

# SPOTLIGHT

## on ladle metallurgy

by D.W. DE VOS\*

A school on the principles and practices of ladle metallurgy, organized by the Technical Committee: Metals Technology of The South African Institute of Mining and Metallurgy, was held at the University of Pretoria from 13th to 16th November, 1989. The course leader, Professor R.J. Fruehan from the Carnegie Mellon University, Pittsburgh, Pennsylvania, presented the main part of the course. Three papers were read by local steelmakers on the experience gained in the field of ladle metallurgy in South Africa. The School also included a special half-day seminar on new and innovative steelmaking and casting processes presented by Professor Fruehan.

Dr O.K.H. Steffen, President of the SAIMM, opened the School by outlining the objectives of the SAIMM. He emphasized that schools and colloquia are intended to facilitate the exchange of information on technological developments in the mining and metallurgical industries. He stressed the importance of ladle metallurgy in meeting the demand for higher-quality steels.

### Thermodynamic Principles

The first part of the course consisted of an overview of the thermodynamic and kinetic principles required for a thorough understanding of ladle-metallurgy processes. Delegates performed calculations on a number of practical examples in steelmaking. This served as a welcome refresher to those who had not been exposed to the theoretical aspects of steelmaking for some time.

### Electric-arc Steelmaking

Current electric-arc-furnace steelmaking was discussed during the second part of the School. Attention was given to the basic chemistry, to energy considerations, to the different types of scrap utilized, and to the consumption of refractories and electrodes. This was followed by a description of recent and future developments in electric-arc-furnace steelmaking, including bottom tapping, scrap preheating, direct-current and plasma furnaces, the Energy Optimizing Furnace, coal injection, and gas stirring.

Dr B. Strohmeier presented a paper on the operation and new developments in the Electric Arc Furnace Plant at Iscor's Vanderbijlpark Works. New developments there include eccentric bottom tapping, the charging of liquid iron to furnaces, and the manufacture of offshore, ultra-low-carbon, and titanium-stabilized steels.

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### Production of Clean Steels

The fundamentals of the processes involved in controlling composition and inclusions for the production of clean steels were analysed. Specific attention was devoted to the effects of deoxidation, desulphurization, and slag carry-over on steel cleanliness.

### Ladle Furnaces

A description was given of the basic chemistry and methods for optimizing ladle furnace processes with regard to optimum refining slag compositions and gas flowrates. The methods employed for the efficient removal of sulphur, phosphorus, hydrogen, nitrogen, and carbon were elucidated. This was followed by a description of specific examples of ladle furnace operations.

Mr F. Nyikos outlined the procedures for the preparation and use of dolomite ladles at Iscor.

### Vacuum Degassing

The basic thermodynamics and kinetics involved in the removal of hydrogen, nitrogen, carbon, and oxygen in degassing processes were explained. The design, basic functions, and operation of the various types of degassing processes were described and analysed.

Mr J.P. de Vos presented a paper on the ladle-metallurgy practices currently employed at Iscor's Pretoria Works and on the control of the gas evolved during the solidification of semi-killed steels.

### Innovative Steelmaking and Casting

During the special half-day seminar, a presentation was given by Professor R.J. Fruehan on new developments in iron- and steelmaking processes. These new developments include ironmaking by a single smelting reduction process utilizing coal and ore directly; continuous refining in a bottom-blown converter; the melting of scrap using fossil fuels; and near-net-shape continuous casting.

After the special half-day seminar the delegates attended a cocktail party, at which they had the opportunity of exchanging ideas in an informal atmosphere.

### Closure

The School was closed by Mr P.F.T. Burger, from Iscor's Newcastle Works, who thanked Professor Fruehan for presenting the School.

The SAIMM is grateful to Middelburg Steel & Alloys, who sponsored the cocktail party, and to all the companies who allowed key personnel to attend the school.