MONDAY, AUGUST 23, 2004, P.M.

SESSION 8: INTERNATIONAL SYMPOSIUM ON OXYGEN IN STEELMAKING: MILESTONES AND CHALLENGES

Sponsor: Iron and Steel Section, The Metallurgical Society of CIM
Room: 314
Chairmen: S. SUN and G. IRONS, McMaster University, Hamilton, Ontario, Canada

PAPER 8.1 — 14:00 (KEYNOTE)
MILESTONES AND CHALLENGES IN OXYGEN STEELMAKING
E. FRITZ, VOEST-ALPINE Industrieanlagenbau GmbH & Co, Linz, Austria

This paper reviews the history, developments and 10 milestones of the oxygen steelmaking processes, with a special focus on conventional autothermic converters, high-speed converters with a blowing rate up to 5 m^3_n/t min and allothermic converters with coal addition, post combustion and the possibility to increase the scrap rate up to 50%. Related operating results are introduced. A new process route, which is based on hot metal and chromium ore, is outlined. The cost advantage for the production of 304 stainless steel grade is higher than 100 US$/t. The synthesis of EAF and oxygen converter steelmaking, a comparison of decarburization rates, refining combustion burners for optimized oxygen-management in EAF and an example for a large advanced EAF are outlined. Possibilities of flexible steelmaking and the growth and outlook of worldwide oxygen steelmaking are described

PAPER 8.2 — 14:45
STRATEGIES FOR EXTENDING HOT METAL AT DOFASCO'S #2 MELT SHOP
M. TRINH and N. PYKE, Dofasco Inc., Hamilton, Ontario, Canada

Dofasco was the first company to adopt oxygen steelmaking in North America in 1954, two years after the first LD vessel installed and operated successfully in Linz, Austria. Since then, Dofasco has investigated and implemented several strategies to maximize hot metal usage and minimize overall cost. Some key strategies -low hot metal silicon, combined blowing conversion, vacuum degassing tank upgrade and BOF slag carryover control - are discussed. Post combustion, scrap preheat, carbon injection trials along with current operating philosophies are described.

COFFEE BREAK – 15:15 – 15:30

PAPER 8.3 — 15:30
DROPLET GENERATION AND RESIDENCE TIME IN SLAG DURING TOP BLOWN OXYGEN STEELMAKING
G. BROOKS, Y. PAN, CSIRO Minerals, Melbourne, Australia,
SUBAGYO, Gadjah Mada University, Indonesia and
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The generation of droplets and their subsequent reaction in the emulsion is critical to the overall kinetics of oxygen steelmaking. High temperature experiments have been performed at McMaster University to study this behavior. The results from this work and other previous studies has formed the basis of a number of physical and chemical models that attempt to describe the critical aspects of droplet behavior in Oxygen Steelmaking. These models include semi-empirical models for predicting droplet generation rate, droplet size distribution and droplet residence time as a function of blowing parameters.

PAPER 8.4 — 16:00
METALLURGICAL OPTIMIZATION AFTER THE REPLACEMENT OF TWO BOF VESSELS AT DILLINGER HÜTTE/GERMANY
R. BRUCKHAUS, V. FIEDLER, H. LACHMUND, Y. XIE, AG der Dillinger Hüttenwerke, Dillingen, Germany

After producing some 50 million tonnes of crude steel the two BOF vessels at Dillinger Hütte steel plant had to be replaced in 2000/01 due to large deformations. The new vessel design was optimised after a number of theoretical evaluations.

Refractory investigations were carried out as well as temperature measurements of the shell to provide a basis for selecting a suitable steel grade. This was found in a DH-GTS development – P420M HT - with high strength at elevated temperatures and excellent weldability and made it also possible to build the vessel without any cooling system.

After putting the first vessel into operation the metallurgical results showed no remarkable improvement compared to the old vessel, and were therefore not satisfying. With the help of cold model investigations the arrangement of the

tuyeres was modified to improve the flow conditions and the interactions between oxygen jet and the heterogeneous plume of the bottom stirring gas. Further optimisations were obtained by a variation of lance tips and a newly developed lime addition model.

PAPER 8.5 — 16:30

CHARACTERISTICS OF SHROUDED SUPERSONIC JETS IN METALLURGICAL REACTOR VESSELS

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The supersonic core of shrouded jets remain coherent over longer distances vs conventional supersonic jets. This phenomenon should allow for greater penetration of oxygen into slag/steel reactor systems. As such, they hold the promise for faster slag/metal mixing in BOF type metallurgical reactor systems, possibly creating greater surface area/volume ratios of reacting phases, and thereby faster kinetics, as compared to conventional supersonic jet systems. In order to assess the potential of shrouded supersonic jets versus their conventional counterparts, an experimental investigation of impinging shrouded supersonic jets into a water model of a simplified BOF system was carried out in the MMPC's water modelling laboratory. The experimental results for three different designs of a shrouded supersonic jet nozzle have been compared in terms of greater penetration depths and reduced mixing times. Based on a novel dimensional analysis, the depth of penetration of a gas jet into a liquid bath is shown to depend on the nozzle-bath distance, the liquid's Froude, Reynolds and Weber numbers, reflecting the ratios of gravity, viscous and surface tension forces to the jet's inertial, or momentum, forces. Good agreement between the mathematical model and experiment was obtained in terms of predicted and observed depths of penetration. Further efforts have been made to study jet penetration into liquid metals. The effects of mean liquid density of slag/metal mixtures and a wide range of gas flow rates on the penetration depth were investigated theoretically. The results show that the penetration depth can be increased with increasing gas flow rate and decreased bath density.