Alert Electric Arc Furnaces (January 2017)

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Metallurgical and Materials Transactions B, February 2017
Rapid dissolution of quicklime into molten slag by internally formed gas. N. Maruoka, H. Nogami
In steelmaking process, quicklime is used to produce CaO-based slag. Although rapid dissolution of quicklime is required for high-efficiency refining, it is known that the rate decreases when dicalcium silicate (C2S) layer forms around the quicklime by reacting with slag. The equation that driving force is the difference of CaO content between in slag and a liquid phase of slag saturated by C2S has been often used for estimating the dissolution rate of lime, in which this saturated value is thermodynamically determined. The authors, however, revealed that the quicklime used in actual operation showed much faster dissolving rate than that of completely calcined lime that is covered by C2S layer during dissolution into slag. This was caused by a gas formation due to a thermal decomposition of residual limestone existed in quicklime. In this study, the dissolution rate of quicklime with the gas formation is quantitatively investigated.

European On-Going Research, January 2017
There are currently very few methods available for analysing slag composition and formation in the EAF and LF. One of the most popular methods to gain information of slag composition is taking slag samples and analysing them in laboratory. The problem with this approach is the only pointwise measurement as well as the long delay between the taking of the sample and getting the result. To tackle problems related to transient process conditions like slag foaming or chromium slagging, real-time and continuous information of slag composition and scrap melting is required. However, currently available online measurement systems in EAF furnaces are indirect in nature; they describe the level of foaming [3, 26, 27] or gas generation [2, 23, 24, 25], but
cannot provide direct information of slag composition. This non-satisfying situation led to the formulation of the OSCANEAF research project funded by the Research Fund for Coal and Steel (RFCS). The OSCANEAF acronym stands for “On-line slag composition analysis for electric arc furnaces”. The basic idea of this project is to develop and test a device for the continuous online measurement of slag composition and formation based on arc emission spectroscopy. This project is aimed at providing important information on the slag composition in LF and EAF and scrap melting in the EAF in real-time to increase the general availability of process data and to optimize the operating practices of alloy additions in stainless steelmaking and slag foaming in carbon steel production, leading to a more resource and energy efficient process.

**SEAISI Quarterly Journal, April-June 2016**  
**EAF Quantum - First results from TYASA.** Alexander Müller, Jens Apfel, Hannes Beile
In previous years, productivity was the main focus for the steel industry as the market was booming and the steel producers were output oriented. But the situation changed and the market downturn forced the industry to work on the efficiency of the equipment and the steel producers became cost oriented. Additionally, more and more countries worldwide are implementing new rules and regulations not only concerning energy efficiency and CO₂ emissions but also with respect to hazardous off gas emissions. The right approach of Primetals Technologies is the EAF Quantum. In combination with an adequate hot heel, the melting phase is reduced to pure flat bath operation with lowest flicker generation. With an optimized tapping system called FAST (furnace advanced slag free tapping system), a renewed variant of scrap charging and retaining technology, latest analyzing technologies and a revolutionary design of the offgas-treatment system, this furnace is the scrap melting technology of the future.

**SEAISI Quarterly Journal, October-December 2015**  
**Successful Shift Management at BSW (Badische Stahl Werke GmbH).** Ralf Hetzel, Carsten Pfundstein
A new goal is to increase production to 2.8 million ton/year planned in the near future. To enable such an achievement a constant improvement is a precondition as well as outstanding plant utilization. Accomplishing this production figures is only possible by a SUCCESSFUL SHIFT MANAGEMENT. This shift management is the core of the success of BSW. Effective shift management means to ensure a high productivity with safe operations and good product quality and becomes an efficient shift management by achieving resourceful consumption figures. This key position in the production chain is discreetly responsible for the production of the steel in the BSW plant. For a successful execution it requires some pre-requisites as well as some execution factors. One major success factor is the real management on the spot, which automatically enforces conversation and enables coordination. It is set up on an organizational structure with clear responsibilities. Reaching the knowledge and experience as well as the level of acceptance and authority to be a shift manager takes a minimum of 10 years of constant training throughout the daily production work. This position is the key in between the managing and the work floor level in regards to information flow, trust and motivation.

**Increasing the Competitiveness of H-Beam by Hot Metal Charging.** Chien-Hung Chen Ming-Hui Tseng, Yu Zen Chen
Dragon Steel produces large H-beam whose maximum size is 900X300mm. To improve the competitiveness of H-beam, hot metal charging process is innovatively introduced into existed EAF shop. The charging ratio is flexibly adjusted from 33% to 66% depending on the quantity and cost of hot metal. Hot metal charging process reduces the demand of electrical power. In addition, the collapse of iron ore price resulted in the reduction of hot metal cost. Comparing the cost of 55% hot metal with 100% scrap, the
utility cost of former is dropped 60% and ferrous source cost is dropped about 24%. On the other side, hot metal charging improves the quality as well. The harmful elements, such as copper, hydrogen ... etc., can be restricted. Therefore, the surface cracks and seams is controlled. The competitiveness of DSC's H-beam is highly improved by cost-reducing and higher quality after the introduction of hot metal charging into EAF.

SEAI Si Quarterly Journal, July-September 2015
**Arcsave in Electric Arc Furnace, Boost Productivity and Reduce Cost.** Lidong Teng, Helmut Hackl, Raghu Badrinathan, Olof Sjoeden, Anders Lehman
Arcsave is a new generation of electromagnetic stirrer (EMS) from ABB for electric arc furnace (EAF) operation that helps the arc furnace process make liquid steel safer, quicker and with lower cost. Electromagnetic stirring of the melt bath during arc furnace operation will affect the arc stability, scrap smelting, bath temperature distribution, refining reactions, and also the tapping practice. This paper has summarized the benefits from the Arcsave@ system. The results show that Arcsave@ has stabilized the arc and enhanced the heat and mass transfer in the arc furnace process which result in a faster scrap melting rate, lower the slag superheat during arcing, more homogenous melt bath, and higher decarburization rate, and higher EBT free opening frequency. Arcsave@ has also reduced the tapping temperature and tapping oxygen in the steel which brings a higher scrap yield and saves ferroalloy consumption in the downstream ladle furnace operation. The lower energy consumption, short tap-to-tap time, and consistent furnace operation greatly increases the productivity and operation safety.

SEAI SI Quarterly Journal, April-June 2015
**Increasing EAF Energy Efficiency and Productivity by Excellence in Bottom Gas Purging.** Marcus Kirschchen, Reinhard Ehrengruber, Ravikumar Periyasamy, Karl-Michael Zettl
Modern EAF processes are subject to the cost-optimized production of raw steel melt in combination with very flexible productivity. Excellent mixing of the steel melt helps to improve mass and heat transfer, in order to accelerate the melting of scrap and direct reduced iron (DRI), decarburization, homogeneous superheating, alloy distribution, and to avoid skull formation. Direct bottom gas purging not only promotes efficiently mixing of the steel melt in the entire steel bath but also provides constant gas bubble columns to avoid CO boiling retardation. Since few years EAF gas purging systems are experiencing a comeback as state-of-the-art EAF technology world-wide. Recent case studies and new developments on refractory and gas control units are presented. It is shown that gas purging systems represent a safe and modern EAF technology to increase energy efficiency with minimum pay-back period. Control on the entire gas purging technology from refractory to valve control and purging strategy is crucial for high reliability and availability of the purging system. With years of purging experience, RHIISTOPINC presents an newly developed gas control system for application at the EAF, BOF, ladles etc in secondary metallurgy.

**Innovative Use of Recycled Polymer in Sustainable EAF Steelmaking.** Zheshi Jin, Paul O’kane, Andrea Fontana, Michael Davies, Catherine Skidmore, Daniel Miles
Polymer Injection Technology has become a standard process at OneSteel's EAF plants in Sydney and Melbourne. OneSteel has also successfully commercialised the Polymer Injection Technology in UMC, Thailand, SeAH Besteel, Korea and Celsa UK. OneSteel is currently working with a number of EAF plants worldwide for possible implementation of Polymer Injection Technology. OneSteel has also been developing an engineering technology to manufacture composite materials called the Polymer Composite Briquette. The composite briquettes can comprise of recycled materials including carbon fines, plastics and iron containing materials such as millscale, for use as carbon and iron units in EAF steelmaking. A series of EAF plant trials have been completed in
Sydney and Melbourne using the Polymer Composite Briquette as charge carbon in place of traditional nutcoke. The results have shown considerable benefits in increased carbon recovery efficiency, reduced electrical consumption and improved productivity. OneSteel is currently in the process of developing commercial scale manufacturing capabilities for the Polymer Composite Briquette.