Circular Economy in Mineral Processing 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

Circular Economy in Mineral Processing Training Course is strategically engineered to bridge the gap between conventional extractive metallurgy and sustainable, closed-loop resource management. By integrating advanced clean technologies, tailings valorization, and industrial symbiosis, this curriculum empowers industry professionals to transform environmental liabilities into high-value economic assets. Participants will master the frameworks required to minimize ecological footprints while maximizing resource efficiency and corporate resilience.

Navigating the complexities of modern mineral processing requires a sophisticated understanding of sustainable materials management, life cycle assessments (LCA), and eco-design principles. This course dives deep into cutting-edge innovations such as urban mining, bio-hydrometallurgy, and critical raw material (CRM) recovery from waste streams. Through a blend of rigorous theoretical insights and real-world industrial applications, attendees will learn to optimize processing plants for reduced water and energy consumption, implement zero-waste methodologies, and drive ESG (Environmental, Social, and Governance) compliance. Ultimately, this training serves as a catalyst for systemic change, positioning organizations to thrive in a circular, low-carbon economy.

Programme Curriculum

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5 Days

Course Objectives

1. Architect Closed-Loop Systems.
2. Execute Tailings Valorization.
3. Optimize Critical Raw Material (CRM) Recovery.
4. Implement Eco-Design Frameworks.
5. Conduct Lifecycle Assessments (LCA.
6. Drive Industrial Symbiosis
7. Deploy Clean Technologies.
8. Master Sustainable Water Management.
9. Navigate ESG and Regulatory Compliance.
10. Leverage Digital Twins and Industry 4.0.
11. Advance Urban Mining Initiatives.
12. Mitigate Scope 1, 2, and 3 Emissions.
13. Build Circular Business Cases

Target Audience

- Mineral Processing Engineers & Metallurgists.
- Sustainability Directors & ESG Managers
- Mine Operations Managers & Plant Superintendents
- R&D Scientists & Innovation Leaders
- Environmental Engineers & Regulatory Compliance Officers.
- Mining Executives & Strategy Consultants
- Investment Analysts & Green Fund Managers
- Government Regulators & Policy Makers

Course Modules

Module 1: Foundations of Circular Economy in Metallurgy

- Transitioning from linear economies to closed-loop metallurgical systems.
- Core pillars of sustainable materials management and resource conservation.
- Regulatory landscapes: Global green deals, circular economy directives, and ESG mandates.
- Decarbonization pathways and carbon accounting basics for mineral processing plants.

- Introduction to eco-design and design-for-recycling principles in mining infrastructure.
- **Case Study:** *The European Union's Critical Raw Materials Act: How major miners reshaped flowsheets to align with circularity targets.*

Module 2: Tailings Management and Valorization Strategies

- Characterization of mine tailings, slags, and residues as secondary resources.
- Reprocessing legacy tailings for the recovery of residual and companion metals.
- Transforming mineral waste into geopolymers, construction aggregates, and green cement.
- Advanced techniques for acid mine drainage (AMD) prevention through desulfurization.
- Economic and risk evaluation of dry stacking versus paste tailings for circular operations.
- **Case Study:** *The Newmont Goldcorp Tailings Reclamation Project: Turning historic mining waste into commercial-grade construction material.*

Module 3: Critical Raw Material (CRM) & Secondary Recovery

- Identifying and mapping CRM streams within existing extractive waste.
- Advanced hydrometallurgical and bio-leaching techniques for low-grade waste processing.
- Processing e-waste, spent catalysts, and industrial by-products.
- Thermodynamic and kinetic limitations of extracting metals from complex secondary matrices.
- Flowsheet optimization for the co-recovery of rare earth elements (REEs) from phosphorus and bauxite residues.
- **Case Study:** *BHP's investment in secondary copper recovery from legacy waste dumps utilizing specialized bio-hydrometallurgy.*

Module 4: Sustainable Water and Reagent Management

- Implementing Zero Liquid Discharge (ZLD) frameworks in high-volume processing plants.
- Advanced water treatment technologies
- Biodegradable and non-toxic flotation reagents.
- Regenerative reagent cycles
- Water footprinting and auditing methodologies for remote and arid mining operations.
- **Case Study:** *Anglo American's "Waterless Mine" Initiative: Achieving 90% water recycling rates in hyper-arid processing zones.*

Module 5: Energy Efficiency and Decarbonization in Comminution

- Optimizing crushing and grinding circuits.
- Implementing high-pressure grinding rolls and stirred mills for energy reduction.
- Renewable energy integration into thermal metallurgical processes.
- Waste heat recovery systems in smelting and roasting operations.
- Electrification of processing equipment and the reduction of Scope 1 and 2 emissions.
- **Case Study:** *The LKAB Kiruna Electrification Project: Transitioning iron ore pelletizing processes from fossil fuels to bio-fuels and green hydrogen.*

Module 6: Industrial Symbiosis and Cross-Sector Collaboration

- Mapping regional industrial clusters to exchange waste, energy, and water inputs.
- Using metallurgical slags as neutralizing agents in chemical industries or agricultural soils.
- Co-processing municipal and industrial plastic wastes as reducing agents in blast furnaces.
- Developing collaborative business contracts and risk-sharing models for waste exchange.

- Logistics, supply chain transparency, and tracking frameworks for shared resources.
- **Case Study:** *The Kalundborg Symbiosis Model: How a metallurgical hub created a closed-loop network across 11 industrial partners.*

Module 7: Urban Mining and Battery Recycling Loops

- The mechanics of the "Black Mass" processing.
- Hydrometallurgical refining of spent lithium-ion batteries for battery-grade cathode precursors.
- Pyrometallurgical processing of e-waste for precious metal recovery.
- Handling feedstock variability and hazardous materials in urban refineries.
- Integrating recycled battery metals back into primary manufacturing supply chains.
- **Case Study:** *Umicore's Ultra-High Temperature (UHT) Smelting Technology: Closing the loop on automotive lithium-ion battery recycling at scale.*

Module 8: Industry 4.0 and Digital Material Passports

- Deploying IoT sensors and online analyzers for real-time mass and energy balancing.
- Utilizing machine learning and AI to predict and optimize recovery rates from highly variable feedstocks.
- Blockchain technology for tracking mineral provenance, chain of custody, and carbon footprints.
- Implementing Digital Product Passports (DPP) for transparent life cycle tracking of mineral products.
- Building digital twins of circular mineral processing plants to simulate complex recycle loops.
- **Case Study:** *Rio Tinto's Smart Mine Deployments: Utilizing AI-driven digital twins to track and optimize iron ore quality and tailing generation in real-time.*

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
23 Nov 2026	27 Nov 2026	Online	$1,000
23 Nov 2026	27 Nov 2026	Physical	$1,500
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$4,500
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$6,000

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