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## Cover Photo:

Deformation-induced martensitic transformation, which offers high manganese steel superior combination of strength and elongation, is influenced strongly by thermal martensite in initial microstructure. The in-situ EBSD technique reveals, as shown in the figure by comparing with initial microstructure, quantitatively the changes of volume fraction in both  $\epsilon/\alpha'$  martensites and their variants, for details, see text in pages 576.

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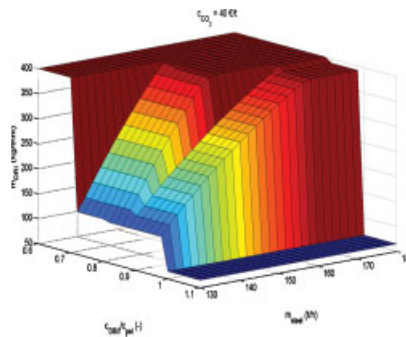
## Contents

### Full Paper

K. Huitu,\* M. Helle, H. Helle, M. Kekkonen, and H. Saxén

### Optimization of Midrex Direct Reduced Iron Use in Ore-Based Steelmaking

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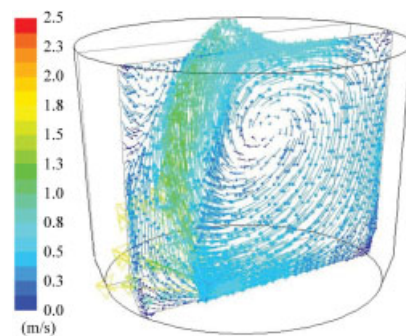


The potential of using direct reduced iron as a partial substitute of pellets in a blast furnace is studied. The main objective is to analyze the prerequisites for an economically feasible operation of a steel plant integrated with a direct reduction plant. The results illustrate the conditions under which it will be economical to use DRI in the blast furnace.

S. Yu, J. Miettinen, L. Shao, and S. Louhenkilpi\*

### Mathematical Modeling of Nitrogen Removal from the Vacuum Tank Degasser

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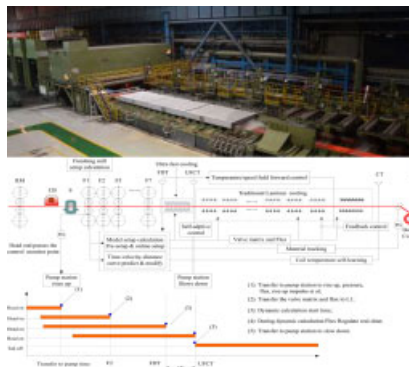
This paper is focused on predicting nitrogen removal from the vacuum degasser specially taking into account the multi-component effect of steel composition. An integrated computational fluid dynamics (CFD) model is developed. Two operating diagrams are obtained to give the correlations between chemical reaction rate constant, initial nitrogen content, and final nitrogen content in liquid steel.

# Contents

Z.-L. Li,\* H.-J. Li, G. Yuan, G.-D. Wang, and X.-Q. Wang

## Research and Application of Ultra-Fast Cooling System and Velocity Controlled Strategy for Hot Rolled Strip

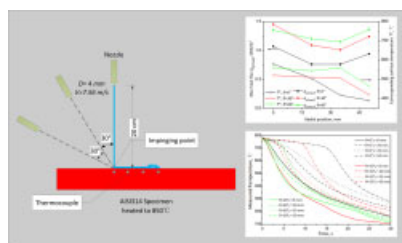
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Ultra-fast cooling is an advanced technology in hot rolling strip for development of low-cost and high-performance steels. Key components, sequential control structure, and mathematical model for ultra-fast cooling are described. Velocity controlled strategy for each strip element is developed. The temperature fluctuation affected by velocity variation is effectively eliminated and the system realizes accurate temperature control of UFCT and CT.

Q. Xie, B. Wang,\* Z. Wang and G. Wang  
The Effect of Jet Angle and Initial Plate Temperature during Jet Impingement Heat Transfer Process in Ultra-Fast Cooling Technology

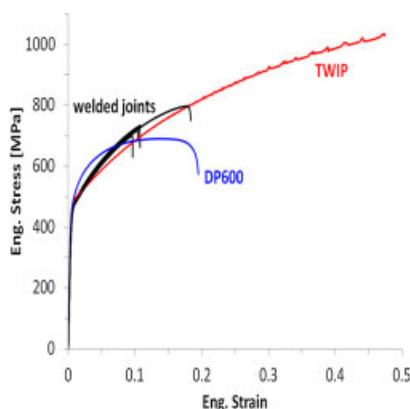
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The AISI314 specimen is heated to 850°C and quenched by the impinging jet, the temperature data is recorded by the thermocouples, which are 2 mm underneath surface. The flow field and heat transfer mechanism under different initial temperature (600 and 750°C) and inclination angle (0°, 30°, and 60°) are studied.

P. Russo Spena,\* P. Matteis, and G. Scavino  
Dissimilar Metal Active Gas Welding of TWIP and DP Steel Sheets

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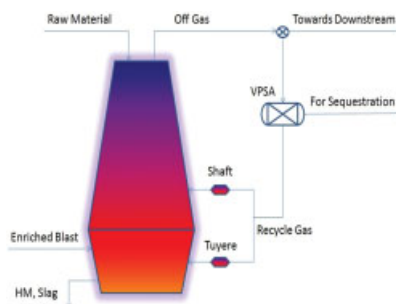
New austenitic high-manganese TWIP steels have been proposed for the fabrication of car-body components, due to their excellent combination of strength and ductility. A widespread usage of TWIP steel grade is conditional on the employment of resistance spot welding to assemble body components made of dissimilar steel grades. For this reason, this work aims at investigating the mechanical and microstructural response of dissimilar butt weld seams of TWIP and dual phase steel sheets, with an austenitic filler, made by MAG welding.

# Contents

R. K. Sahu, S. K. Roy, and P. K. Sen\*

## Applicability of Top Gas Recycle Blast Furnace with Downstream Integration and Sequestration in an Integrated Steel Plant

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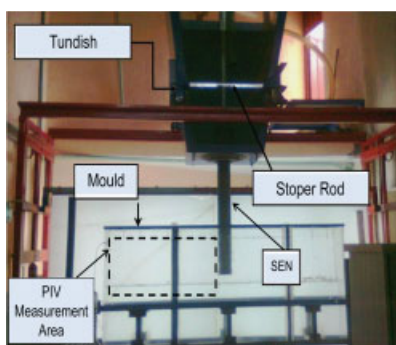


Global warming has led to consideration of the top gas recycle (TGR) blast furnace with significant potential to reduce CO<sub>2</sub> emissions. A TGR system model has been developed to simulate the behavior of TGR furnace under different operating conditions. Under optimal conditions, the estimated total carbon requirements can be brought down substantially. But simultaneously there is a considerable reduction in the available downstream energy as well as an increase in sequestration load.

J. de J. Barreto, R. D. Morales, S. Garcia-Hernandez,\* A. Najera-Bastida and I. Calderon-Ramos

## Modeling Study of Molten Steel Turbulence Control by SEN Design Improvement in a Conventional Slab Caster

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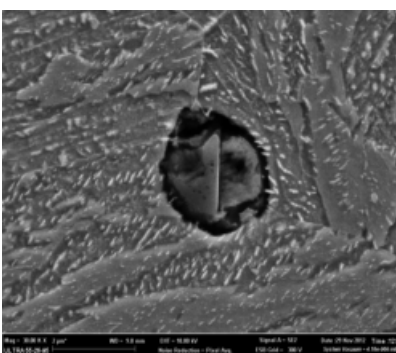


A study to improve the fluidynamics of a slab mould by redesigning the SEN ports is carried out. The results indicate that the original design induces vortexes formation at the free surface and the backflow phenomena. The proposed design eliminates the formation of this phenomenon. Additionally, the backflow induces jet fluctuations, and its elimination provided stable flow patterns.

N. Saeidi,\* F. Ashrafizadeh, B. Niroumand, M. R. Forouzan, and F. Barlat

## Influence of Bainite Morphology on Ductile Fracture Behavior in a 0.4C-CrMoNi Steel

528



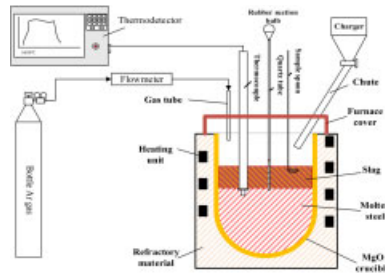
SEM analysis is involved in studying ductile fracture mechanism in upper and lower bainitic steels. Detailed microstructural analysis reveals that cracking and interface decohesion of Al<sub>2</sub>O<sub>3</sub> inclusions at lower strains and decohesion of cementite/ferrite matrix interfaces at higher strains are the main void nucleation mechanisms. Void growth behavior is also modeled. Moreover, final fracture mechanisms are examined and cleared in both steels studied.

# Contents

D. Kai,\* W. Long, L. Wenjuan, and Z. Rong

## Experimental Study on the Refining Desulfurization Slag Made from the Reduced Red Mud

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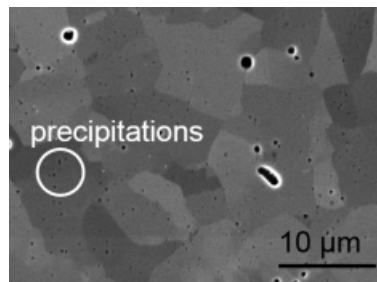


Refining desulfurization slags made from the reduced red mud are studied by thermodynamic simulation, orthogonal experiments, and verification experiment. The results of the optimal combination slag with the best desulfurization and the metal Fe separation from the reduced red mud prove that, manufacture refining desulfurization slag is a feasible method on the disposal and recycling of the red mud.

S. Decker,\* K. Lange, L. Krüger, and T. Dubberstein

## Influence of the Sulfur Content on the Sintering Behavior and the Mechanical Properties of a CrMnNi-TWIP-Steel

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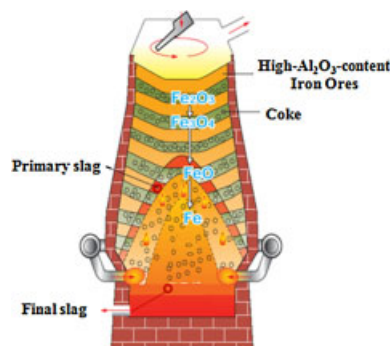


Sulfur reduces the surface tension of steel melts and enables the generation of very small steel particles during gas atomization. Results show, that high-alloyed steel with sulfur contents in the range of 0.02–0.1wt% exhibits a high strength and a good deformability under quasi-static compression despite the formation of a large fraction of sulfur precipitations.

S. Wu,\* W. Huang, M. Kou, X. Liu, K. Du, and K. Zhang

## Influence of Al<sub>2</sub>O<sub>3</sub> Content on Liquid Phase Proportion and Fluidity of Primary Slag and Final Slag in Blast Furnace

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The objective of this study is to understand the effect of Al<sub>2</sub>O<sub>3</sub> on blast furnace operation by studying the properties of liquidus temperature, liquid phase proportion and fluidity of the primary slag in the cohesive zone and the final slag in the hearth of the blast furnace. The optimization measures by adding MgO content and increasing CaO/SiO<sub>2</sub> are discussed.

# Contents

D. Lindell,\* T. Ekman, and R. Pettersson  
**Fast and Efficient Annealing of Stainless Steel Strip Using Oxyfuel Burners**

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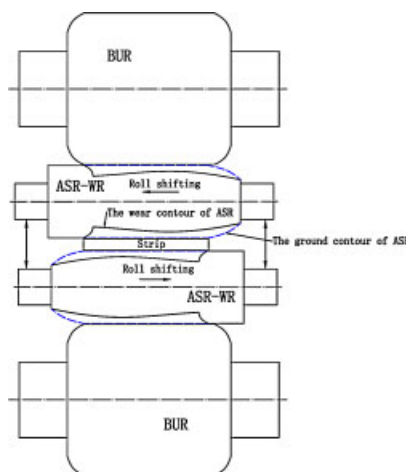


Pilot plant annealing experiments have been conducted to study the effect of the higher water content, caused by altering the oxidizer in combustion furnaces, on oxidation and pickling of cold rolled stainless steel. Characterization of oxide, microstructure, mechanical properties, and pickling response suggests that the increasing the water content from 15 to 50 mol% does not result in any negative downstream effects.

Y.-L. Li, J.-G. Cao,\* G.-H. Yang, D. Wen, Y.-Z. Zhou, and H.-H. Ma

**ASR Bending Force Mathematical Model for the Same Width Strip Rolling Campaigns in Hot Rolling**

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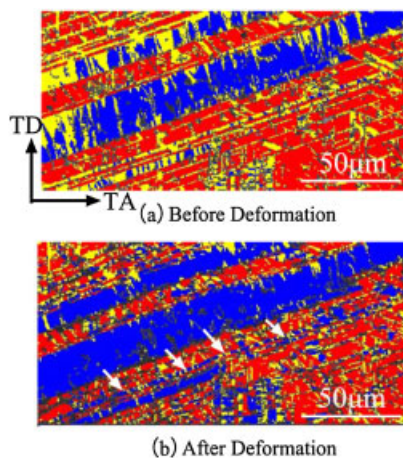


ASR bending force mathematical model for different rolling schedules is established. The model is related with the strip width, the rolling force, the diameters of rolls and the roll shifting stroke. The developed model lead a better crown of non-oriented electrical steel and an increase in coil numbers within a large number of the same width strip rolling campaign in production mills.

H. Yang, J. Li, and P. Yang\*

**Interaction Between Deformation-Induced and Thermal Martensite in High-Manganese TRIP Steel**

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In-situ observation and EBSD reveal the interaction of deformation-induced and thermal martensite which is manifested by the formation means of deformation-induced  $\alpha'$ -M. Two means exist: nucleation in the intersection of two thin  $\epsilon$ -M plates and direct growth of existing thermal  $\alpha'$ -M in thick  $\epsilon$ -M plates. Good content consistency exists between thermal and deformation-induced martensite which quantitatively demonstrate the interaction between the two.