



# MODERN ELECTRIC FURNACE STEELMAKING

## — A PRACTICAL TRAINING SEMINAR

*in conjunction with Specialty Steelmaking Training*

4–8 FEBRUARY 2013 | SHERATON WILD HORSE PASS, CHANDLER, ARIZ.

### MONDAY 4 FEBRUARY 2013

**Noon**

Early Registration (for Plant Tour: Option #1)

**1 p.m.**

Plant Tour of CMC Steel Arizona: Option #1

**4 p.m.**

Registration

**5:30 p.m.**

Welcome Reception

### TUESDAY 5 FEBRUARY 2013

**7 a.m.**

Registration and Continental Breakfast

**8 a.m.**

**CMC STEEL ARIZONA PREVIEW**

*Alan Jackson, CMC Steel Arizona*

**8:30 a.m.**

**SAFETY AS A CULTURE CHANGE**

*Fred Rine, FDR Safety*

**9:30 a.m.**

Break

**9:45 a.m.**

**CHEMISTRY OF EAF STEELMAKING**

*Larry Heaslip, Interflow TechServ Inc.*

The chemistry of steelmaking, with particular reference to the electric arc furnace (EAF), is presented in a manner that is designed to interest, involve and inform both those having little or no background or previous training in the chemical metallurgy of steel production, as well as those who

do have such a background. The topics covered will relate to the interactions between the thermal behavior, physical behavior and chemical behavior of liquid steel and slag during the melting, alloying and removal of undesirable elements from steel, with the goal of improved understanding of the practices and procedures that are undertaken in an EAF shop to produce heats of quality liquid steel ready for casting.

**Noon**

Lunch

**1 p.m.**

**CHEMISTRY OF EAF STEELMAKING (CONT'D)**

*Larry Heaslip, Interflow TechServ Inc.*

**2:15 p.m.**

Break

**2:30 p.m.**

**CHEMISTRY OF EAF STEELMAKING (CONT'D)**

*Larry Heaslip, Interflow TechServ Inc.*

**3:45 p.m.**

**CHEMICAL AND ELECTRICAL ENERGY INPUTS AND EAF PERFORMANCE**

*Sam Matson, CMC Americas*

### WEDNESDAY 6 FEBRUARY 2013

**7 a.m.**

Continental Breakfast

**8 a.m.**

**EAF DESIGNS AND OPERATIONS**

*Jeremy Jones, Transfield Services*

Over the period of 1980–2005, EAF operations went through a rapid evolution as facilities pushed to increase productivity and improve product quality. Chemical energy use in the EAF tripled in magnitude, and many new technologies were introduced. In addition, many different EAF designs introduced were aimed at heat recovery from the offgas, reducing electrode consumption,

increasing productivity and providing greater flexibility in the choice of raw materials. This section of the seminar focuses on EAF technologies and designs implemented over the past 25 years.

9 a.m.

Break

9:10 a.m.

### **EAF TECHNOLOGIES — THE PATH TO EAF OPTIMIZATION**

*Jeremy Jones, Transfield Services*

The focus of EAF technology for the past 20 years has been on the increased use of chemical energy, reduced energy losses from the EAF, flexibility in choice of energy inputs to the EAF, higher productivity (more energy, faster tap-to-tap) and a minor focus on raw materials and environmental issues. Many different EAF designs focused on leveraging specific local conditions to reduce steel-making costs.

Over the last few years, the steel industry has consolidated. Due to economic considerations, facilities have focused less on the design of the EAF and more on the process itself. The importance of auxiliary equipment has grown, and steelmakers now demand better tools to help the operator make better decisions. There is a much greater emphasis on understanding energy utilization in the EAF because, as the use of chemical energy has grown, energy efficiency has suffered. This section of the seminar focuses on development of a proven approach to EAF optimization. It draws on the experience gained at several North American EAF facilities.

10:20 a.m.

Break

10:30 a.m.

### **LADLE METALLURGY FURNACE PROCESSING OF STEEL FROM THE EAF**

*Helmut Oltmann, Nucor Steel–Berkeley*

The ladle metallurgy furnace (LMF) transforms raw steel from the EAF into a castable product and delivers it to the caster at the right time, temperature and chemistry (bulk and inclusion chemistry). The ability to do so is determined by equipment and processing approach, as well as the quality from the EAF — the LMF is the first customer. A review of killing and alloying the steel, making a slag, controlling temperature and non-metallic inclusions is provided.

11:30 a.m.

Lunch

Noon

Plant Tour of CMC Steel Arizona: Option #2

4:30 p.m.

### **ROUNDTABLE DISCUSSION**

*Harriet Dutka, ThyssenKrupp USA; Eugene Pretorius, Nucor Steel–Berkeley; Jeremy Jones, Transfield Services; and Dennis Rodal, ELG Haniel Metals*

**THURSDAY**  
**7 FEBRUARY 2013**

7 a.m.

Continental Breakfast

### **EAF TRACK**

8 a.m.

#### **EAF MAINTENANCE OF SECONDARY ELECTRICAL AND STRUCTURAL COMPONENTS**

*Dave Bauer, Erie Copper Works*

This presentation will focus on conductive power components, various designs and their features. Important maintenance suggestions will be made, and problem areas that are often overlooked will be identified, along with practical remedies for increased operating reliability.

9 a.m.

Break

9:10 a.m.

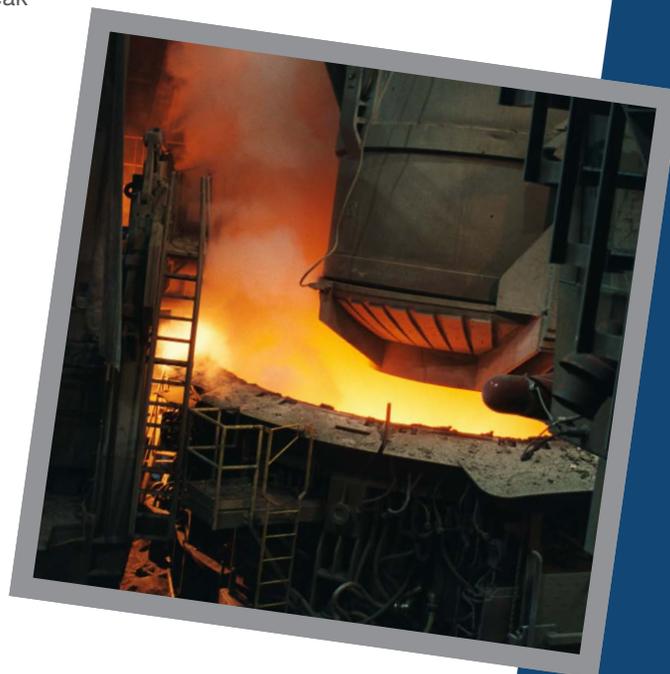
#### **EAF ENERGY EFFICIENCY AND ASSOCIATED ENVIRONMENTAL CONSIDERATIONS**

*Doug Zuliani, Tenova Goodfellow*

This paper will focus on improving EAF energy use and recovery as a means to simultaneously reduce operating costs, improve yield and minimize emissions. Major energy losses and sources of offgas emissions will be identified for a typical scrap melting practice. The focus will first be on optimizing “in-EAF” energy efficiency to utilize energy inputs as efficiently as possible for the production of steel. Various technologies designed to improve in-EAF process energy efficiency and the resulting impact on gaseous emissions will be explored. Once in-EAF energy efficiency has been optimized, the second focus will be on the efficient recovery of remaining energy leaving the EAF in the offgas. Heat recovery technology and possible uses for the recovered energy will be explored. The net impact of these technological improvements on energy use and related emissions will be summarized.

10:10 a.m.

Break



10:20 a.m.

## **ELECTRICAL ENGINEERING 101**

*Billy Bryant, Sterling Steel*

Noon

Lunch

1 p.m.

## **THE BASICS OF EAF REGULATION**

*Reinzi Santiago, Tenova Core*

This course is designed to define the basic electrical components in an electric arc furnace regulation system. It is aimed at explaining the difference between the modes of electrical arc furnace regulation and the feature that makes a regulator a good regulator, keeping in mind that a heating practice can only be as good as the electric arc furnace regulator.

2 p.m.

Break

2:15 p.m.

## **GAS/CARBON INJECTION SYSTEMS**

*Mike Grant, Air Liquide S.A.*

This lecture will contain a practical scope describing the use of oxygen and gaseous fuels in the electric arc furnace. The importance and use of carbon injection will also be presented. The presentation will include the latest technologies of EAF burner and injection systems, as well as the general theory and strategy of their use. A strong emphasis on the safe use of oxygen will be made.

3 p.m.

Break

3:15 p.m.

## **GAS/CARBON INJECTION SYSTEMS (CONT'D)**

*Mike Grant, Air Liquide S.A.*

4 p.m.

Break

4:15 p.m.

## **THE SELECTION AND THE USE OF REFRACTORIES IN ELECTRIC ARC FURNACES**

*Tomas Richter, North American Refractories Co.*

The chemical, physical and application attributes of refractories which are used during the electric arc furnace steelmaking process will be presented. Proper refractory selection and wear mechanism in the relationship with the operational and metallurgical parameters will be summarized.

## **SPECIALTY STEEL TRACK**

8 a.m.

### **SCRAP SELECTION FOR QUALITY SPECIALTY STEEL**

*Dennis Rodal, ELG Haniel Metals*

What makes scrap blending so difficult is tramp residual element control. An in-depth explanation of the effects and sources of tramp residual elements and the effects on both the specialty steelmaker and scrap supplier is given.

9 a.m.

Break

9:10 a.m.

### **ON THE CHEMISTRY OF SPECIALTY STEELMAKING**

*David Kundrat, SGL Carbon Corp.*

Chromium is the key element distinguishing stainless from carbon steels. Principally due to its greater affinity for oxygen than iron, stainless steel requires different melting and steelmaking practices. In this presentation, basics of the Fe-Cr-C-O-X system are discussed. Application is made with particular emphasis on melting in the EAF, including slag foaming. The role of the phase diagram in eutectic versus peritectic solidification and in determining solid-state microstructure of stainless steels, such as described by the Schaeffler De Long diagram in welding, is also briefly explored.

10:10 a.m.

Break

10:20 a.m.

### **ON THE CHEMISTRY OF SPECIALTY STEELMAKING (CONT'D)**

*David Kundrat, SGL Carbon Corp.*

Noon

Lunch

1 p.m.

### **REFRACTORIES AND SLAGS FOR QUALITY SPECIALTY STEEL PRODUCTION**

*Jim Conrad, Fedmet Refractories*

2 p.m.

Break

2:15 p.m.

### **LIME IN QUALITY SPECIALTY STEEL PRODUCTION**

*Larry Wolfe, Carmeuse Lime and Stone Inc.*

High-quality lime is essential to the primary specialty steelmaking furnace and critical to secondary metallurgical refining of specialty steels. An overview of how lime is produced, what impacts the production of quality lime and key quality parameters of lime for steelmaking are discussed. The importance of lime in slag chemistry for the electric furnace and secondary refining in the AOD and ladle furnace, with the influence on the quality of the final steel product, is presented.

3 p.m.

Break



3:15 p.m.

### **REFINING OF SPECIALTY STEELS**

*Allen Chan, Praxair Inc.*

This presentation covers decarburization, degassing and desulfurization of specialty steels, along with a brief overview of the various refining processes, equipment and operations.

4 p.m.

Break

4:15 p.m.

### **REFINING OF SPECIALTY STEELS (CONT'D)**

*Allen Chan, Praxair Inc.*

**FRIDAY**

**8 FEBRUARY 2013**

7 a.m.

Continental Breakfast

## **EAF TRACK**

8 a.m.

### **GRAPHITE ELECTRODE MANUFACTURE AND USE**

*Jerry Castleman, Showa Denko Carbon Inc.*

A description of the equipment and raw materials used in the manufacture of graphite electrodes and their use will be discussed.

9 a.m.

Break

9:15 a.m.

### **SCRAP IN THE NEW MILLENNIUM**

*Ray Turner, River Metals Recycling LLC*

What is generally considered to be the least known component of steelmaking? Scrap. What constitutes more than 50% of the cost of steelmaking? Scrap. This presentation focuses on the advantages/disadvantages of different scrap grades and their performance characteristics in the modern EAF.

10:15 a.m.

Break

10:30 a.m.

### **BENCHMARKING THE MODERN MELTSHOP**

*Wayne Adams, GrafTech International Holdings Inc.*

This presentation will focus on providing insight into achieving maximum efficiency in an EAF. Industry statistics showing productivity and power inputs will be presented. There will also be displays showing time utilization, heats per day, tons per hour, and electrode and energy consumption. Comparisons will be made between worldwide geographic regions and various types of furnace. The presentation will finish with some key steps for continuous improvement.

## **SPECIALTY STEEL TRACK**

8 a.m.

### **STEELMAKING IN STEEL FOUNDRIES**

*Raymond Monroe, Steel Founders' Society of America*

Steel foundries cast around 1 million tons of steel a year to produce specialty custom steel products. They use much smaller equipment and melt a wider range of alloys than most steelmaking operations. This presentation will be an overview of some of the special techniques and issues in steelmaking for steel casting production.

9 a.m.

Break

9:15 a.m.

### **INTRODUCTION TO CASTING OF SPECIALTY STEELS AND ALLOYS**

*Mark Suer, Special Metals Corp.*

This presentation will first focus on the effect of alloy chemistry on the solidification behavior of Fe-Cr-Ni alloys and how this relates to the established practices of continuous casting of stainless steels. The layout of a typical continuous caster will be reviewed. In addition, a brief overview of ingot casting will be given, and the practical aspects of bottom pouring will be discussed.

10:15 a.m.

Break

10:30 a.m.

### **INTRODUCTION TO CASTING OF SPECIALTY STEELS AND ALLOYS (CONT'D)**

*Mark Suer, Special Metals Corp.*

Noon

Conference Adjourn

