Spotlight

Symposium on Clean Steel Production

Vanderbijlpark, 18–20 September 1995

by: A.W. Cramb*

A three-day symposium on the production of clean steel organized by The South African Institute of Mining and Metallurgy, was held in September 1995 at Vanderbijlpark. It was attended by 151 delegates, who represented the whole of the steel industry in South Africa: Iscor Works, Saldanha Steel, Columbus Stainless, Highveld Steel & Vanadium, Iscor Research & Development, University of Pretoria, and Technikon Witwatersrand, as well as the users of steel products were represented.

Professor Allan Cramb held the delegates attention with well-presented research and practical information. He obtained excellent interaction with the delegates by responding in depth to the questions put to him during the Symposium.

In summary, he emphasized the following aspects of the elimination of defects during the processing of steel in continuously cast materials.

The modern continuous caster has become a sophisticated computerized machine capable of the high-quality production of almost all grades of steel. However, efficient operation of a caster necessitates the implementation of complex scheduling and control strategies, which have led to caster operation becoming highly technical. Not only must the caster operator understand the basics of caster operation (i.e. how to run the machine at high productivity), but he must also have sufficient technical background including a thorough understanding of physical chemistry, mechanical metallurgy, fluid flow, process control, and heat-transfer and solidification theory, in order to consistently produce defect-free slabs, billets, and blooms. Professor Cramb explained some recent trends in caster technology by discussing key problems associated with caster operation. He outlined theoretical solutions to these problems and the technology that has been developed, or is under development, to aid in the solution of practical problems.

To make clean steel, one must understand all aspects of the formation, transportation, and separation of inclusions. Lack of attention to these details will lead to products of poor quality. The manufacture of clean steel requires attention to details, and the sources of inclusions must be eliminated before steel refining can begin. The transportation of the inclusion to the interface must be designed into the system, and suitable interfaces must be designed to accomplish the removal of inclusions. Once the system has been designed, it must be continually measured to ensure adherence to the strict rules necessary for the manufacture of clean steel. Once these steps have been understood and implemented, clean steel will consistantly be cast.

The old adage 'Look after the slag and the steel will look after itself' reveals much practical truth for modern processes. A modern re-statement of the old steelmakers' catch phrase would be 'Ignore the slag at your peril'. Modern refining and casting processes depend on a thorough understanding of the physical and chemical characteristics of the liquid slags that are in contact with liquid steels. Today's steel-processing systems are complicated refiners in which the steelmaker adjusts the chemistry of the slag to allow refining reactions to take place while ensuring that the physical properties of the slag do not vary significantly during the processing.

Control of the fluid flow in the ladle, tundish, and mould is necessary for the production of high-quality steel. In the past 10 years, physical and mathematical modelling of these systems has been fully developed. A combination of both modelling approaches seems to be optimal. Inplant experiments have shown that model prediction, if appropriate models are used, yields useful guidelines for the operation of ladles, tundishes, and moulds. In all such studies, both steady and non-steady state conditions must be fully understood before the fluid flow can be optimized. ◆

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