Comminution & Crushing Systems Training Course

Professional Development Training Course Outline

Category	General Training	**Duration**	5 Days
Base Fee	$1,500 USD	**Delivery Mode**	Online / On-site Hybrid

Course Introduction

The modern mineral processing landscape demands unprecedented levels of volumetric throughput under stringent economic and environmental constraints. Comminution and crushing systems represent the operational core of mineral extraction, dictating both downstream metallurgical liberation efficiency and global plant power budgets. Consequently, optimization of these initial size-reduction stages through advanced technical training is no longer optional; it is a foundational prerequisite for ensuring operational survival, protecting high-value downstream processes, and maximizing asset utilization across the entire circuit.

Comminution & Crushing Systems Training Course is dedsigned to bridge the gap between historical empirical comminution practices and modern, automated process engineering frameworks. Integrating state-of-the-art diagnostic paradigms including real-time discrete element method (DEM) modeling, variable-speed drive configurations, and predictive liner wear tracking this curriculum equips professionals to design, operate, and continuously optimize complex crushing and milling loops. Participants will learn to balance the mechanical realities of heavy crushing assets with the strategic goals of maximum mineral liberation, minimal specific energy consumption, and long-term decarbonization.

Programme Curriculum

Comminution & Crushing Systems Training Course

Introduction

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Course Duration

5 days

Course Objectives

- Deconstruct Comminution Circuits.
- Optimize Specific Energy Consumption
- Master Advanced Asset Diagnostics
- Predict Mechanical Liner Wear
- Execute Dynamic Crusher Cavity Tuning.
- Integrate Next-Generation Technologies
- Architect Smart Closed-Loop Controls
- Mitigate Tramp Metal Damage
- Enhance Operational Plant Safety
- Perform Rigorous Particle Size Analysis (PSA)
- Minimize Environmental and Carbon Footprints
- Troubleshoot Complex Structural Failures
- Formulate Data-Driven Capital Expenditure (CAPEX) Strategies

Target Audience

- Mineral Processing and Metallurgical Engineers
- Crushing Plant Operations Supervisors
- Reliability and Asset Maintenance Engineers
- Process Control and Automation Specialists
- Mining Engineering and Quarry Managers
- Capital Equipment Procurement Directors
- EH&S Compliance Officers
- Technical Consultants and Process Auditors

Course Modules

Module 1: Fundamentals of Rock Mechanics and Comminution Theory

- Analysis of rock compressive strengths, tensile limits, and geological fracture propagation mechanics.
- Practical mathematical applications of Bond, Kick, and Rittinger size-reduction energy equations.
- Characterization of ore variability using JK Drop-Weight tests and Bond Work Index validation.
- Mechanisms of size reduction: isolating impact, compression, attrition, and shear forces within active zones.

- Correlating mineralogical grain liberation profiles directly to downstream gold, copper, and iron recovery metrics.
- *Case Study:* Resolving an unexplained 15% recovery drop at a major copper operation by tracing mineral locked-in textures back to an incorrect tertiary crush target size.

Module 2: Primary Crushing Systems

- Mechanical comparison of heavy-duty double-toggle jaw crushers versus ultra-high-capacity primary gyratory crushers.
- Operational management of spider-arm wear, eccentric bush clearances, and mainshaft hydraulic step adjustments.
- Strategies for managing feed bin bridging, eliminating rock-box chokage, and optimizing dump-pocket feeding dynamics.
- Lubrication system parameters: monitoring oil viscosity, micro-filtration levels, temperature differentials, and moisture ingress.
- Automated hydraulic tramp-relief system responses during uncrushable alloy ingress events.
- *Case Study:* Root-cause failure analysis of a primary gyratory mainshaft fracture caused by prolonged operation with uncalibrated hydraulic relief valves.

Module 3: Secondary and Tertiary Reduction

- Kinematics of cone crushing
- High-Pressure Grinding Rolls (HPGR) engineering: Managing inter-particle compression, micro-fracturing, and edge-effect product recycling.
- Vertical Shaft Impactors (VSI) applications in producing highly cubical aggregate geometries and manufactured sand.
- Evaluating choke-feeding vs. regulated trickle-feeding on mantle wear profiles and fine particle generation.
- Assessing structural differences between traditional spring-loaded cone crushers and modern multi-cylinder hydraulic systems.
- *Case Study:* Upgrading a gold plant circuit from conventional cone crushers to an HPGR system, yielding a 22% reduction in total specific energy consumption.

Module 4: Screening, Sizing, and Classification Circuits

- Mechanics of industrial screening
- Evaluating modern screen media selection
- Diagnosing and mitigating common screening inefficiencies
- Hydrocyclone classification physics
- Quantifying circuit circulating loads and evaluating separation sharp index curves
- *Case Study:* Resolving a severe tailing loss issue by replacing blinded wire-mesh screens with modular polyurethane panels, stabilizing the recirculating load by 35%.

Module 5: Conveying, Feeding, and Material Handling Logistics

- Design and optimization of heavy-duty apron feeders, vibratory pan feeders, and belt feeders under high hopper heads.
- High-capacity overland belt conveyor engineering
- Advanced dust suppression and collection systems
- Wear liner optimization inside transfer chutes using high-chromium white irons and ceramic-matrix composites.

- Implementing inline conveyor instrumentation: Belt scales, cross-belt elemental analyzers, and optical fragmentation sizing cameras.
- *Case Study:* Eliminating structural chute tearing and downtime at an iron ore port facility by redesigning impact zones with rock-box ledges and ceramic liners.

Module 6: Circuit Automation, Digitalization, and Advanced Process Control (APC)

- Deploying smart instrumentation
- Designing feedback and feedforward Proportional-Integral-Derivative (PID) loops for automated variable-speed feeder controls.
- Implementing Expert Systems and Artificial Intelligence (AI) models to navigate fluctuating ore hardness profiles autonomously.
- Real-time integration of Discrete Element Method (DEM) simulation data into active plant supervisory networks.
- Developing and interpreting SCADA dashboards for early warning signs of system overloading and imminent thermal trips.
- *Case Study:* Implementing an AI-driven Advanced Process Control system on a tertiary crushing loop, increasing overall circuit volumetric throughput by 8.5% without expanding capital footprint.

Module 7: Asset Reliability, Predictive Maintenance, and Liners

- Designing and executing non-destructive testing (NDT) programs for eccentric shafts, pits, and mainframe castings.
- Oil analysis diagnostics
- Selecting optimized liner alloys
- Developing standardized procedures for safe mantle changes, backing-compound pouring, and jaw die rotations.
- Vibration analysis signature mapping
- *Case Study:* Shifting a copper concentrator from reactive maintenance to a predictive liner-wear scheduling program, extending production window lengths by 14 operational days annually.

Module 8: Sustainable Operations, Decarbonization, and Safety Engineering

- Analyzing the carbon reduction benefits of modern coarse particle recovery (CPR) and pre-sorting comminution flowsheets.
- Energy demand management
- Rigorous safety protocols for high-energy operations
- Designing noise mitigation structures, acoustic enclosures, and vibration-isolation foundation springs for urban-adjacent quarries.
- Managing operational water loops
- *Case Study:* Redesigning an aggregate plant's water injection system to lower water consumption by 40% while safely achieving strict dust mitigation metrics.

Training Methodology

- Interactive lectures and presentations.
- Group discussions and brainstorming sessions.
- Hands-on exercises using real-world datasets.
- Role-playing and scenario-based simulations.
- Analysis of case studies to bridge theory and practice.

- Peer-to-peer learning and networking.
- Expert-led Q&A sessions.
- Continuous feedback and personalized guidance.

Register as a group from 3 participants for a Discount

Send us an email: info@fineskilltrainingcenter.org or call *+254769199797*

Certification

Upon successful completion of this training, participants will be issued with a globally- recognized certificate.

Tailor-Made Course

We also offer tailor-made courses based on your needs.

Key Notes

a. The participant must be conversant with English.

b. Upon completion of training the participant will be issued with an Authorized Training Certificate

c. Course duration is flexible and the contents can be modified to fit any number of days.

d. The course fee includes facilitation training materials, 2 coffee breaks, buffet lunch and A Certificate upon successful completion of Training.

e. One-year post-training support Consultation and Coaching provided after the course.

f. Payment should be done at least a week before commence of the training, to Fineskill Training Center account, as indicated in the invoice so as to enable us prepare better for you.

Upcoming Scheduled Sessions

Start Date	End Date	Location	Price
07 Sep 2026	11 Sep 2026	Online	$1,000
07 Sep 2026	11 Sep 2026	Physical	$1,500
14 Sep 2026	18 Sep 2026	Online	$1,000
14 Sep 2026	18 Sep 2026	Physical	$1,500
21 Sep 2026	25 Sep 2026	Online	$1,000
21 Sep 2026	25 Sep 2026	Physical	$1,500

Start Date	End Date	Location	Price
28 Sep 2026	02 Oct 2026	Online	$1,000
28 Sep 2026	02 Oct 2026	Physical	$1,500

Ready to enroll or request a customized program? Book online or contact us:

Register Online Now

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