

# RUTH ENGEL

121 Olde Farm Road  
Oxford, OH 45056  
+1.513.378.0190

[ruthengel@refractoryexpert.com](mailto:ruthengel@refractoryexpert.com)  
[www.refractoryexpert.com](http://www.refractoryexpert.com)

---

## EXPERIENCE

### CONSULTANT/ CONTRACTOR

2006 – present

- Analyzed refractory issues, recommended changes to lining design and materials for use in furnace for dental implants
- Developed strategies for ensuring reliability of a copper melting furnace, analyzed its failures and determined expected physical properties
- Worked and developed methodology for refractory selection for solar Si production
- Inspected blast furnace stoves and recommended approaches for keeping them operational
- Determined reasons for refractory failure at secondary aluminum melting/holding furnaces and made recommendations for better refractories and operation
- Retained as a refractory expert witness for plaintiffs and defendants in actions involving steelmaking, iron foundries, glass production, aluminum melters, boilers, power producers and others
- Expert for insurance companies to analyze refractory failure(s) and comment on repair recommendations: for kilns, glass, iron foundries, boilers, other.
- Determined the root cause for the failure of a refractory component used in a tile kiln
- Carried out refractory failure analysis of coreless, channel and vacuum induction furnaces used to melt and/or hold iron, copper, silicon, aluminum, alloys, etc.
- Developed long and short-term refractory recommendations and process changes for customers to improve life of steel ladles, degassers, etc.
- Carried out failure analysis of used refractories and recommended material changes and quality control procedures
- Analyzed reason for excessive refractory wear of glass tank, recommended changes in installation procedure and operation.
- Carried out quality audits in the steel melting, rolling and finishing areas to prepare for ISO/TS 16949:2002 recertification effort
- Determined reason for coke oven refractory failures, through petrography and special tests
- Conducted training seminars on refractory and steelmaking topics at customer locations
- Developed multi step refractory improvement plan covering refractory selection, maintenance, tracking, and process changes for a steel melt shop
- Recommended refractory changes for submerged arc furnace for better and more reliable life
- Worked for a specialty steel melt shop on refractory selection, analyzed production/process data and combined it with a systematic approach for refractory trial evaluations to improve life.

### REFRACTORY COMPANY

2004-2005

#### **SR. APPLICATIONS SPECIALIST**

***Development and Support of Brick Market for the production of carbon and stainless steels  
Customer Support: Electric Arc Fce. – Ladle Met. Fce. Practice Analysis***

- Recommended EAF slag, oxygen and carbon injection modifications to customers for more efficient melting, better refractory life and more consistent LMF operation

## **STEEL COMPANY**

**1979-2003**

### ***Selected Refractory projects:***

- Carried out failure analysis, recommended changes and wrote standard practice for refractory installation in torpedo cars, for Ti refining furnaces, etc.
- Modified induction furnace linings for melting Zn and Al
- Determined reasons for catastrophic failure of lining of 5 month old thin slab walking beam furnace, interfaced with turnkey vendor to obtain approval of a new lining design, refractory quality, and installation procedure, and supervised its installation
- Recommended and selected the refractory systems for the conversion of 3 pusher to walking beam furnaces, assessed failure mechanism and designed installation procedure
- Analyzed blast furnace trough failure mechanisms
- Developed refractory systems for use in a specialty steels horizontal caster
- Determined required ladle sand characteristics for consistent free opens
- Designed refractory linings for reheat and other finishing end furnaces

Additional areas:

***Developed steps to improve AOD electrical steel, Cr and CrNi refining practices***

***Modified EAF practices for more compatible slag chemistries and shorter heat times***

## **AWARDS**

### **35 Year Life Member AIST**

Write up published April 2019 in Iron and Steel Technology

2019

### **Armco Research Technical Achievement Award**

for "Improvements to the AOD Refining Process", with W. Beltz and L. Evans

1997

### **ISS Electric Furnace Conference**

Honorable Mention for Best Paper in the Melt Shop Refractories Session

1991

## **LANGUAGES**

Fluent in spoken German and Spanish.

## **EDUCATION**

***BSc. and Masters in Geology***, University of Michigan

## PUBLICATIONS

"Refractory Challenges in Furnaces", Glass International, February 2019

"Anti-oxidant Additions to Refractories: Roles and Effects", The Refractories Engineer, May 2016

"Metals: Roles and Effects", Am. Ceram. Soc. St. Louis Section/Refractory Ceramics Division, 52<sup>st</sup> Annual Symposium, 2016

"Refractory Considerations", Aluminium International Today, V 27, # 3, May/June 2015

"Refractory Considerations for Aluminum Melting and Holding Furnaces", The Refractories Engineer, Jan. 2015

"Magnesia-Carbon Brick: a Retrospective", The Refractories Engineer, July 2013

"Changes in Raw Materials – History Repeats Itself", Refractory Applications and News, V 15, No.5, p. 6, 2010

"Chrome Bearing Refractories: Is there a Future?", The Refractories Engineer, p. 19, May 2010

"Spinel and Refractories", Refractory Applications and News, V 15, No.3, p. 9, 2010

"It's a Refractory Failure", Refractory Applications and News, V 15, No.2, p. 5, 2010

"Silica Refractory: Something Old that is New", Refractory Applications and News, V 14, No.6, p. 19, 2009

"Lining Design Considerations", Refractory Applications and News, V 14, No.2, p. 17, 2009

"Insulation: Friend or Foe", Refractory Applications and News, V 13, No.2, p. 7, 2008

"Resolution of Clogging at Armco Mansfield Slab Caster", Electric Fce. Conf. Proc, V 56, p. 553, 1998, with A. McKague, M. Suer, D. Wolf, M. Garbowsky and L. Reed.

Published a Keeping Current Series in the Iron and Steelmaking Bulletin based on the Ladles and Ladle Furnace Slags 1996, short course with U. Pretorius and R. Marr

"Ladle Sands: Testing and Application", Electric Fce. Conf. Proc., V. 48, p. 451, 1990, with F. S. Cox.

"Use of Design of Experiments to Improve the Performance of Degasser Nozzle Refractories", UNITECR Proceedings, p. 708, 1989, with K. McKeever.

"Armco's Experimental 184 Mile Hot Metal Shipment", Ironmaking Conf. Proc., p. 3, 1988, with J. Niedringhaus, J. Blattner

"Microstructural Characterization of Commercial Hot Pressed Boron Nitride", Adv. Cer. Mat., V. 3, No. 5, p. 452, 1988, with J. H. Steele.

"Non-Destructive Testing of Boron Nitride", *Ceramic Transactions*, V. 4, Advances in Refractories Technology, p. 595, 1988.

"Refractories for the Steel Industry - A Diagnosis and Prognosis", Fall Meeting of the Refractories Division of the Am. Cer. Soc., Oct. 1986, with R. Shultz, R. Breneman, B. Baker

"Laboratory Testing of Boron Nitride Break Rings", *Electric Fce. Conf. Proc.*, V. 43, p. 329, 1985.

"Evaluation of Zircon Brick for Ladle Slag Lines", *Cer. Soc. Bull.*, V. 63, p. 880, 1984, with B. Brezny.

"On the Laboratory Testing of Insulating Fiber Products", *Interceram Special Issue*, V. 31, 1982, with P. Schroth and F. S. Cox.

"A New 5C Pyrrhotite", *Am. Min.*, Nov.-Dec., 1978, with W. Kelly, D. Peacor.

### **PRESENTATIONS**

"The Elkem Furnace, a Submerged Arc Furnace Used for Copper", AIST Refractory Committee, Febr. 2020

"Refractories: Yesterday's Challenges / Today's Opportunities", AK Steel Research, 2018

"Glass Furnaces: Refractory Challenges", *Am. Ceram. Soc. St. Louis Section/Refractory Ceramics Division*, 54th annual symposium, 2018

"Microscopy of Steel Mill Refractories", *Micrs. Soc. Ohio River Valley Spring Meeting*, April 2016

"Antioxidants: Role and Effect or what we call metal additions", *Am. Ceram. Soc. St. Louis Section/Refractory Ceramics Division*, 52st annual symposium, 2016

"Failure Analysis", *Missouri Univ. of S&T, Materials Science & Engr.*, Refractory Seminar, 2009

"Ladle Sands: Testing and Application", *ISS Electric Fce. Conf.*, 1990

"Laboratory Testing of Boron Nitride Break Rings", *ISS Electric Fce. Conf.*, 1985

"Evaluation of Zircon Brick for Ladle Slag Lines", *Am. Cer. Soc. Fall Meeting*, 1983

### **TRAINING SEMINARS**

- Presented refractory, slag and process training seminars to management, professional and hourly personnel addressing site specific topics or for ISO requirements at: Armco/AKSteel and other steel companies and, refractory manufacturers in the US and other countries (1980 to present).

- Invited presenter: Ladle Refractory and Secondary Steelmaking training seminar, AIST Specialty Conf.: San Antonio, TX, Oct. 14-17, 2019, Charleston, SC, Oct. 22-25, 2018, Milwaukee, WI, Oct. 23-26, 2017, Birmingham, AL, Oct. 11-13, 2016, Memphis, TN Oct. 5-8, 2015, Indianapolis, IN, Oct. 6-8, 2014, Charleston, SC, Sept. 30-Oct. 2, 2013
- Invited presenter: Refractory and Slags, Modern Electric Fce. Steelmaking – A Practical Training Seminar: Specialty Steelmaking break-out section, AIST Specialty Conf., Charleston, SC, Febr. 6-10, 2012, Pittsburgh, PA, Oct. 19-22, 2009
- Chair and presenter: Ladle Refractory Training Seminar, AIST Specialty Conf.: Oct. 2-3, 2012, Jacksonville, FL, Oct. 25-26, 2011, Merrillville, IN, Oct. 12-13, 2010, Birmingham, AL, March 1-2, 2010
- Invited lecturer, “Failure Analysis”, Missouri Univ. of S&T, Refractory Seminar, 2009
- Invited presenter: Refractory section of the Stainless Steelmaking and Casting Training Seminar, AIST Specialty Conf., Cleveland, OH, Oct. 21-23, 2007
- Quality trainer for replacement workers during a strike (2006 and 2007)
- Organizer and presenter: Ladle Refractories and Slags at the ISS Chicago Section Meeting, Merrillville, IN, with U. Pretorius and R. Marr; Jan. 1996 and Jan. 1995, and at the ISS Off the Record meeting in Pittsburgh, PA, Nov. 1995.
- Presenter Armco Mansfield Works start up training courses for meltshop, caster and masonry personnel, 1994
- Organizer and presenter: Refractories for Reheat Furnaces, Globetrotters Meeting, St. Charles, Illinois, Sept. 1991
- Organizer and presenter: Melt Shop Refractories, at the Off the Record Meeting, King of Prussia, Pennsylvania, Oct. 1990, with B. Brezny

### **PROFESSIONAL ACTIVITY HIGHLIGHTS**

<b>MEMBER AIST*<sup>1</sup> LADLE AND SECONDARY REFINING TECHNOLOGY COMMITTEE</b> Past education Chair	2007 - Pr.
<b>MEMBER AIST*<sup>1</sup> REFRACTORY TECHNOLOGY COMMITTEE</b> Committee started in 2010	2010 - Pr.
<b>MEMBER AMERICAN CERAMIC SOCIETY ST. LOUIS SECTION</b>	2011 - Pr.
<b>Org. 1st refractory session at the ISS*<sup>1</sup> Electric Furnace Annual Meeting</b>	1986-2002
<b>MEMBER OF THE BOARD OF DIRECTORS OF THE ISS*<sup>1</sup></b>	1994-1996

<b>CHAIRMAN ELECTRIC FURNACE DIVISION OF THE ISS*<sup>1</sup></b>	1994
<b>MEMBER AMERICAN CONCRETE INSTITUTE</b> , Committee 547- Refractory Concrete Co-authored the castables and the plastics handbook	1985-1989
<b>MEMBER ASTM-C8</b> (refractories)	1982-1985
<b>MEMBER: AMERICAN CERAMIC SOCIETY REFR. DIV.</b>	1979 - Pr.

\*1 ISS and AISE merged in 2004 to became AIST