

## 5-Day Cement Industry Training Course In

### PYRO PROCESS TECHNOLOGY (SITE VISIT)

Cairo - Egypt, 17 – 21 Aug. 2026

#### COURSE LEVEL: INTERMEDIATE

#### COURSE OVERVIEW:

Pyro process technology is the high-temperature heart of cement manufacturing, where raw meal undergoes the critical chemical transformation into clinker. This course defines the thermodynamic and chemical principles of the preheater, calciner, and rotary kiln systems that define modern production. It provides an in-depth exploration of the complex interactions between heat transfer, gas flow, and material chemistry.

The scope of this training involves the technical operation of multi-stage preheaters and the efficiency of the clinker cooler. It covers the combustion chemistry of traditional and alternative fuels, the management of the sintering zone, and the physics of heat recovery. Furthermore, the course addresses the environmental impacts of the pyro process, focusing on the mitigation of Nitrogen Oxides (NOx), Sulfur Oxides (SOx), and Carbon Dioxide (CO<sub>2</sub>) emissions.

Coverage includes a comprehensive site visit to the kiln tower and burner floor, allowing participants to observe the equipment in operation. Attendees will explore the mechanical components of the rotary kiln, the logic of burner adjustment, and the troubleshooting of preheater blockages. Through the study of the "thermal balance," participants will gain the analytical skills to optimize energy consumption and maximize the operational life of refractory linings.

#### COURSE OBJECTIVES:

After completion of this course, the participants will be able to:

- Describe the function of each stage in the multi-stage preheater tower.
- Understand the chemical reactions of calcination and clinkerization.
- Optimize the burner flame for efficient heat transfer and clinker quality.
- Analyze the kiln's thermal balance and specific heat consumption.
- Identify the causes of preheater blockages and implement recovery plans.
- Evaluate the efficiency of the clinker cooler and heat recovery systems.
- Manage the use of alternative fuels in the calciner and main burner.
- Monitor and control NOx and SOx emissions through process tuning.
- Inspect and maintain the kiln's mechanical seals and drives.
- Understand the role of refractory materials in protecting the kiln shell.
- Troubleshoot "kiln rings" and "snowmen" formations in the cooler.
- Correlate gas analyzer data with combustion and process stability.

**TARGET AUDIENCE:**

This course is intended for Kiln Operators, Process Engineers, Production Supervisors, and Maintenance Professionals working in the pyro-processing department.

**TRAINING COURSE METHODOLOGY:**

A highly interactive combination of lectures, discussion sessions, and case studies will be employed to maximize the transfer of information, knowledge, and experience. The course will be intensive, practical, and highly interactive. The sessions will start by raising the most relevant questions and motivating everybody to find the right answers. The attendants will also be encouraged to raise more of their questions and to share in developing the right answers using their analysis and experience. There will also be some indoor experiential activities to enhance the learning experience. Course material will be provided in PowerPoint, with necessary animations, learning videos, and general discussions.

The course participants shall be evaluated before, during, and at the end of the course.

**COURSE CERTIFICATE:**

National Consultant Centre for Training LLC (NCC) will issue an Attendance Certificate to all participants completing a minimum of 80% of the total attendance time requirement.

**COURSE OUTLINE / COURSE CONTENT:****MODULE 1: THE PREHEATER TOWER AND CYCLONE TECHNOLOGY**

- Principles of gas-solid heat exchange in cyclones.
- Design and function of the riser ducts and splash plates.
- Managing pressure drops and gas velocities in the tower.
- Troubleshooting material bypass and dust circulation.
- Role of the ID fan in maintaining preheater draft.

**MODULE 2: CALCINATION AND THE PRE-CALCINER SYSTEM**

- Chemical kinetics of the decarbonization reaction.
- Types of calciner designs: ILC (In-Line) vs. SLC (Separate-Line).
- Fuel dosing and combustion in the calciner environment.
- Managing tertiary air and its impact on calcination levels.
- Optimizing the degree of calcination before kiln entry.

**MODULE 3: THE ROTARY KILN: MECHANICAL AND THERMAL DESIGN**

- Components of the kiln: Shell, tires, rollers, and drive.
- Understanding kiln slope, rotation speed, and material residence time.
- The sintering zone: Forming the clinker mineral phases.
- Mechanical health: Monitoring shell temperature and "red spots."
- Refractory zones: Selection and installation of bricks and castables.

**MODULE 4: BURNER TECHNOLOGY AND COMBUSTION**

- Design of multi-channel burners for coal, oil, and gas.
- Adjusting primary air, axial air, and radial air for flame shaping.
- The chemistry of combustion and excess air management.
- Impact of flame temperature on clinker mineralogy and NO<sub>x</sub>.
- Alternative fuel injection and its effect on flame stability.

#### **MODULE 5: THE CLINKER COOLER AND HEAT RECOVERY**

- Principles of grate cooling technology: Reciprocating vs. Cross-bar.
- Managing the cooler bed depth and under-grate pressure.
- Heat recovery: Secondary and Tertiary air functions.
- Troubleshooting cooler "red rivers" and clinker "snowmen."
- Clinker crusher (breaker) operation and maintenance.

#### **MODULE 6: PYRO PROCESS EMISSIONS AND ENVIRONMENT**

- Monitoring of NO<sub>x</sub>, SO<sub>x</sub>, CO, and dust at the stack.
- Strategies for NO<sub>x</sub> reduction: SNCR and Low-NO<sub>x</sub> burners.
- Managing volatile cycles: Alkalies, Chlorides, and Sulfates.
- Role of the bypass system in removing process bypass dust.
- Energy efficiency and the carbon footprint of the pyro process.

#### **MODULE 7: THERMAL BALANCE AND ENERGY OPTIMIZATION**

- Calculating the heat balance: Inputs vs. Losses.
- Specific heat consumption (kcal/kg clinker) benchmarks.
- Reducing radiation losses and "false air" ingress.
- Impact of alternative fuels on the kiln's thermal profile.
- Waste Heat Recovery (WHR) system integration.

#### **MODULE 8: PROCESS INSTRUMENTATION AND CONTROL (SITE VISIT)**

- Operation of gas analyzers: Oxygen, CO, and NO<sub>x</sub> probes.
- High-temperature cameras for kiln and cooler monitoring.
- Infrared shell scanners: Interpreting temperature maps.
- Pressure and temperature sensors in the preheater tower.
- Managing the "Central Control Room" operator interface.

#### **MODULE 9: TROUBLESHOOTING PYRO PROCESS UPSETS**

- Recovering from preheater blockages and "meal flushes."
- Handling kiln "rings" and "balls" through process adjustment.
- Managing emergency shutdowns and rapid restarts.
- Troubleshooting erratic kiln torque and motor amperage.
- Root cause analysis of refractory failure and shell damage.

#### **MODULE 10: MAINTENANCE AND OPERATIONAL EXCELLENCE**

- Daily inspection checklists for the kiln and preheater.
- Preventive maintenance of lubrication and hydraulic systems.
- Strategic planning for kiln shutdowns and overhauls.



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YOUR GATE TO HANDS-ON TRAINING

- Collaboration between process and maintenance teams.
- Course wrap-up, site visit review, and final assessment.