Hydrometallurgy & Refining of Precious Metals

Course general description:

The refining of precious metals is a cornerstone of modern industry, supporting sectors ranging from electronics to jewelry and catalysis. This 5-day course delves into the cutting-edge technologies and methodologies in hydrometallurgical processing and refining of gold, silver, and Platinum Group Metals (PGMs). Participants will explore advanced leaching techniques, purification processes, and refining methods while addressing sustainability through circular economy principles. By adhering to global standards like the London Bullion Market Association (LBMA) and environmental regulations, this course equips participants with the skills to design closed-loop systems that maximize recovery while minimizing environmental impact.

Audience:

This course is designed for:

- Metallurgists and process engineers specializing in hydrometallurgy.
- Managers and operators in precious metals refining plants.
- Environmental specialists focused on sustainable mining practices.
- Researchers and academics studying precious metal extraction and recycling.
- E-waste recyclers and catalyst recovery professionals

Course objectives:

Upon completion of this course, participants will be able to:

- Understand and apply advanced leaching technologies such as bioleaching, pressure oxidation (POX), and thiosulfate leaching for refractory ores.
- Master purification techniques including solvent extraction (SX), ion exchange, and carbon-in-pulp (CIP) for gold and silver recovery.
- Gain expertise in refining processes like electrorefining, smelting, and producing 99.99% pure bullion.
- Learn how to recover precious metals from e-waste and spent catalysts within a circular economy framework.
- Ensure compliance with LBMA standards and environmental regulations such as the Cyanide Code and mercury management protocols.
- Design sustainable, closed-loop systems for efficient and environmentally responsible extraction and refining

Course duration:

5 days

Course location:

Cairo-Dubai-Istanbul

Course contents:

Day 1: Leaching Technologies for Precious Metals

1. Introduction to Hydrometallurgy – Principles, bioleaching mechanisms, industrial applications, and challenges in refractory ores.
2. Alternative Leaching Methods – Pressure oxidation (POX) chemistry, equipment, and case studies; thiosulfate leaching advantages over cyanidation.
3. Process Comparison – Evaluating leaching techniques for different ore types and optimizing their selection.
4. Case Study & Simulation – POX implementation for sulfide gold ores; HSC Chemistry modeling of thiosulfate leaching.
5. Assessment – Quiz on bioleaching, POX parameters, and process selection.

Day 2: Purification Techniques – Solvent Extraction & Ion Exchange

1. Solvent Extraction (SX) Fundamentals – Chemistry, process flow, extractant selection, and circuit optimization.
2. Ion Exchange Principles – Applications in precious metals recovery, resin selection, and regeneration strategies.
3. Integrated Purification Processes – Combining SX and ion exchange for efficient metal recovery.
4. Case Study & Hands-on Training – Copper removal via SX in gold processing; METSIM simulation of an SX circuit.
5. Assessment – Quiz on extractant properties, resin performance, and circuit design.

Day 3: Carbon-in-Pulp (CIP) & Gold/Silver Recovery

1. CIP Process Overview – Adsorption kinetics, carbon activity, elution, and regeneration of activated carbon.
2. Silver Recovery Challenges – Cyanidation vs. alternative methods; simultaneous gold and silver extraction.
3. Technological Innovations – Advancements in CIP technology for improved efficiency and recovery rates.
4. Case Study & Practical Exercise – Optimizing a CIP circuit for higher gold recovery; analyzing carbon adsorption data.
5. Assessment – Quiz on CIP process variables and factors affecting efficiency.

Day 4: Refining Processes – Electrorefining & Smelting

1. Electrorefining Basics – Principles, cell design, operational parameters, and high-purity gold/silver production.
2. Smelting Process – Furnace types, dore production, further refining steps, and emerging trends.
3. High-Purity Metal Production – LBMA certification requirements and PGM recovery from anode slime.
4. Case Study & Process Modeling – High-purity gold production for certification; HSC Chemistry modeling of electrorefining.
5. Assessment – Quiz on refining process control, purity standards, and product quality optimization.

Day 5: Circular Economy & Final Assessment

1. Precious Metal Recycling – E-waste recovery, spent catalyst processing, and economic considerations.
2. Sustainability & Compliance – LBMA standards, assaying, cyanide code, mercury management, and environmental regulations.
3. Designing Closed-Loop Systems – Sustainable refining approaches for minimizing waste and maximizing recovery.
4. Final Discussion & Strategic Planning – Group activity on designing a closed-loop recycling system.
5. Final Assessment & Wrap-Up – Written test, feedback session, and certification distribution.

Methodology:

- 50% lectures & concepts
- 10% Videos
- 15% Case studies
- 15% Exercises
- 10% Discussions

Course code: (TPRS040)