5-Day Cement Industry Training Course
In

GRINDING TECHNOLOGY AND PROCESS OPTIMISATION

Abu Dhabi - UAE, 22 – 26 June 2026

COURSE LEVEL: ADVANCED

COURSE OVERVIEW:

Process optimization in the grinding department is a sophisticated discipline that balances mechanical capacity, energy efficiency, and product quality. This course defines the advanced technical parameters required to achieve the highest possible throughput while minimizing the environmental and financial cost per ton. By focusing on the "Total System" approach, participants will learn how to synchronize every component of the grinding circuit—from the weigh-feeder to the final silo.

The scope of this training includes the application of mathematical modeling for particle size distribution, the implementation of advanced process control (APC), and the technical management of high-capacity milling systems. It covers the optimization of "staged" grinding (e.g., Roller Press followed by a Ball Mill) and the use of supplementary cementitious materials (SCMs). Furthermore, the course addresses the "Chemical-Mechanical" interaction, ensuring that the grinding process enhances the physical properties of the final cement.

Coverage includes detailed modules on "Tromp Curve" analysis, the optimization of mill ventilation for heat and moisture management, and the use of "Digital Twins" for process simulation. Through advanced troubleshooting workshops, participants will learn to resolve complex process instabilities such as "Vibration Surges" and "Separator Inefficiency." Attendees will gain the strategic expertise required to lead large-scale optimization projects and to ensure that the grinding department remains a center of operational excellence.

COURSE OBJECTIVES:

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

- Design an optimized "Grinding Circuit" for specific material types.
- Utilize "Particle Size Distribution" (PSD) models to improve cement quality.
- Optimize the "Roller Press" and "V-Separator" for pre-grinding.
- Manage the interaction between "Chemical Additives" and "Mill Fineness."
- Implement "Advanced Process Control" (APC) for autonomous mill operation.
- Analyze "Circulating Loads" to maximize circuit capacity.
- Conduct a "Mass and Heat Balance" for the entire milling system.
- Optimize the "Separator Rotor Speed" based on real-time quality data.
- Minimize the "Energy-to-Blaine" ratio through process tuning.
- Troubleshoot "Mechanical-Process" conflicts in high-capacity mills.

- Develop "Standard Operating Procedures" (SOP) for optimized grinding.
- Lead a "Root Cause Analysis" (RCA) for chronic milling inefficiencies.

TARGET AUDIENCE:

This course is intended for Process Engineers, Production Managers, Senior Control Room Operators, and Technical Consultants.

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 SCIENCE OF PARTICLE SIZE DISTRIBUTION (PSD)

- Beyond "Blaine": Understanding the "Rosin-Rammler" distribution.
- Impact of the "Steepness" of the PSD on cement strength.
- Managing the "Water Demand" of cement through PSD control.
- Relationship between "Residue on 45 microns" and hydraulic reactivity.
- Using "Laser Diffraction" for real-time PSD monitoring.

MODULE 2: PRE-GRINDING TECHNOLOGY AND OPTIMIZATION

- Operation and optimization of the "Roller Press" (HPGR).
- Managing the "V-Separator" and its impact on the final mill.
- Benefits of "Partial" vs. "Full" pre-grinding circuits.
- Troubleshooting "Material Bypassing" and "Cake Formation."
- Specific power savings associated with pre-grinding stages.

MODULE 3: ADVANCED SEPARATOR AND CLASSIFIER CONTROL

- In-depth analysis of the "Tromp Curve": Bypass, Sharpness, and Cut-point.
- Impact of "Stray Air" on classification efficiency.
- Adjusting the "Internal Vanes" and "Rotor Clearance" for optimization.
- Correlating "Air Flow" and "Rotor Speed" for optimal fineness.

- Case studies: Resolving "High Residue" issues in modern separators.

MODULE 4: MILL VENTILATION AND PROCESS DYNAMICS

- Optimizing the "Gas-to-Material" ratio in the mill.
- Impact of "Pressure Drop" across the mill on material transport.
- Managing the "Inlet and Outlet Seals" to prevent energy loss.
- Role of the "Main Mill Fan" in stabilizing process flow.
- Optimizing "Dust Load" in the separator air circuit.

MODULE 5: HEAT MANAGEMENT AND GYPSUM DEHYDRATION

- Controlling the "Mill Exit Temperature" for optimal cement setting.
- Physics of "Gypsum to Bassanite" transformation.
- Calculating the "Cooling Water" requirements for high-output mills.
- Impact of "False Air" on the mill's thermal balance.
- Managing "Internal Grinding Temperature" through process tuning.

MODULE 6: PROCESS STABILIZATION AND CONTROL LOOPS

- Tuning the "Weigh-Feeder" to "Mill Load" control loop.
- Using "Electronic Ear" and "Torque" for multi-parameter control.
- Implementing "Fineness-based" feedback control for separators.
- Managing "Material Surges" in the return circuit.
- Role of "DCS Interlocks" in maintaining process safety.

MODULE 7: ADVANCED PROCESS CONTROL (APC) AND AI

- Introduction to "Model Predictive Control" (MPC) for mills.
- Benefits of "Autonomous" grinding: Consistency and energy.
- Using "Artificial Intelligence" to predict "Mill Vibrations."
- Integrating "Expert Systems" for real-time decision making.
- Managing "Quality Target" transitions through automation.

MODULE 8: SUPPLEMENTARY CEMENTITIOUS MATERIALS (SCM) OPTIMIZATION

- Grinding "Multi-Component" cements (Slag, Fly Ash, Limestone).
- Managing the different "Grindability" of SCMs in the same mill.
- Impact of SCM "Fineness" on the final "Clinker Factor."
- Chemical and mechanical interaction of SCMs during grinding.
- Optimizing the "Dosing Accuracy" for blended cement quality.

MODULE 9: TROUBLESHOOTING COMPLEX PROCESS ISSUES

- Root cause analysis of "Mill Vibrations" in VRMs.
- Resolving "Separator Plugging" and "Material Build-up."
- Managing "Quality Deviations" during "Raw Material" changes.
- Troubleshooting "High Specific Power" without production loss.
- Case study: Recovering a mill from a "Full Loading" event.

MODULE 10: WEAR AND MECHANICAL-PROCESS INTERFACE

- Impact of "Liner Profile" on the "Grinding Curve."
- Monitoring "Roller and Table" wear to maintain throughput.
- Relationship between "Hydraulic Pressure" and "Wear Rate."
- Optimizing "Media Re-charging" based on process data.
- Managing "Diaphragm Wear" and its impact on material flow.

MODULE 11: DESIGN AND COMMISSIONING OF GRINDING SYSTEMS

- Key considerations for mill "Sizing" and "Selection."
- Principles of "Mass Balance" for new project designs.
- Benchmarking and "Performance Guarantee" testing.
- Commissioning protocols for high-capacity grinding circuits.
- Future trends: "Horomill" and "Centrifugal" grinding technology.

MODULE 12: STRATEGIC OPTIMIZATION PROJECT WORKSHOP

- Final exam on advanced grinding and optimization.
- Group exercise: Developing an optimization plan for a "Bottlenecked" mill.
- Presenting "Return on Investment" (ROI) cases for upgrades.
- Course summary and feedback.