



Agenda August 20, 2014

Continuous Casting Consortium Annual Meeting 2014

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



Tentative Attendees

ABB:	Martin Sedén, and R. Chaudhary?		
ArcelorMittal:	Tatha Bhattacharya, Rui Liu,		
	Joydeep Sengupta, Pascal Gardin, & Rich Gas	S	
Baosteel:	Xiaoming Ruan		
Magnesita Refractories:	Ramon Resende, Bruno Ribeiro, and Rubens	Freire	
Nucor Steel:	Bryan Petrus and Madeline Rembold (Nucor D	ecatur), and ?	
Nippon Steel & Sumitomo Met.:	: Norimasa Yamasaki, and Nobuyuki Takahira		
Postech:	Seon-Hyo Kim, Seong-Mook Cho		
Severstal:	Jon Powers, Ron Radzilowski, Joe Ryan?		
SSAB:	Sunday Abraham, Rick Bodnar, Yufeng Wang,	& Xiaoxu Zhou	
Tata Steel:	?		
Ansys / Fluent Inc.:	Ashwini Kumar?		
University of Illinois:	Brian G. Thomas, Joseph Bentsman, Prata	p Vanka,	
	Hyunjin Yang, Kai Jin, Kun Xu, Zhelin Chen,		
	Lance Hibbeler, Yonghui Li, Prathiba Duvvuri, I	<. Swartz,	
	Aravind Murali, Gavin Hamilton, M. Zappulla, H	lyoung-jun Lee.	
Other CCC Researchers:	Hai Hao, Tyler Sierzega, Gaurav Chaudhary, N S-H Kim, Seid Koric.	lathan Seymour,	
Jniversity of Illinois at Urbana-Champaign	Metals Processing Simulation Lab	BG Thomas	3



Day 1: Morning Session

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

8:05	B.G. Thomas	1 Overview of Projects	
8:20	R. Liu BG Thomas	System of Models for Transient Multiphase Flow in UTN, Slide- gate, SEN, and CC mold	
8:40	SM. Cho	Transient Two-phase Flow in a Slide-gate Nozzle and Mold with Double-ruler EMBr	
9:05	K. Jin	Effect of EMBr on Flow and Particle Capture and Parametric Studies of Transient Flow with LES on GPU	
9:30	X. Yan	5 Effect of SEN Conductivity on Meniscus Solidification	
10:00	Break		
10:30	K. Swartz, L Hibbeler	Modeling Mold Flux Entrainment	
10:50	H. Hao L. Hibbeler	Mold Filling, Heat Transfer, and Mold Distortion during Startup	
11:10	P. Duvvuri	Correlation for Mold Heat Transfer Measured in Slab Casters	
11:30		Discussion of Flow Projects	
12:00pr University of	n Lunch Illinois at Urbana-Champaign	2005 Mech. Eng. Lab • BG Thomas 4 • Metals Processing Simulation Lab • BG Thomas 4	



Day 1: Afternoon Session

1:00	H. Yang	Two-phase turbulent flow in a wide CC mold	
1:20	L. Hibbeler	10 Reduced-Order Model of CC Mold Heat Transfer	
1:40	G. Hamilton	Thermal Distortion of a Slab-Casting Mold	
2:00	M. Zappulla L. Hibbeler	Effect of Steel Grade on Thermal-Mechanical Behavior during Solidification in the Mold and Ideal Taper	
2:20	Z. Chen	Investigating Dynamic Thermal Behavior with CONOFFLINE	
2:40	Break		
3:20	A. Murali	Thermal-stress analysis of columnar microstructures and inter- granular crack formation	
3:40	K. Xu	15 Heat Transfer, Shrinkage, & Machine Taper; Precipitate Models	
4:00	H-J Lee	Thermal-stress Cracking of Ladle Sliding-gate Plates	
4:20	Y. Li	Modeling SEN Preheating	
4:40		Group Discussion of Future Projects and Directions	
5:30	Adjourn		
6:00 University of	Dinner Illinois at Urbana-Champaign	Colonial Room, Illini Union Building Metals Processing Simulation Lab BG Thomas 5	





Transient Model of Preheating a Submerged Entry Nozzle

Yonghui Li MS Thesis, University of Illinois, MechSE, 139p, 2014, CCC Report 201405

Transient Model of Preheating a Submerged Entry Nozzle

Li, Y., and B.G. Thomas AISTech 2014, Indianapolis, IN, May 5-8, 2014, Assoc. Iron Steel Technology, Warrendale, PA, pp. 2907-2922

Model of Gas Flow through Porous Refractory Applied to an Upper Tundish Nozzle

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Rui Liu and Brian G. Thomas CCC Report 201402



2014 CCC Reports – Mold Flow

Measurements of Molten Steel Surface Velocity and Effect of Stopper-rod Movement on Transient Multiphase Fluid Flow in Continuous Casting Rui Liu, Brian G. Thomas, Joydeep Sengupta, Stephen D. Chung and ManhKha Trinh,

CCC Report 201401

University of Illinois at Urbana-Champaign

Modeling Transient Multiphase Flow and Mold Top Surface Behavior in Steel Continuous Casting

Rui Liu PhD Thesis, University of Illinois, MechSE, 332p, 2014, CCC Report 201406

Numerical Investigation of Slag Entrainment in Continuous Casting Molds Swartz, Kenneth E, Lance C. Hibbeler, Brendan P. Joyce, and Brian G. Thomas AISTech 2014, Indianapolis, IN, May 5-8, 2014, Assoc. Iron Steel Technology, Warrendale, PA, pp. 1865-1879

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Large Eddy Simulations of Double-Ruler Electromagnetic Field Effect on Transient Flow during Continuous Casting (reprint)

Singh, R., B.G. Thomas, and S.P. Vanka. *Metallurgical and Materials Transactions B, Vol. 45B, No. 3, (June), 2014, pp. 1098-1115. DOI: 10.1007/s11663-014-0022-2*

Slidegate Dithering Effects on Transient Flow and Mold Level Fluctuations Iron and Steel Technology (reprint)

Liu, Rui, Brian G. Thomas, Love Kalra, Tathagata Bhattacharya, and Aloka Dasgupta Iron and Steel Technology, 11:7, July, 2014. (reprinted from AISTech 2013 Proceedings, Pittsburgh, PA, May 6-8, 2013, Assoc. Iron Steel Technology, Warrendale, PA, pp. 1351-1364)

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Transient Fluid Flow During Steady Continuous Casting of Steel Slabs Part I: Measurements and Modeling of Two-phase Flow (reprint) Seong-Mook Cho, Seon-Hyo Kim, and Brian G. Thomas ISIJ International, Vol. 54, No. 4, (April), 2014, pp. 845-854

Transient Fluid Flow During Steady Continuous Casting of Steel Slabs Part II: Effect of Double-Ruler Electromagnetic Braking (EMBr) (reprint) Seong-Mook Cho, Seon-Hyo Kim, and Brian G. Thomas ISIJ International, Vol. 54, No. 4, (April), 2014, pp. 855-864

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2014 CCC Reports – Model Fundamentals

Transport and Entrapment of Particles in Steel Continuous Casting (reprint) Thomas, B.G., Q. Yuan, S. Mahmood, R. Liu, and R. Chaudhary Metallurgical and Materials Transactions B, Vol. 45B, No. 1, pp. 22-35, 2014. DOI: 10.1007/s11663-013-9916-7.

Particle Transport in a Turbulent Square Duct Flow with an Imposed Magnetic Field

Liu, R., Surya P. Vanka, and Brian G. Thomas J. Fluids Engineering, submitted, 2014.

Round Continuous Casting with EMS-CFD Coupled

Galdiz, P., J. Palacios, J.L. Arana, and B.G. Thomas 8th European Continuous Casting Conference, (ECCC2014), Graz, Austria, June 23-26, 2014, pp. 1312-1321

Combining Models and Measurements to Better Understand Steel Continuous Casting

Brian G. Thomas, Rui Liu, and Bret Rietow 8th European Continuous Casting Conference, Graz, (ECCC2014), Austria, June 23-26, 2014, pp. 1130-1139

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2014 CCC Reports – Meniscus Heat Transfer

Estimation of Time-Temperature-Transformation Diagrams of Mold Powder Slags from Thermo-analysis of Non-Isothermal Crystallization

Maldonado, Yadira G., Claudia Barraza de la P., Sergio Rodríguez A., A. Humberto Castillejos E. and Brian G. Thomas CCC Report 201404

Transient Thermo-Fluid Model of Meniscus Behavior and Slag Consumption in Steel Continuous Casting

ASM Jonayat and Brian G. Thomas *Metallurgical and Materials Transactions B,* submitted April, 2014

Transient Thermo-Fluid Model of Meniscus Behavior and Slag Consumption in Steel Continuous Casting

ASM Jonayat

University of Illinois at Urbana-Champaign

MS Thesis, University of Illinois, MechSE, 132p, 2014, CCC Report 201407



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Correlation for Mold Heat Flux Measured in a Thin Slab Casting Mold

Duvvuri, Prathiba, Bryan Petrus, and Brian G. Thomas AISTech 2014, Indianapolis, IN, May 5-8, 2014, Assoc. Iron Steel Technology, Warrendale, PA, pp. 2881-2893

Simulation and Online Measurement of Narrow Face Mold Distortion in Thin-Slab Casting

Lance C. Hibbeler, Brian G. Thomas, Ronald C. Schimmel, and Henk H. Visser 8th European Continuous Casting Conference, (ECCC2014), Graz, Austria, June 23-26, 2014, pp. 675-684

Multiphysics Modeling of the Steel Continuous Casting Process

Lance Hibbeler

PhD Thesis, University of Illinois, MechSE, 156p, 2014, CCC Report 201408

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2014 CCC Reports – Secondary Cooling and

Control

Distributed Parameter Control of Heat Diffusion with

Solidification

Bryan Petrus

PhD Thesis, University of Illinois, MechSE, 181p, 2014, CCC Report 201409

Applications of Enthalpy-Based Feedback Control Methodology for the Two-Sided Stefan Problem

B. Petrus, J. Bentsman, and B. G. Thomas

American Control Conference 2014. Portland, Oregon, USA, in press



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