5-Day Cement Industry Training Course
In

CLINKER RING FORMATION

Dubai - UAE, 07 – 11 Sep. 2026

COURSE LEVEL: ADVANCED

COURSE OVERVIEW:

Clinker ring formation is one of the most significant operational challenges in cement production, often leading to reduced kiln capacity and unplanned shutdowns. This course defines the chemical and thermal mechanisms that cause material to adhere to the kiln's refractory lining, forming restrictive rings. By understanding the root causes of these build-ups, participants will learn how to stabilize the kiln environment and prevent the onset of ring growth.

The scope of this training covers the various types of rings, including sintering zone rings, coal ash rings, and "mid-kiln" or "mud" rings. It explores the role of volatile cycles—specifically sulfur, chlorine, and alkalis—in creating the "sticky" liquid phase that initiates adhesion. Furthermore, the course addresses the impact of burner alignment, fuel quality, and raw mix consistency on the internal geometry of the kiln and the subsequent formation of obstructions.

Coverage includes advanced detection methods, such as kiln shell scanners and internal pressure monitoring, to identify ring formation at an early stage. Participants will learn practical removal techniques, ranging from thermal "shooting" and chemical adjustments to mechanical removal during shutdowns. By the end of this program, attendees will be equipped with the diagnostic tools and operational strategies necessary to maintain a clear kiln profile and ensure continuous, high-volume clinker production.

COURSE OBJECTIVES:

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

- Identify the different types of kiln rings and their typical locations.
- Explain the chemical role of sulfur and chlorine in ring initiation.
- Analyze the impact of raw meal "burnability" on clinker adhesion.
- Evaluate the influence of secondary fuel ash on ring formation.
- Use kiln shell scanners to detect and monitor ring growth in real-time.
- Adjust burner flame shape and intensity to prevent localized overheating.
- Understand the "snowball" effect and its relationship to ring development.
- Implement chemical "shocks" and raw mix adjustments to melt existing rings.
- Describe the mechanical risks of rings on kiln drive torque and tires.
- Perform a root cause analysis (RCA) on chronic ring formation issues.
- Design a preventive operational strategy based on volatile balance.
- Execute safe procedures for the manual removal of rings during a shutdown.

TARGET AUDIENCE:

This course is intended for Kiln Operators, Process Engineers, Production Managers, and Refractory Specialists.

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: TYPES AND CHARACTERISTICS OF KILN RINGS

- Definition of clinker rings and their impact on gas flow.
- Sintering zone rings vs. calcining zone rings.
- Identifying "ash rings" caused by low-grade coal.
- The phenomenon of "mud rings" in the kiln inlet.
- Impact of rings on kiln shell temperature and mechanical stress.

MODULE 2: CHEMICAL TRIGGERS: THE VOLATILE CYCLES

- The behavior of sulfur, chlorine, and alkalis in the kiln.
- Formation of low-melting-point eutectic salts.
- How the "liquid phase" percentage influences ring adhesion.
- Calculating the "Alkali-Sulfur Ratio" to predict ring risk.
- Impact of phosphorus and other trace elements on stickiness.

MODULE 3: RAW MIX AND FUEL IMPACTS

- Effect of raw meal fineness and homogenization on coating stability.
- Influence of the "Silica Modulus" on clinker ring formation.
- Coal quality: ash content, fusion temperature, and moisture.
- Impact of alternative fuels (RDF/Tires) on the internal kiln chemistry.
- Managing the "Sulfur Spurrite" formation in the preheater.

MODULE 4: THERMAL DYNAMICS AND BURNER CONTROL

- The relationship between flame length and heat distribution.
- Preventing "over-burning" and excessive liquid phase.
- Impact of secondary and tertiary air temperatures on the burning zone.
- Adjusting the burner pipe position to shift the coating zone.
- Thermography: interpreting shell scanner data for ring detection.

MODULE 5: MECHANICAL AND OPERATIONAL CONSEQUENCES

- Monitoring kiln motor torque as an indicator of internal obstructions.
- Impact of rings on the "Filling Degree" and material residence time.
- Vibration and mechanical stress on kiln tires and rollers.
- The effect of rings on the ID fan load and kiln pressure.
- Managing "dust cycles" and their contribution to build-ups.

MODULE 6: DETECTION AND DIAGNOSTIC TOOLS

- Interpreting "cold spots" and "hot spots" on the kiln shell.
- Using internal cameras and pyrometers to view ring growth.
- Analyzing kiln exit gas for clues on volatile recirculations.
- Pressure drop analysis across the kiln and preheater.
- Laboratory analysis of ring samples (XRD/XRF).

MODULE 7: PREVENTIVE OPERATIONAL STRATEGIES

- Implementing a "Kiln Shell Cooling" program.
- Establishing stable raw mix set-points for "Easy Burnability."
- Strategies for managing sulfur-rich fuels.
- The use of chemical additives to prevent build-ups.
- Training operators on early warning signs of ring growth.

MODULE 8: REMOVAL TECHNIQUES: THERMAL AND CHEMICAL

- The "Thermal Shock" method: cooling and heating the kiln.
- Adjusting the "LSF" (Lime Saturation Factor) to loosen rings.
- Using chemical "bombs" or industrial shotguns for ring removal.
- Managing the "surge" of material after a ring falls.
- Risks of damaging the refractory during aggressive removal.

MODULE 9: MECHANICAL REMOVAL AND SHUTDOWN PROCEDURES

- Planning for a mechanical ring removal during a stop.
- Safety protocols for entry: cooling time and gas testing.
- Tools for removal: hydro-demolition and pneumatic hammers.
- Inspecting the refractory lining after ring removal.
- Coordinating with the maintenance team for a quick turnaround.

MODULE 10: BYPASS SYSTEMS AND VOLATILE CONTROL

- The role of the Chlorine Bypass in preventing rings.
- Operation and maintenance of bypass quenching chambers.

- Impact of bypass dust removal on the overall volatile balance.
- Economic considerations of bypass operations.
- Troubleshooting bypass blockages.

MODULE 11: CASE STUDIES IN RING MANAGEMENT

- Review of chronic ring formation in a global cement plant.
- Analysis of "Snowman" formation in the clinker cooler.
- Solving mud ring issues in wet and semi-dry processes.
- Success stories in using AI for kiln coating optimization.
- Group exercise: developing a ring-mitigation plan.

MODULE 12: COURSE CONCLUSION AND FINAL ASSESSMENT

- Summary of the chemical and mechanical drivers of rings.
- Final knowledge test on detection and removal.
- Discussion on the future of "Anti-Coating" refractory materials.
- Course feedback and closing remarks.