Institute Lecture

The Importance of Gas Bubble sizes in Liquid Metal Processing Operations

Prof. Roderick Guthrie, Macdonald Professor of Metallurgy
and Director of the McGill Metals Processing Centre (MMPC), Montreal, Canada.

Friday, 20th December 2013, Time: 5.00 PM, Venue: L-16,
Lecture Hall Complex

Abstract

We will start with a brief review of the importance of gas liquid metal interactions in metallurgical refining processes in Basic Oxygen Furnaces, and then focus on a current problem. This is to produce micro-bubbles in steelmaking tundish systems. We will review the mechanisms of bubble formation, by describing some previous work on bubble formation from a horizontal nozzle submerged in liquid pig iron. Then an empirical correlation will be developed, correlating bubble size with gas flow rate, liquid metal surface tension, nozzle outer diameter and the “capacitance number” of the gas delivery system. Good agreement between predicted and measured bubble size was obtained for non-wetting, ceramic-liquid metal systems, but the bubbles were always quite large. However, based on these previous investigations, and other observations, the question of how to create much smaller bubbles than those generally formed in liquid metals, is addressed. This new work is critically important to further improvements for liquid metal quality in tundishes, prior to continuous casting. One method could be to use a submerged porous plug creating gas bubbles in the liquid jet of steel entering through the ladle shroud, so as to create a fine cloud of tiny bubbles. However, a better alternative might be to create small bubbles within the liquid steel passing through the ladle shroud itself.

About the speaker

Prof. Roderick I. L. Guthrie, Ph.D. (Imperial College), ARSM, Eng., is Macdonald Professor of Metallurgy and Director of the McGill Metals Processing Centre (MMPC), Montreal, Canada. Dr Guthrie is an Honorary Member of ISIJ, a Distinguished Member of AIST, a Fellow of the Canadian Institute of Mining and Metallurgy, Royal Society of Canada, and the Canadian Academy of Engineering. He is the author of two text books titled “Engineering in Process Metallurgy”, and “Physical Properties of Liquid Metals”. He has over 500 publications and 200 patents to his name, and has been the recipient of many best paper awards. The winner of the 2006 Killam Prize for Engineering in Canada, he was co-inventor of the successful LiMCA process for detecting inclusions in liquid metals, and also of the Horizontal Single Belt Casting (HSBC) process for casting steel and aluminum alloy strip materials. As a researcher with fifty years experience, he has been a leader in the application of fluid flow, heat and mass transfer phenomena in metallurgical processes. A long time consultant to the steel industry, Prof. Guthrie has worked in all segments of an integrated steel plant, from blast furnaces through steelmaking and hot rolling mills, to annealing and finishing lines. He is currently working for the development of near net shape casting processes for advanced sheet steel production, as well as studies on ladle-tundish-mold designs which include the role of bubbles in removing inclusions from the liquid steel.

_____

Tea at 4.45 PM **All interested are welcome.**

Ajit Kumar Chaturvedi
Dean of Research and Development
IIT Kanpur