



INTERNATIONAL COURSE 2019

New Trends on the Use of Refractory Materials in the Iron and Steel Industry

Reactivity and Corrosion - Impact on Performances, Cleanliness and Metal Quality

14-15 May 2019 | Instituto Argentino de Siderurgia



Prof. Jacques Poirier
CEMHTI/CNRS - University of
Orléans, France

>ABOUT THE COURSE

Refractory materials have a strategic role for the production of pig iron and steel and improving their performance is a major challenge for steel industry.

- The direct refractories consumption cost and indirect cost (down-time cost) are very high
- The refractory products play a crucial role in guaranteeing the reliability of steel units and personnel safety
- They also have a direct influence on the quality of elaborate grades.
- Refractories must be selected according to the aggressive environment they will be exposed to.

This course reviews the impact of reactivity and corrosion on:

- the refractory performance
- the quality of metallurgical products.

It mentions all the important developments that limit the contribution of refractory products concerning wear, secondary metallurgical treatments, clogging phenomena, steel cleanliness in conjunction with efforts of the metallurgists to produce high quality steel.

The new trends on the use of refractories in the Iron and Steel Industry will be presented and discussed.

>PROFESSOR

Prof. Jacques Poirier: He received a M.Sc. degree in Material Science, INSA, 1980 and subsequently a Ph.D. degree from the University of Orleans in 1983. His research activities are the corrosion of refractory materials by gases, metals and liquid oxides at high temperature, evolution of mineral phases and glasses at high temperature, applications of the thermodynamic calculations to refractories design, development of better-adapted refractory materials for specific applications (steel making, none ferrous metallurgy, cement, incineration, biomass gasification and new energies). He has published over 130 articles in journals and given more than 250 oral presentations. J. Poirier has co-authored 10 books. He has 15 patents and has graduated 22 Ph.D. students. He serves on the Executive of the "Groupe Français de la Céramique" and he is a member of the Federation for International Refractories Research and Education (FIRE).

>REGISTRATION:

Early bird until April 15:

- IAS Member USD 700
- Non-Member USD 800

Registration after April 15:

- IAS Member USD 800
- Non-Member USD 900

THE COURSE INCLUDES: simultaneous translation, course handouts, lunches, coffee breaks, welcome breakfast.

REGISTER HERE

COURSE PROGRAM

Introduction and context

- Issues of refractory performances
- Degradation factors in pig iron and steel making
- Characteristics and durability of refractories

Corrosion of refractories: the fundamentals

- Thermodynamics
- Wetting and infiltration, kinetics
- Mechanisms of transport and corrosion, Marangoni effect
- Slag structure and basicity, viscosity
- Refractory corrosion applications and study of industrial cases

Reactions by liquid and gas, the key factors of corrosion

- Corrosion by liquid phases: direct and indirect dissolution, carbothermic reaction, oxido-reduction reaction, complex reactions with new compounds, dissociation, ...
- Corrosion by gas: reduction, oxidation, volatilization or dissociation under vacuum, condensation of corrosive vapors (Na, K, F, Zn, S, Cl), Boudouard reaction
- Steel making industrial examples

Thermal, chemical and mechanical coupling

- Stress/strain induced by chemical reactions, phase changes, structural spalling ...
- Impact on the design of refractory lining
- Steel making industrial examples

Tools to study corrosion

- Testing methods for corrosion
- Traditional and advanced characterization methods
- Post-mortem analysis, sampling on industrial sites

Impact of operating conditions on refractory lining wear – ways to minimize corrosion damage

- Adjusting the thermal cycle and the thermal gradient of the refractory lining
- Composition adjustment of the penetrant fluid (slag)
- Reducing the reactivity by changing the wetting characteristics
- Select well adapted refractories (raw materials, matrix, less porous and less permeable microstructure)
- Limit the penetration of the liquids into the refractory porosity by new precipitated solids that clog the pores
- Use of glazing or coating

Impact of refractory materials on inclusionary Cleanliness and steel quality

- Interactions of refractories and steel during the processes of secondary metallurgy
- Metallurgical consequences: control of oxide cleanliness, steel desulphurization, Ca treatments of deoxidation inclusions, elaboration of ultra-low carbon steels,
- Interactions of refractory materials and steel during continuous casting
- Metallurgical consequences: clogging, hydrogen pick-up, re-oxidation of the metal, control and prevention of non-metallic inclusions

Case studies considering different applications in ironmaking and in steelmaking

- Blast furnace
- BOF, EAF
- Vacuum degasser
- Steel ladle
- Continuous casting

Quality Assurance

- refractory quality control
- non-destructive testing
- customer service

New trends of refractory materials in the iron and steel industry

- Raw materials and design of new refractories
- Design optimization of linings regarding thermomechanical behaviour
- Simulations: computational fluid dynamic (CFD), thermomechanical modelling by finite elements, thermochemical software
- Energy savings
- Robotic solutions, maintenance methods, technology integration
- Recycling of refractories, health and safety

Conclusion