Continuous Casting Consortium
Annual Report

University of Illinois, August 16, 2012

USB -Drive - Table of Contents

1. B.G. Thomas: Overview of projects

2. R. Liu Slide-gate Dithering Effect on Transient Flow & Mold Level Fluctuations

   Videos:
   02_LIU_R_des_cp.avi
   02_LIU_R_des_fs.avi
   02_LIU_R_dithering_sloshing_fs_v3.avi
   02_LIU_R_sloshing_tank.avi
   02_LIU_Rui_dithering_sloshing_cp_v2.avi
   02_LIU-R_dithering_meniscus_old_level_static_pressure.avi
   02_LIU-R_dithering_meniscus_old_moving_grid

3. S.-M. Cho Bubble formation, breakup and coalescence in stopper-rod nozzle flow and effect on multiphase mold flow

   Videos:
   03_CHO-SM_Lagrangian_Multiphase_Argon_Gas.avi
   03_CHO-SM_Lagrangian_Multiphase_Mold_Flow.avi

4. S.-M. Cho EMBr Effect on Mold Level Fluctuations

   Videos:
   04_CHO-SM_FC_Off_Surface_Flow-Nailboards.wmv
   04_CHO-SM_FC_On_Surface_Flow-Nailboards.wmv

5. K. Jin and Z. Fan Mold Flow with Argon Gas, EMBr and Evaluation using Nailboard Measurements

   Videos:
   05_JIN-K Fan-Z Multiphase Mold Flow with EMBr_EE_Ar_developing.avi
   05_JIN-K Fan-Z Multiphase Mold Flow with EMBr_EE_Rotating_ISO_Ar_VOF
   05_JIN-K Fan-Z Multiphase Mold Flow with EMBr_Mix_ISO-NF.avi

05_JIN-K Fan-Z Multiphase Mold Flow with EMBr_Mix_ISO-Top.avi
05_JIN-K Fan-Z Multiphase Mold Flow with EMBr_Mix_ISO-WF

6.	R. Singh	Effect of EMBr on Transient Mold Flow with DNS Modeling and Ga-In-Sn Benchmark Measurements Videos: 06_92_mm_case_Dresden_Conducting_wall_24.5to44.0sec_5fps.wmv 06_92-mm_EMBR_Conducting_wall_actual_speed.wmv 06_121mmEMBr_Conducting_wall_actual_speed.wmv
7.	L. Zhou, W. Wang B.G. Thomas	Modeling crystallization process of mold slag
8.	ASM Jonayat	Mold Heat Transfer Using CON1D and Slag Consumption Model Videos: 08_Jonayat-ASM_Meniscus_Model_full.wmv 08_Jonayat-ASM_Slag_Rim.wmv 08_Jonayat-ASM_Velocity.wmv
9.	I. Hwang L. Hibbeler	CON1D Mold Geometry Calibration: “Offset Method”
10.	L. Hibbeler	Stress Analysis of Dendritic Microstructure During Solidification
11.	B. Petrus	Control of Spray Cooling: CONONLINE Implementation Issues
12.	K. Xu	Multiphase Model of Precipitate Formation and Grain Growth in Secondary Spray Cooling
13	M. Zappulla	Equilibrium Precipitation Model Graphical User Interface
14.	P. Srisuk	Heat Transfer and Ideal Shrinkage for Soft Reduction Modeling
15.	Y. Li	Modeling Heat Transfer in SEN during Preheating, & Cool-down
16.	H.-J. Lee	Thermal Stress Cracking of Sliding Gate Plates
17.	V. Natarajan	Control of Mold Oscillation with New Periodic Disturbance Rejection System
18.	B.G. Thomas	CCC 2012 USB Table of Contents and List of Reports

EQPrecip (CCC Precipitation Model – Equilibrium)

(K. Xu program; M. Zappulla GUI)

1. Readme.txt
2. Installation Program EQPrecip.exee (need to rename as EQPrecip.exe)

2012 CCC Reports

Nozzle-related Behavior

Model of Gas Flow through Upper Tundish Nozzle Refractory and Initial Bubble Size
Liu, Rui, and Brian G. Thomas
AISTech 2012, (Atlanta, GA, May 7-9, 2012), 2012.

Transient Turbulent Flow Simulation with Water Model Validation and Application to Slide Gate Dithering
Liu, Rui, Brian G. Thomas, Bruce Forman and Hongbin Yin
AISTech 2012, (Atlanta, GA, May 7-9, 2012), 2012.

Thermal Stress Cracking of Sliding Gate Plates
Lee, Hyoung-Jun, Seong-Mook Cho, Seon-Hyo Kim, Brian G. Thomas, Sang-Woo Han, Tae-In Chung, Joo Choi
AISTech 2012, (Atlanta, GA, May 7-9, 2012), 2012.

Effect of Nozzle Clogging on Surface Flow and Vortex Formation in the Continuous Casting Mold (reprint)
Cho, S.-M., S.H. Kim, R. Chaudhary, B.G. Thomas, H.-J. Shin, W.-R. Choi and S.-K. Kim
Iron and Steel Technology, 9: 7, pp. 85-95, 2012. (reprinted from AISTech 2011, Indianapolis, IN, May 2-5, 2011, Assoc. Iron Steel Technology, Warrendale, PA).

Transient Mold Flow

Effect of Electromagnetic Ruler Braking (EMBr) on Transient Turbulent Flow in Continuous Slab Casting using Large Eddy Simulations (reprint)
Chaudhary, R., B.G. Thomas, and S.P. Vanka
Metallurgical and Materials Transactions B, 2012, in press.
DOI: 10.1007/s11663-012-9634-6.

Simulation of Transient Fluid Flow in Mold Region during Steel Continuous Casting (reprint)
Liu, R., B G Thomas, and J Sengupta
Modeling of Casting, Welding, and Advanced Solidification Processes (MCWASP) XIII, (Styria, Austria, June 17-22, 2012), 2012.

Transport and Entrapment of Particles in Steel Continuous Casting
Thomas, B.G., Quan Yuan, Sana Mahmood, Rui Liu, and Rajneesh Chaudhary
2012, CCC Report, No. 201202. (detailed version)

Transport and Entrapment of Particles in Steel Continuous Casting
Thomas, B.G., Quan Yuan, Rui Liu, Sana Mahmood, and Rajneesh Chaudhary
in *CFD Modeling and Simulation in Materials*, L. Nastac, L. Zhang, B. G. Thomas, A. Sabau, N. El-Kaddah, A. C. Powell and H. Combeau, eds., Orlando, FL, Mar. 12-15, 2012, TMS, 2012, pp. 279-286. (summary version of CCC Report 201202)

Other Mold Phenomena

Thermal-Mechanical Model Calibration with Breakout Shell Measurements in Continuous Steel Slab Casting
Iwasaki, Junya, and B.G. Thomas
in *Supplemental Proceedings: Volume 2: Materials Properties, Characterization, and Modeling, TMS Annual Meeting, Defects and Properties of Cast Metals Symposium* Orlando, FL, Mar. 12-15, 2012, 2012, pp. 355-362.

Kinetic Study of the Devitrification of Mold Powder Slags
Maldonado, Yadira G., F. Andrés Acosta, A. Humberto Castillejos and Brian G. Thomas
AISTech 2012, (Atlanta, GA, May 7-9, 2012), 2012.

Calibration of Thermal Models of Continuous Casting of Steel
Hibbeler, Lance C., Melody M. Langeneckert, Junya Iwasaki, Inwho Hwang, Ron J. O'Malley, Brian G. Thomas
AISTech 2012, (Atlanta, GA, May 7-9, 2012), 2012.

The Thermal Distortion of a Funnel Mold (reprint)
Hibbeler, Lance C., Brian G. Thomas, Ronald C. Schimmel and Gert Abbel
Metal. Mater. Trans. B., in press, 2012.
DOI: 10.1007/s11663-012-9696-5.

Spray Cooling

Measuring heat transfer during spray cooling using controlled induction heating experiments and computational models
Zhou, Xiaoxu, Brian G. Thomas, C. Alberto Hernández B., A. Humberto Castillejos E. and F. Andrés Acosta G.
CCC Report 201203.

Measurement of heat flux in dense air-mist cooling: Part I – A novel steady-state technique (reprint)
Hernández-Bocanegra, Constantin A., A. Humberto Castillejos E., Francisco A. Acosta-González, Xiaoxu Zhou and Brian G. Thomas
Experimental Thermal and Fluid Science, 2012, in press.
DOI: 10.1016/j.expthermflusci.2012.06.015

Measurement of heat flux in dense air-mist cooling: Part II – The influence of mist characteristics on steady-state heat transfer (reprint)
Hernández-Bocanegra, Constantin A., Jesús I. Minchaca-Mojica, A. Humberto Castillejos E., Francisco A. Acosta-González, Xiaoxu Zhou and Brian G. Thomas
Experimental Thermal and Fluid Science, 2012.
DOI: 10.1016/j.expthermflusci.2012.06.007.

Precipitates and Control

Multiphase Particle-Size-Grouping Model of Precipitation and its Application to Thermal Processing of Microalloyed Steel
Xu, Kun
MechSE, University of Illinois, 2012, PhD Thesis, 216p, CCC Report No. 201201.

Particle-Size-Grouping Model of Precipitation Kinetics in Microalloyed Steels
Xu, Kun and Brian G. Thomas
Metallurgical and Materials Trans. A, 43A: 3, pp. 1079-1096, 2012,
DOI: 10.1007/s11661-011-0938-y.

Robust Rejection of Sinusoids in Stable Nonlinearly Perturbed Unmodelled Linear Systems: Theory and Application to Servo
Natarajan, Vivek and Joseph Bentsman
2011 American Control Conference, (San Francisco, CA, USA, June 29 - July 01, 2011), 2011, pp. 3289-3294.

Enthalpy-based feedback control algorithms for the Stefan problem
Petrus, Bryan, Joseph Bentsman and Brian G. Thomas
51st IEEE Conference on Decision and Control, (Maui, Hawaii, Dec. 10-13, 2012), 2012.