

ПН,  
382/р

# steel research

international

March · Vol. 84 · DP17644

3  
2013

[www.steel-research.com](http://www.steel-research.com)

WILEY-VCH







# steel research

international



www.steel-research.de

## Cover Photo:

The cover shows a multifaceted parabolic solar concentrator and absorber at the Almeria Solar Platform, Spain, used to reduce hematite to magnetite. More details can be found in the manuscript by I. Ruiz-Bustinsa et al.

## Publishing company:

Wiley-VCH Verlag GmbH & Co. KGaA,  
Boschstraße 12, D-69469 Weinheim,  
Germany

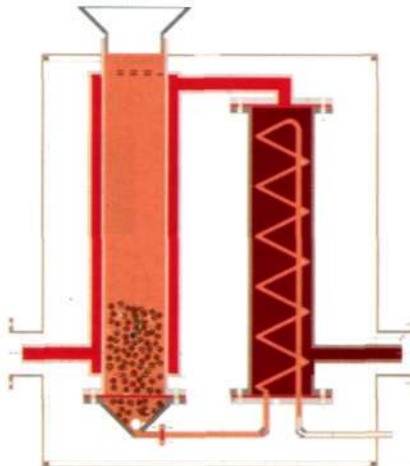
## Contents

### Full Paper

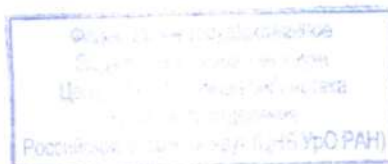
I. Ruiz-Bustinsa\*, I. Cañadas,  
J. Rodríguez, J. Mochón, L. E. Verdeja,  
E. Garcia-Carcedo, and A. J. Vázquez

**Magnetite Production from Steel  
Wastes with Concentrated Solar  
Energy**

**EDITOR'S CHOICE** ————— 207



The use of solar thermal energy is quite interesting because of its direct application to metallurgical and chemical processes. A fluidized bed furnace, heated by solar energy has been used to reduce mill scale. The search of the objectives, "zero waste" and "clean energy", may pose an interesting challenge in the manufacturing of primary iron and steel, as well as in areas of other metal production and even in the recycling of wastes, minimizing CO<sub>2</sub> emissions.

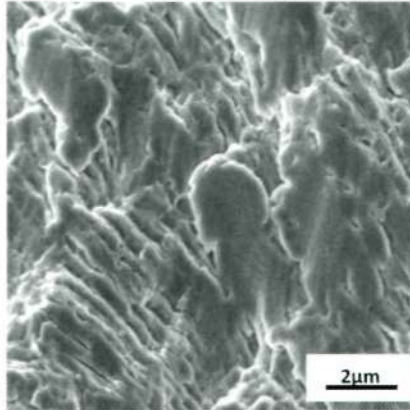


# Contents

T. S. Srivatsan\*, K. Manigandan,  
A. M. Freborg, and T. Quick

**Investigating and Understanding  
the Cyclic Fatigue, Deformation, and  
Fracture Behavior of a Novel High  
Strength Alloy Steel: Influence of  
Orientation**

218

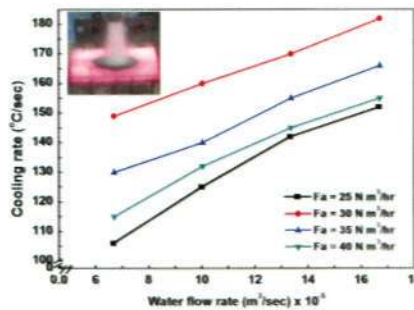


Influence of orientation on high cycle fatigue properties and final fracture behavior of alloy steel Pyrowear 53 is the focus. Test specimens prepared from both the longitudinal and transverse orientations were deformed in cyclic fatigue over a range of maximum stress, under fully-reversed loading, and number of cycles-to-failure recorded. The fracture surfaces were examined to establish the macroscopic mode and characterize intrinsic features on the surface.

S. S. Mohapatra, S. V. Ravikumar,  
S. K. Pal, and S. Chakraborty\*

**Ultra Fast Cooling of a Hot Steel  
Plate by Using High Mass Flux Air  
Atomized Spray**

229

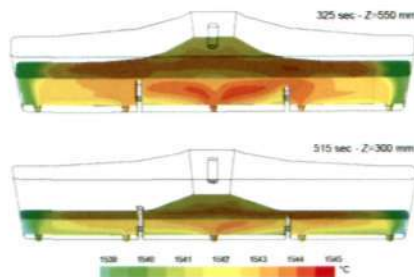


The ultra fast cooling of a 6 mm thick hot steel plate has been studied using high mass flux (>130 kgm<sup>-2</sup> s) air atomized spray. The heat transfer analysis depicts that air atomized spray has an excellent control over heat transfer even at a high initial surface temperature of 900°C and as a result the maximum cooling rate of 182°Cs<sup>-1</sup> has been achieved which is in the ultra fast cooling regime.

V. Battaglia, M. De Santis\*, V. Volponi,  
and M. Zanforlin

**Steel Thermo-Fluid-Dynamics at  
Tundish Drainage and Quality  
Features**

237



CFD modeling of steel flow and temperature fields are described during 5-strand long product tundish drainage at ORI Martin Steelworks. The vortices formation was shown, at first from the strands close to corners. The bath height was found to avoid slag entrapment through vortices. Once applied into operating practice, no rejection or claims for cleanliness were achieved. The beneficial effect of both good insulation and regular drainage rate to prevent steel freezing was found and confirmed by a ORI campaign at tundish start operations including about 700 heats.

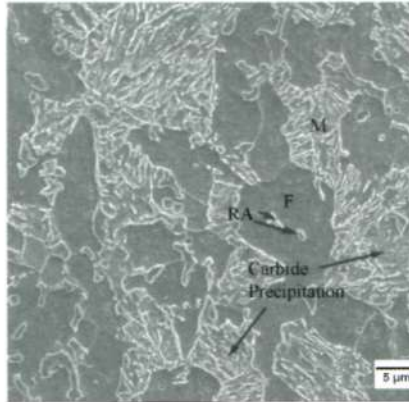


# Contents

W. Feng\*, Z. Wu, L. Wang, and J. G. Speer

**Effect of Testing Temperature on Retained Austenite Stability of Cold Rolled CMnSi Steels Treated by Quenching and Partitioning Process**

246



The effect of testing temperature on retained austenite stability of industrially cold rolled CMnSi sheet steel treated by quenching and partitioning process has been investigated through the deformation and transformation behavior of retained austenite at different testing temperatures. And a correlation between retained austenite stability and mechanical properties is also established.

J. J. Jonas\*, C. Ghosh, and V. V. Basabe

**Effect of Dynamic Transformation on the Mean Flow Stress**

253

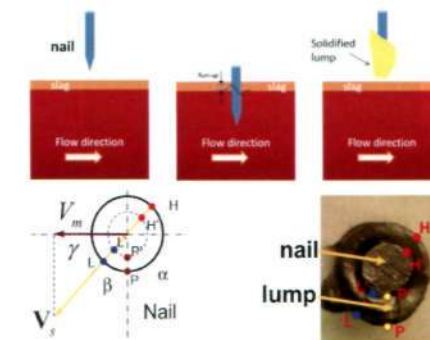


Mean flow stresses are calculated from experimental flow curves determined on four steels of increasing C content. These are plotted against inverse temperature so as to define the stress drop or upper critical temperature applicable to rolling. These temperatures are shown to be well above the equilibrium transformation temperatures, an observation that is attributed to the occurrence of dynamic transformation.

C. Ji\*, J. Li, H. Tang, and S. Yang

**Effect of EMBr on Flow in Slab Continuous Casting Mold and Evaluation Using Nail Dipping Measurement**

259



The information provided in this paper can be applied in steel plant to measure the mold top surface velocity and meniscus fluctuation with time variation. This work can be used to investigate the effect of EMBr and others casting condition on mold surface flow pattern and furthermore improving the casting defect. Also the method in this paper provides a way to validate the accuracy of computational model. This paper is free of charge.

M. Raudensky\*, J. Horsky, J. Ondrouskova, and B. Vervaeet

**Measurement of Thermal Load on Working Rolls during Hot Rolling**

269



An experimental technique developed for monitoring the work roll surface temperature by sensors embedded in the work roll is presented. Continuous hot rolling pilot line trials were performed for different process conditions. These thermal measurements give very detailed information about the temperature field in the roll. The heat flux and heat transfer coefficient distribution along the roll circumference were obtained.

# Contents

P. Ni, L. T. I. Jonsson, and P. G. Jönsson\*  
Simulations of the Ladle Teeming  
Process and Verification With Pilot  
Experiment

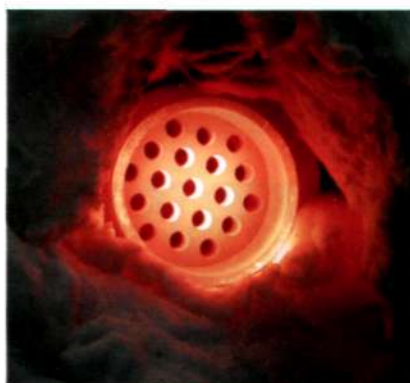
276



Predicted interface in an inclined bottom ladle with an expanding diameter nozzle during teeming by VOF+ realizable  $k-\epsilon$  model with enhanced wall treatment.

K. Janiszewski\*  
The Slenderness Ratio of the Filter  
Used in the Process of Liquid Steel  
Filtration as the Additional Param-  
eter of the Filter Form

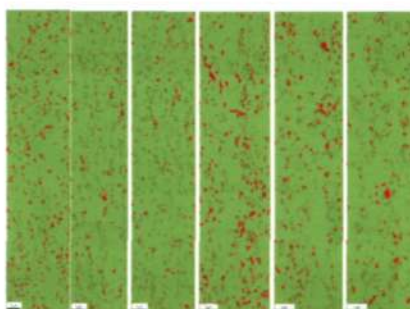
288



We propose in this publication the introduction of new, additional definition describing the multiple orifice ceramic filters used in research works on the liquid steel filtrations, calling this the filter slenderness ratio. Using this coefficient we obtain the possibility to compare the filtration effectiveness of different types of ceramic filters, not only for filters with cylindrical filtrating orifices, but also for other types, e.g., with orifices of rectangular section.

E. Emadoddin\*, A. Akbarzadeh,  
R. Petrov, and L. Zhao  
Anisotropy of Retained Austenite  
Stability during Transformation to  
Martensite in a TRIP-Assisted Steel

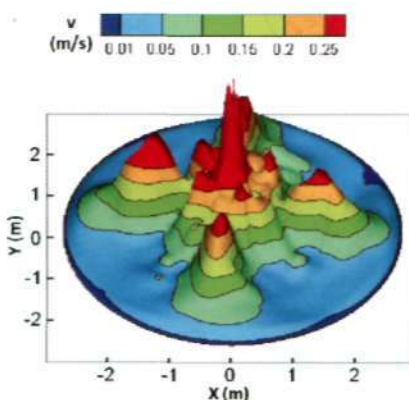
297



Strain induced martensitic transformation of retained austenite has been studied in Al-containing TRIP steel samples with similar retained austenite characteristics. It was found a difference of retained austenite stability by tensile straining along RD and TD. This behavior has been explained by the texture component of ferrite causes anisotropy of crystal plasticity so that more transformation of retained austenite is measured along RD rather than TD.

M. Lv\*, R. Zhu, H. Wang, and R. G. Bai  
Simulation and Application of Swirl-  
Type Oxygen Lance in Vanadium Ex-  
traction Converter

304



This paper described jet characteristics of conventional and various swirl-type oxygen lances by water model experiment and numerical simulation. The swirl-type oxygen lance was experimented in 150 t vanadium extraction converter. The research shows that the swirl-type lance can strengthen stirring ability and guarantee the normal converter vanadium extraction process. It is helpful to improve vanadium extraction efficiency.