



Mineral Processing and Extractive Metallurgy

Course: Comminution, Flotation and Leaching



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Introduction:

Mineral processing and extractive metallurgy, covering comminution, flotation and leaching, is the subject of this 10-day course for plant metallurgists, process engineers and shift supervisors, who build a circuit optimisation and metallurgical balance plan for a case concentrator. Phosphate, gold and copper plants often lose recovery and throughput through poorly tuned mills, flotation reagent regimes and leach circuits, while unreconciled mass balances hide where value escapes. Nominees already operate or support processing circuits, and teaching is by modelling build on plant survey data. CoreConcept Training Center delivers this mineral processing course.

Course Objectives:

- Characterise an ore using mineralogy, liberation and grindability data to predict how it will behave in the plant
- Set and adjust crushing, SAG and ball milling and hydrocyclone classification parameters to meet a target grind size
- Operate froth flotation and gravity circuits by selecting reagents, cell conditions and rougher, cleaner and scavenger arrangements
- Run cyanide and acid leaching, carbon adsorption and heap leach circuits to target extraction and reagent consumption
- Control thickening, filtration and tailings dewatering to recover process water and produce stable deposits
- Build a reconciled metallurgical balance and use it to prioritise circuit optimisation actions

Target Audience:

- Plant metallurgists responsible for recovery, grade and reagent performance in concentrators
 - Process engineers who model, survey and debottleneck crushing, milling and separation circuits
 - Shift supervisors accountable for day-to-day throughput and stability of processing plants
 - Hydrometallurgy operations staff running leach, adsorption and elution sections
 - Metallurgical accounting staff who prepare production and recovery reports
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Course Outline:

Day 1: Ore Characterisation and Process Mineralogy Foundations

- Process Mineralogy Review Using Automated Mineral Analysis Data
- Liberation and Locking Assessment From Particle Size Fractions
- Grindability Testwork Interpretation for Crushing and Milling Design
- Phosphate, Gold and Copper Ore Type Flowsheet Comparison
- Geometallurgical Domain Mapping for Plant Feed Variability

Day 2: Crushing, SAG and Ball Milling Circuits

- Jaw, Gyratory and Cone Crusher Closed Side Setting
- SAG Mill Load, Speed and Ball Charge Control
- Ball Mill Circulating Load Calculation and Media Selection
- Specific Energy Consumption Analysis Using Work Index Methods
- High Pressure Grinding Rolls Option Screening for Hard Ores

Day 3: Classification and Froth Flotation Practice

- Hydrocyclone Cut Size and Partition Curve Adjustment
- Vibrating Screen Efficiency Checks in Closed Grinding Circuits
- Xanthate Collector, Frother and Depressant Dosing Regimes
- Rougher, Cleaner and Scavenger Flotation Bank Arrangement
- Fatty Acid Flotation of Phosphate Rock and Gangue Rejection

Day 4: Gravity Concentration, Leaching and Carbon Adsorption

- Centrifugal Concentrator and Spiral Gravity Recovery Circuits
- Cyanide Leach Kinetics, pH and Dissolved Oxygen Control
- Carbon in Pulp and Carbon in Leach Adsorption Profiles
- Elution, Electrowinning and Carbon Regeneration Kiln Operation
- Heap Leach Pad Irrigation and Acid Leaching of Copper Oxides

Day 5: Guided Case Study on a Copper-Gold Concentrator

- Case Plant Survey Data Sampling and Sizing Review
 - Case Grinding Circuit Bottleneck Diagnosis From Survey Results
 - Case Flotation Recovery Loss Analysis by Size Fraction
 - Case Leach Circuit Cyanide Consumption Investigation
 - Week One Findings Register for the Case Concentrator
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Day 6: Specialised Separation and Hydrometallurgical Routes

- Flotation Column and Jameson Cell Application for Fines
- Pressure Oxidation and Bio-Oxidation of Refractory Gold Ores
- Solvent Extraction and Electrowinning of Copper Leach Solutions
- Magnetic and Electrostatic Separation of Heavy Mineral Products
- Phosphate Beneficiation by Calcination and Desliming Circuits

Day 7: Dewatering, Tailings and Process Quality Control

- High Rate and Paste Thickener Flocculant Dosing Control
- Pressure and Vacuum Filter Cake Moisture Optimisation
- Tailings Dewatering Options From Thickened to Filtered Stack
- Cyanide Destruction and Process Water Recycle Quality Checks
- On-Stream Analyser Calibration and Plant Sampling Protocol Design

Day 8: Metallurgical Accounting and Plant Communication

- Two-Product Formula Recovery and Grade Calculation Practice
- Mass Balance Data Reconciliation Using Least Squares Adjustment
- Mine-to-Mill Reconciliation of Tonnes, Grade and Metal
- Shift Handover Reports for Grind, Recovery and Reagent Use
- Metallurgical Performance Briefing for Mining and Maintenance Teams

Day 9: Process Control, KPIs and Circuit Benchmarking

- Advanced Process Control Strategy for Mills and Flotation
- Plant KPI Dashboard for Throughput, Recovery and Availability
- Reagent and Grinding Media Cost per Tonne Benchmarking
- Plant Trial Design and Statistical Evaluation of Changes
- Energy Efficiency Improvement Roadmap for Comminution Circuits

Day 10: Modelling Build of the Circuit Optimisation and Metallurgical Balance Plan

- Reconciled Mass Balance Build for a Case Concentrator
 - Grinding and Classification Improvement Options From Day Two Methods
 - Flotation and Leach Recovery Gain Estimates From Earlier Analyses
 - Dewatering and Water Recovery Actions in the Plan
 - Circuit Optimisation and Metallurgical Balance Plan Presentation
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Skills You Will Gain:

- Process Mineralogy Interpretation
- Grinding Circuit Optimisation
- Hydrocyclone Classification Tuning
- Flotation Reagent Management
- Leach and Adsorption Circuit Control
- Thickening and Filtration Control
- Metallurgical Accounting
- Plant Survey Analysis

Why Attend This Course:

- Deliver a Circuit Optimisation and Metallurgical Balance Plan to the plant manager and the processing superintendent
- Decide which grinding, flotation or leach change to trial first based on a reconciled balance
- Avoid recovery losses, excess reagent use and filter or thickener upsets that cut plant output
- Coach operators and junior metallurgists on survey sampling, reagent control and balance reporting

Conclusion:

Back at work, the participant presents the Circuit Optimisation and Metallurgical Balance Plan to the plant manager, processing superintendent and maintenance leads, who use it to select the grinding, flotation, leach and dewatering trials to fund first. Metallurgical accounting staff adopt the reconciled balance method for monthly reporting. After the first plant trial, the processing team should compare actual recovery, throughput and reagent use with the plan estimates, then update the balance model and the next trial priorities.

Frequently Asked Questions FAQ:

What should participants know before a mineral processing and extractive metallurgy course?

Participants should already operate, supervise or support a processing plant and be comfortable with basic chemistry and spreadsheet calculations. Bringing anonymised survey, assay or production data from their own plant helps during the modelling build.

How does this mineral processing and extractive metallurgy course differ from a mining overview course?

It teaches hands-on control of crushing, milling, classification, flotation, leaching and dewatering circuits and metallurgical balances. A mining overview course explains the mine life cycle and business decisions without operating any process unit.

Why does grind size matter so much in mineral processing and extractive metallurgy?

Grind size sets mineral liberation, which limits flotation and leach recovery. Grinding too coarse leaves valuable minerals locked, while grinding too fine wastes energy and creates slimes that harm flotation, thickening and filtration.

What do participants take back from the mineral processing and extractive metallurgy course?

Participants take back a Circuit Optimisation and Metallurgical Balance Plan, a reconciled mass balance template, survey analysis worksheets and a prioritised list of plant trials for grinding, flotation, leaching and dewatering.