TUESDAY, AUGUST 24, 2004, A.M.

SESSION 20: INTERNATIONAL SYMPOSIUM ON OXYGEN IN STEELMAKING: MILESTONES AND CHALLENGES

SPONSOR: IRON AND STEEL SECTION, THE METALLURGICAL SOCIETY OF CIM
Room: 314
Chairmen: R. BOOM, CORUS, Ijmuiden, Netherlands, and
K. PEASLEE, University of Missouri – Rolla, Rolla, Missouri, U.S.A.

PAPER 20.1 — 9:00 (KEYNOTE)
FUTURE OF OXYGEN STEELMAKING: MYTHS AND REALITY
R.J. FRUEHAN, Center for Iron and Steelmaking Research, Carnegie Mellon University Pittsburgh, PA, U.S.A.

Oxygen steelmaking (OSM) is not only the dominant steelmaking process but defines the structure of the industry. There are a number of myths regarding the future of OSM, which are false. These myths include that the EAF will become the dominant process in the near future, it is less costly to produce steel in an EAF and OSM is a mature technology and no new developments are occurring. These myths are shown to be false. Selected new developments are discussed such as post combustion, recycling of waste oxides, slag splashing and sensors.

PAPER 20.2 — 9:45
REMOTE, NON-CONTACT SENSORS FOR CONTROL OF THE INTEGRATED PROCESS ROUTE
M.S. MILLMAN, Corus R.D. & T., Grangetown, Middlesbrough, United Kingdom

Close monitoring of performance at each process stage, from raw material through to finished product, is vital for operational consistency and the production of high quality steel. However, many of the integrated iron and steelmaking process route stages operate under such severe conditions of temperature, dust, water, thermal radiation, vibration, pressure, vacuum, extreme dynamic events, high material flows, corrosion, erosion, electrical-noise, electromagnetic-noise, or audio-noise that, in general, it is a very difficult challenge to obtain useful information for control. Thus, state-of-the-art non-contact and remote sensors are applied to help monitor and control specific process operations. Often, these sensor systems have been developed especially for the steel industry and they are based on four principal technologies: Laser, Microwave, Electro-Magnetics and Thermal Imaging with supporting technologies such as: X-ray Fluorescence, Audiometry, Digital Image Processing, Radio Telemetry, GPS and many others. These advanced sensor technologies are reviewed with respect to their application at various stages along the integrated process route.

COFFEE BREAK — 10:15 – 10:30

PAPER 20.3 — 10:30
TECHNOLOGICAL PROGRESS OF OXYGEN STEELMAKING IN CHINA
L. LIU, Central Iron and Steel Research Institute, Beijing, China

In the recent 10 years the rapid development of Chinese steel industry has attracted the attention of the world. The technological progress of converter steelmaking has played an important role in this process. First of all, slag splashing has been extensively adopted by Chinese steel companies in various sizes of converters from largest to smallest ones, and even including those using special hot metal containing V and Ti. Remarkable metallurgical results have been achieved. Up to now the average converter campaign life has reached nearly 10,000 heats, and the longest exceeds 30,000 heats in three melt shops. Based on this process, the long-life combined-blowing converter steelmaking technology has been developed. Slag splashing has been used to form a gas permeable “slag mushroom” on the top of bottom nozzles to protect the nozzles. In order to keep the effective bottom blowing, furnace bottom thickness control technique has been developed to prevent the furnace bottom growth. It makes the service life of bottom nozzle the same as the converter campaign life (average 10,000 heats and longest > 30,000 heats). The complete combined blowing was ensured through out the furnace campaign. Concentration product [C][O] is in the range of 0.0023 ~ 0.0030%, the T.Fe in the slag is lowered by 4 ~ 6%, and the [O] in steel is decreased by 100 ~ 250 ppm.

PAPER 20.4 — 11:00
NITROGEN ABSORPTION BEHAVIOR OF MOLTEN STEEL IN NITROGEN BLOWING PROCESS UNDER VACUUM
O. TIE, C. YU, L LIU, Wuhan Iron and Steel (Group) Co., Wuhan, Hubei, P.R. China, and
G. LI, Wuhan University of Science and Technology, Wuhan, Hubei, P.R. China

For stabilizing the production of containing nitrogen steels, a study on nitrogen absorption behavior of killed molten steel has been carried out by means of the RH vacuum device in which nitrogen was used as a driving gas. The

results showed that there was an increase of nitrogen content in molten steel under vacuum processing but the rate of nitrogen absorption was slowed down by the surface active elements. Therefore, a kinetic equation for nitrogen absorption of molten steel with apparent first order reaction was derived by constructing a modified model in which the adsorption of closed surface site was taken into account. The experimental results confirmed that the calculated values agreed with the observed ones. This model is suitable for the prediction of nitrogen adsorption operation for containing nitrogen steels.

PAPER 20.6 — 11:30

A STUDY OF LIME DISSOLUTION AND DIFFUSIVITY IN STEELMAKING SLAGS.

T. KANEYASU, Nippon Steel Corp., Kitakyusyu-shi, Fukuoka-ken, Japan
K.S. COLEYand G.A. IRONS, McMaster University, Hamilton, Ontario, Canada

It is very important to reveal the lime dissolution mechanism in steelmaking slag, to promote its dissolution without calcium fluoride, which is now almost forbidden for use in most industrialized countries. In this research, the purpose was focused on the development of an experimental method to measure the mutual diffusivity of Ca^{2+} under the condition of lime dissolution into slag. By forming diffusion couples using a "vacuum slag aspirating technique", the method was established. The following mutual diffusivities of Ca^{2+}, in CaO-SiO_2-FeO slag systems, imitating oxygen steelmaking slag, were determined using this method:

$4.1*10^{-10}$ m^2/s at 1400°C for 27wt.%CaO-53wt.%SiO_2-20wt.%FeO slag,

$4.3*10^{-10}$ m^2/s and at 1400°C for 20wt.%CaO-40wt.%SiO_2-40wt.%FeO slag, and

$1.3*10^{-10}$ m^2/s at 1250°C for 20wt.%CaO-40wt.%SiO_2-40wt.%FeO slag.

It was also verified that, if the basicity and ferrite content of the bulk slag are low, then a calcium silicate film forms on the lime surface, and drastically deters the lime dissolution.