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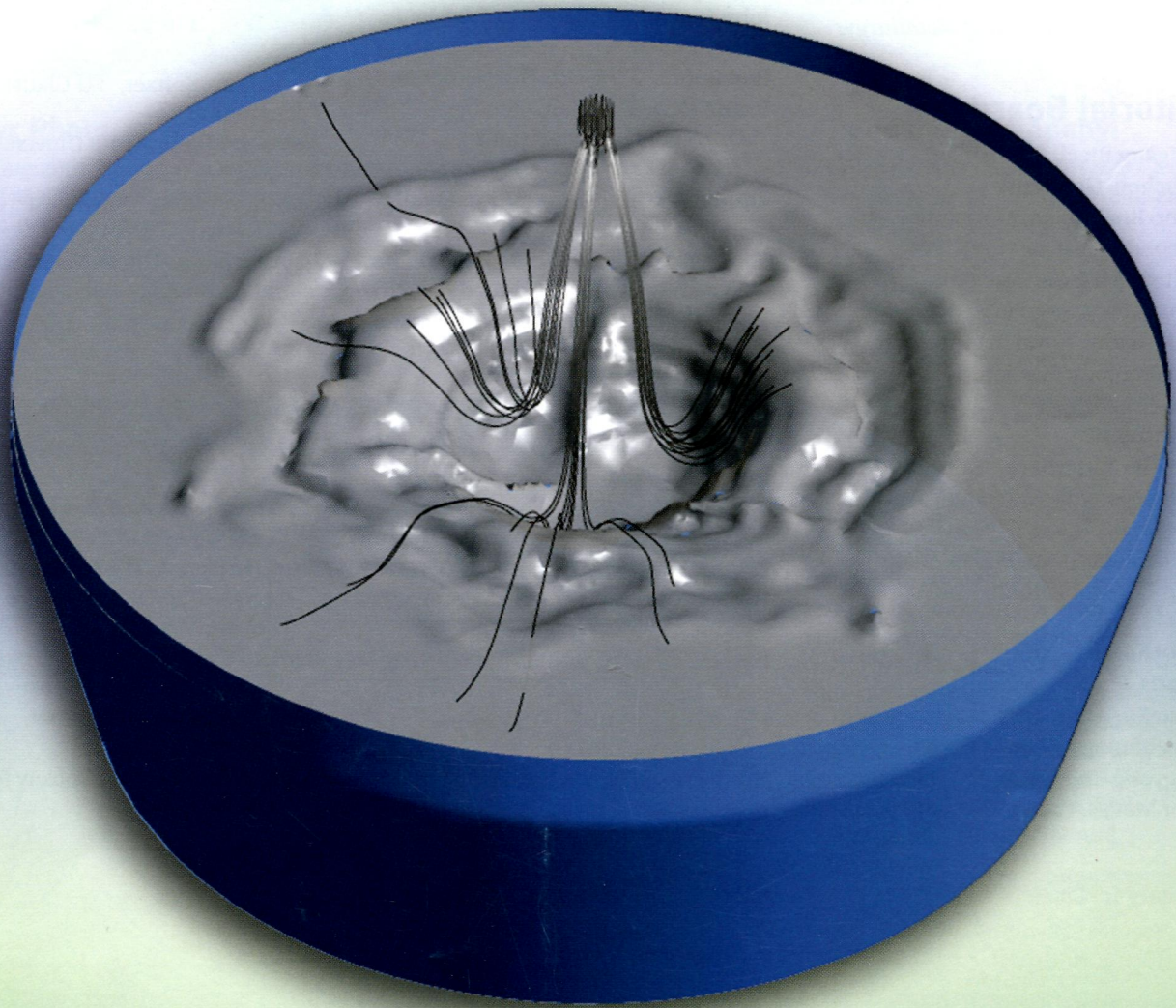
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# steel research

international

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2014

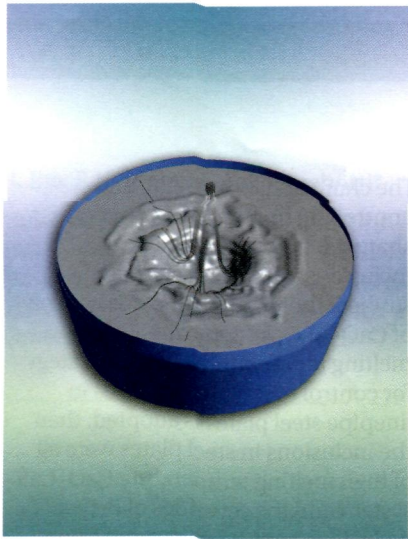


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## Cover Photo:

A mathematical model of a top blown converter, which was based on a physical model of a 30 t vessel, has been developed in this study as described by Xiaobin Zhou and co-workers on page 273. The cover shows the top view of the impinging jet from the simulation results.

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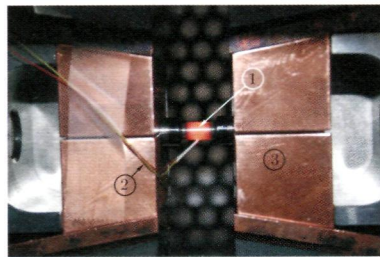
## Contents

### Full Paper

E. Gamsjäger,\* R. E. Werner,  
W. Schiller and B. Buchmayr

**Kinetics of the Austenite-to-Ferrite  
Phase Transformation – Simulations  
and Experiments**

**EDITOR'S CHOICE** 131

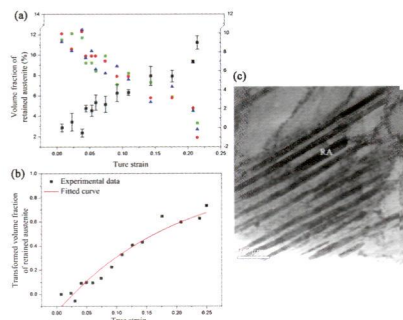


Sharp as well as thick interface models have been developed to describe austenite-to-ferrite transformation kinetics. This work confirms that diffusion processes in the interface solute drag and diffusion of interstitial components like carbon control the kinetics of the austenite-to-ferrite transformation in low-alloyed steels. The models are compared with and verified by the results of experimental investigations.

N. Zhu, Q. Wu, Y. He,\* X. Lu, L. Li and  
P. Hu

**Effect of Ni on the Stability of Re-  
tained Austenite and Mechanical  
Properties for TRIP Steels Containing  
Vanadium**

143



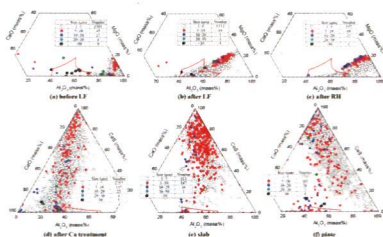
*Addition of Ni content inhibits the carbon diffusion during bainitic isothermal holding resulting in the bainite morphology consisting of laths of bainitic ferrite and film-type retained austenite with nearly equal width which increases the strength of TRIP steels. More volume fraction of film-type retained austenite greatly increases the stability of retained austenite without contribution to the total elongation.*

# Contents

X. Wang, X. Li, Q. Li, F. Huang,\* H. Li and J. Yang

**Control of Stringer Shaped Non-Metallic Inclusions of CaO–Al<sub>2</sub>O<sub>3</sub> System in API X80 Linepipe Steel Plates**

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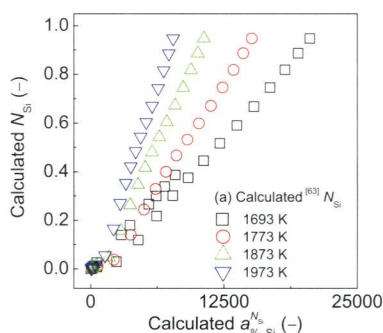


The characteristics, origin, and controlling method of stringer shaped B type non-metallic inclusions in pipeline steel are studied, their composition are mainly of CaO–Al<sub>2</sub>O<sub>3</sub> system with lower melting temperatures. A new strategy for control of B type inclusions in linepipe steel plates is adopted, than the inclusions in steel plates were all of high melting temperature CaO–CaS system and the severities of B-type inclusions have been lowered from “<2.0” to “0.”

X. M. Yang,\* J. Y. Li, P. C. Li, M. Zhang and J. Zhang

**Determination of Activity Coefficients of Elements and Related Thermodynamic Properties of FeSi Binary Melts Based on the Atom–Molecule Coexistence Theory**

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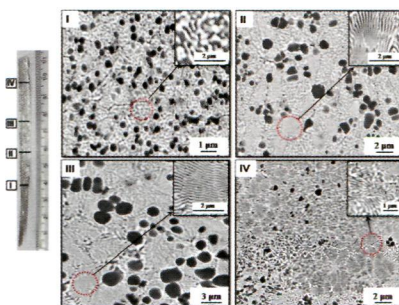


The Raoultian activity coefficient  $\gamma_{Si}^0$  of Si and  $\gamma_{Fe}^0$  of Fe in the infinitely dilute solution of Fe–Si binary melts at temperatures of 1693, 1773, 1873, and 1973 K have been determined from the calculated mass action concentrations  $N_i$  of structural units in Fe–Si binary melts based on the atom and molecule coexistence theory (AMCT). The figure shows the accurate agreement between the calculated mass action concentration  $N_{Si}$  of Si and the calculated activity  $a_{Si}^N$ ; Si of Si referred to 1 mass percentage of Si as standard state in the full composition range of Fe–Si binary melts at temperatures of 1693, 1773, 1873, and 1973 K, respectively.

S. Sahoo and S. Ghosh\*

**Heat Transfer, Solidification, and Microstructural Evolution in Al-33Cu Alloy During the Starting of Twin Roll Strip Casting**

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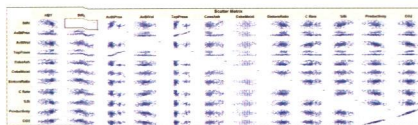
Numerical simulations for high speed twin roll strip casting is carried out to estimate the time which is required for steady state condition to set in and solidification front speed during the transient stage. By using this model it is possible to determine the transient length of the cast strip which needs to be rejected during the starting process.



# Contents

R. Jha, P. K. Sen and N. Chakraborti\*  
**Multi-Objective Genetic Algorithms and Genetic Programming Models for Minimizing Input Carbon Rates in a Blast Furnace Compared with a Conventional Analytic Approach**

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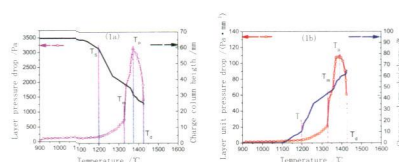


Novel nature inspired strategies are used to construct models of Productivity, CO<sub>2</sub> emission, and Si content of an operational Blast furnace and the optimum tradeoffs between the level of CO<sub>2</sub> emission and productivity at different Si levels are computed and analyzed in detail. Also, comparisons are made with the results of a thermodynamic model and those from some commercial software.

S. Wu, B. Tuo,\* L. Zhang, K. Du and Y. Sun

**New Evaluation Methods Discussion of Softening–Melting and Dropping Characteristic of BF Iron Bearing Burden**

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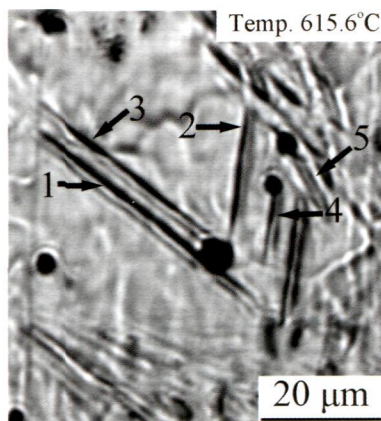


A high temperature characteristic evaluation method of BF iron bearing burden (IBD) has been put forward. It provides more information under the same experiment conditions. It evaluates high temperature behavior of IBD accurately through dividing into three temperature ranges. The permeability of charge column can be analyzed by pressure drop and characteristic value of cohesive zone and dropping zone.

X. L. Wan, K. M. Wu,\* G. Huang and R. Wei

**In Situ Observations of the Formation of Fine-Grained Mixed Microstructures of Acicular Ferrite and Bainite in the Simulated Coarse-Grained Heated-Affected Zone**

243



Single, multiple, and sympathetic nucleation of acicular ferrite are observed. Acicular ferrite laths or plates effectively partitioned austenite grains into many smaller and separated regions. The later formed bainite at lower temperature is confined in those smaller regions, thus resulting in the fine-grained mixed microstructures of acicular ferrite and fine bainite plate packets.

# Contents

F. Martell,\* K. Krüger, A. Llamas and O. Micheloud

**Signal Processing of Virtual-Neutral to Ground Voltage for Power Control in Electric Arc Furnaces**

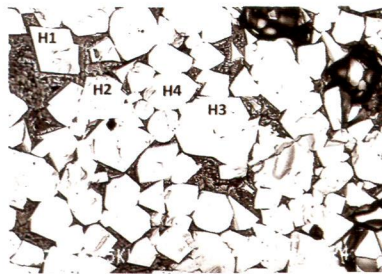


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The time and frequency domain analysis of the voltage difference between a virtual-neutral, from the delta connected transformer, to the furnace shell ground voltage, showed relevant information of the heat process like arc stability, arc slag coverage, and electrical circuit imbalance. The proposed arc indexes can be considered as process variables to improve the power control of Electric Arc Furnaces.

S. Ferreira, A. Cores, J. I. Robla, L. F. Verdeja, I. Ruiz-Bustinza,\* F. García-Carcedo and J. Mochon

**The Influence of Gangue and Additives on the Divalent Iron Content of Magnetite Pellets**

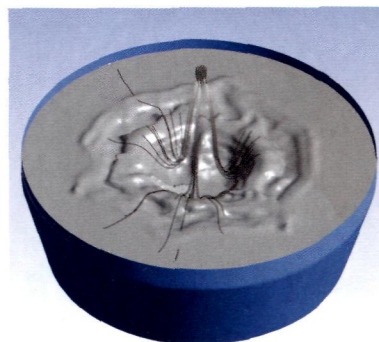


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During the pyroconsolidation of magnetite pellets in an aerobic atmosphere, the mineral practically oxidizes in the beginning stages of the process. However, as the temperature increases, the hematite dissociates into magnetite. The temperature at which this phenomenon occurs depends on the additives present and is significantly lower than that corresponding to pure magnetite. In this paper a series of magnetite pellets were formed, varying the alkalinity, and pyroconsolidated at temperatures ranging from 1050 to 1350°C.

X. Zhou,\* M. Ersson, L. Zhong, J. Yu, and P. Jönsson

**Mathematical and Physical Simulation of a Top Blown Converter**



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A simplified model consisting of the converter has been used in the mathematical simulation. The comparison between the physical model and the mathematical model shows that the simplified top blown model can successfully be used to calculate long-time simulations, and the mixing time calculations in frozen field can save a large amount of time compared to the simulation time using a transient flow field.

Top view of the impinging jet from the simulation results