaudhary & BGT	Effect of EMBr on Transient Turbulent Flow in CC using DNS Models and Ga-In-Sn Benchmark Measurements
10:10	*Break*	
10:30	R. Liu	Transient Fluid Flow Simulation with Water Model Validation and Application to Slide Gate Dithering
11:10	Cinvestav & BGT	Heat Transfer during Air-Mist Spray Cooling
11:30		Discussion of Flow Projects

12:00pm Lunch 2005 Mech. Eng. Lab

Day 1: Afternoon Session

1:00	B. Petrus; R. Yang	Online Control of Spray Cooling and offline model validation using CON1D, ConOffline, and measurements
1:30	K. Xu	Modeling Precipitate Formation During Casting and Reheating
10 2:10	L. Hibbeler	Thermal-Mechanical Behavior of CC Funnel Molds
2:30	L. Hibbeler	Micromechanical Modeling of Stress during Solidification
3:00	*Break*	
3:20	P. Srisuk, Y. Wang	Preliminary model of ideal Soft Reduction Modeling
3:40	I. Huang	Automation of Mold Thermal Analysis for CON1D calibration
4:00	Y. Li	Modeling Heat Transfer in SEN during Preheating
15 4:20	H.-J. Lee	Thermal Stress Cracking of Slide Gate Plates
4:50	V. Natarajan	Modeling and Control of Mold Oscillation
5:10		Group Discussion of Future Projects and Directions
5:40	Adjourn	
6:00	*Dinner*	Colonial Room, Illini Union Building

Day 2

B.G. Thomas: 356 Mech. Eng. Bldg.
Informal discussions on future projects

8:00 – 9:00	Nippon Steel – H. Yamamura et al.
9:00 – 10:00	Tata – G. Abbel & B. Santillana
10:00 – 11:00	Severstal – R. Radzilski & Y. Wang
11:00 – 12:00	SSAB – X. Zhou and S. Abraham
12:00 – 1:00pm	Arcelor-Mittal – J. Sengupta.
1:00 – 2:00pm	Arcelor-Mittal
2:00 – 3:00pm	ABB – H. Yang & C. Carlsson
3:00 – 4:00pm	Magnesita - Rob Nunnington, Bruno Ribeiro

8:00 am-? *Research group: 345 Mech. Eng. Bldg.*
Informal discussions with students
Further details on current projects and software
CON1D operation etc.
Questions

Day 3 (Aug. 7) ??

New CCC Software

New version of CON1D

- CON1D 10.01.01
  Program and Source code for latest version of program
  Manual explaining theory and use of program
  Example input and output files
- User Interface Version 10.12.03
  Works with Version 10.01.01
- Dual-Output Interface 10.09.04
  For graphing comparisons from different runs

2011 CCC Reports New p1

Measurement of Heat Flux in Dense Air-Mist Cooling: Part I. A Novel Steady-State Technique
C.A. Hernández, J.I. Minchaca, A.H. Castillejos, F.A. Acosta, X. Zhou, and B.G. Thomas
CCC Report 201101.

Measurement of Heat Flux in Dense Air-Mist Cooling: Part II. The Influence of Mist Characteristics on Heat Transfer
C.A. Hernández, J.I. Minchaca, A.H. Castillejos, F.A. Acosta, X. Zhou, and B.G. Thomas
CCC Report 201102.

The Thermal Distortion of a Funnel Mold
Lance C. Hibbeler*, Brian G. Thomas*, Ronald C. Schimmel†, and Gert Abbel
CCC Report 201103.

Particle-Size-Grouping Model of Precipitation Kinetics in Microalloyed Steels
Kun Xu, Brian G. Thomas
CCC Report 201104.

2011 CCC Reports New p2

Direct Numerical Simulations of Transverse and Spanwise Magnetic Field Effects on Turbulent Flow in a 2:1 Aspect Ratio Rectangular Duct
Chaudhary, R, A.F. Shinn, S.P. Vanka, and Brian G. Thomas
CCC Report 201105

Effect of Electromagnetic Ruler Braking (EMBr) on Transient Turbulent Flow in Continuous Slab Casting using Large Eddy Simulations
Chaudhary, R, B.G. Thomas , and S.P. Vanka
CCC Report 201106

Hybrid Control of Continuous Casting for Whale and Crack Prevention and Resonance Control in Mold Oscillation System
Bentsman, J., Brian G. Thomas, B. Petrus, X. Zhou, V. Natarajan, and R. O'Malley
NSF CMMI Conference, Atlanta, GE, Jan. 4-7, 2011, Grant # DMI-0900138

2011 CCC Reports (emailed Jan. 2011) p1

Transient Turbulent Flow in a Liquid-Metal Model of Continuous Casting, Including Comparison of Six Different Methods (reprint)
Chaudhary, Rajneesh, Surya P. Vanka, and Brian G. Thomas
Metallurgical and Materials Trans. B, Online May 17, 2011.
DOI: 10.1007/s11663-011-9526-1

Measurement of Molten Steel Surface Velocity with SVC and Nail Dipping during Continuous Casting Process
Sengupta, J., R. Liu, D. Crosbie, S. Chung, M. Trinh and Brian G. Thomas
Sensors, Sampling, and Simulation for Process Control, TMS Annual Meeting Symposium, San Diego, CA, Feb. 27- Mar. 3, 2011, 51-58.

Measurement of Transient Meniscus Flow in Steel Continuous Casters and Effect of Electromagnetic Braking
Cho, S.-M., H.-J. Lee, S.-H. Kim, R. Chaudhary, Brian G. Thomas, D.-H. Lee, Y.-J. Kim, W.-R. Choi, S.-K. Kim and H.-S. Kim, "," in Sensors, Sampling, and Simulation for Process Control, Sensors, Sampling, and Simulation for Process Control, TMS Annual Meeting Symposium, San Diego, CA, Feb. 27- Mar. 3, 2011, 59-66.

2011 CCC Reports (emailed Jan. 2011) p2

Monitoring of Meniscus Thermal Phenomena with Thermocouples in Continuous Casting of Steel
Thomas, Brian G., M.A. Wells and D. Li
Sensors, Sampling, and Simulation for Process Control, TMS Annual Meeting Symposium, San Diego, CA, Feb. 27- Mar. 3, 2011, 119-126.

Implementation of Temperature and Strain Micro-Sensors into a Casting Mold Surface
Thomas, Brian G. and M.K. Okelman
Sensors, Sampling, and Simulation for Process Control, TMS Annual Meeting Symposium, San Diego, CA, Feb. 27- Mar. 3, 2011, 127-134.

Implementation of a Real-Time Model-Based Spray-Cooling Control System for Steel Continuous Casting
Petrus, B., K. Zheng, X. Zhou, Brian G. Thomas, J. Bentsman and R. O'Malley
Sensors, Sampling, and Simulation for Process Control, TMS Annual Meeting Symposium, San Diego, CA, Feb. 27- Mar. 3, 2011, 77-84.

2011 CCC Reports (emailed Jan. 2011) p3

Review of Mold Flux Entrainment Mechanisms and Model Investigation of Entrainment by Shear-Layer Instability
Hibbeler, L.C. and Brian G. Thomas
7th European Continuous-Casting Conference, (ECCC2011), 2011, MetTec InSteelCon, (Dusseldorf, Germany, June 27- July 1, 2011), 2011.

Effects of Stopper Rod Movement on Mold Fluid Flow at ArcelorMittal Dofasco's No. 1 Continuous Caster
Rui Liu, Joydeep Sengupta, M.M. Yavuz, and Brian G. Thomas
AISTech 2011, Indianapolis, IN, May 2-5, 2011, Assoc. Iron Steel Tech., Warrendale, PA.

Effect of Nozzle Clogging on Surface Flow and Vortex Formation in the Continuous Casting Mold
Seong-Mook Cho, Seon-Hyo Kim, Rajneesh Chaudhary, Brian G. Thomas, Ho-Jung Shin, Woong-Ryul Choi, Sung-Kwang Kim
AISTech 2011, Indianapolis, IN, May 2-5, 2011, Assoc. Iron Steel Tech., Warrendale, PA.

2011 CCC Reports (emailed Jan. 2011) p4

Thermal Distortion of Funnel Molds
Hibbeler, L.C., and Brian G. Thomas
AISTech 2011, Indianapolis, IN, May 2-5, 2011, Assoc. Iron Steel Tech., Warrendale, PA.

Model of Microalloy Precipitation during Continuous Casting and Reheating
Kun Xu, Brian G. Thomas, Myra S. Dyer, John G. Speer, David K. Matlock
AISTech 2011, Indianapolis, IN, May 2-5, 2011, Assoc. Iron Steel Tech., Warrendale, PA.

Multiphysics Model of Continuous Casting of Steel Beam-Blanks
Thomas, Brian G., S. Koric, L.C. Hibbeler and R. Liu
4th International Conference on Modelling and Simulation of Metallurgical Processes in Steelmaking, (STEELSIM2011), (Dusseldorf, Germany, June 27- July 1, 2011), 2011.

2011 CCC Reports (Reprints)

Measuring Mechanical Behavior of Steel During Solidification: Modeling the SSCC Test (reprint)
Matthew Rowan, Brian G. Thomas, Robert Pierer, and Christian Bernhard
Metallurgical and Materials Trans. B, Vol. 42B, No. 4, (Aug), 2011, pp. 837-851.
DOI: 10.1007/s11663-010-9470-5

Equilibrium Model of Precipitation in Microalloyed Steels (reprint)
Xu, K., Brian G. Thomas, and R.J. O'Malley
Metallurgical and Materials Transactions A, Vol. 42A, Feb., 2011, pp. 524-539.
DOI: 10.1007/s11661-010-0428-7

Real-Time Model-Based Spray-Cooling Control System for Steel Continuous Casting (reprint)
Bryan Petrus, Kai Zheng, Xiaoxu Zhou, Brian G. Thomas, Joseph Bentsman
Metallurgical and Materials Transactions B, Vol. 42B (1), Feb., 2011, pp. 87-103.
DOI: 10.1007/s11663-010-9452-7

Effect of Stopper-Rod Misalignment on Fluid Flow in Continuous Casting of Steel (reprint)
Chaudhary, R., G.-G. Lee, Brian G. Thomas, S.-M. Cho, S.-H. Kim, O.-D. Kwon
Metallurgical and Materials Transactions B, Vol. 42B, No. 2, (Apr), 2011, pp. 300-315.
DOI: 10.1007/s11663-011-9478-5