

Electrochemical Engineering and Process Applications Training Course

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Overview

Electrochemical Engineering and Process Applications Training Course is a one-week intermediate course for engineering and laboratory teams who leave with an Electrochemical Process Evaluation and Scale-Up Plan. Participants connect electrochemical cell thermodynamics, electrode kinetics and polarization, mass transport, electrochemical measurement methods, industrial electrolysis, electrodeposition, corrosion control, energy conversion, treatment processes, scale-up, safety, and troubleshooting. Agile Leaders Training Center delivers this course on electrochemical engineering applications.

Who Should Attend

- Teams responsible for evaluating electrochemical cells and process feasibility
- Functions responsible for materials, corrosion, coatings, and surface treatment
- Groups responsible for laboratory measurements and electrochemical data interpretation
- Engineering teams responsible for electrolysis, treatment, energy, and production systems
- Technical specialists responsible for scale-up, safety, monitoring, and troubleshooting

The course assumes participants can interpret engineering data and basic chemical calculations, and it leaves out live hazardous experiments, proprietary cell design, and detailed power-electronics design.

Departments and Industries

The course supports electrochemical process decisions across research, production, maintenance, and technical-assurance environments.

- Chemical, process, materials, corrosion, and production engineering
- Metals, coatings, mining, refining, and specialty chemicals
- Water treatment, environmental services, and industrial utilities
- Batteries, fuel cells, hydrogen, and energy systems
- Laboratories, research, reliability, and technical services

Learning Objectives

By the end of this course, participants will be able to:

- Analyze electrochemical cell thermodynamics and electrode potentials
- Apply electrode kinetics, polarization, and mass-transport methods
- Use cyclic voltammetry and impedance concepts to interpret behavior
- Compare industrial electrochemical process applications
- Evaluate scale-up, safety, monitoring, and control constraints
- Diagnose electrochemical process performance and failure evidence

Course Agenda

Day 1: Establish Cell Thermodynamics

- Oxidation-Reduction Half-Reaction and Cell-Notation Map
- Electrode Potential, Reference Electrode, and Measurement Checklist
- Nernst Equation, Activity, Concentration, and Equilibrium Worksheet
- Faraday Law, Charge, Current Efficiency, and Material-Balance Sheet
- Electrochemical Cell Thermodynamics Evidence Register

Day 2: Analyze Kinetics and Transport

- Electrode-Solution Interface and Double-Layer Model
- Butler-Volmer Current-Potential Relationship Worksheet
- Tafel Polarization and Exchange-Current Analysis Method
- Diffusion, Migration, Convection, and Limiting-Current Map
- Electrode Kinetics and Mass-Transport Diagnostic Matrix

Day 3: Interpret Electrochemical Measurements

- Three-Electrode Cell, Potentiostat, and Connection Verification Sheet
- Cyclic Voltammetry Peak and Scan-Rate Interpretation Method
- Chronoamperometry Transient and Charge-Response Review
- Electrochemical Impedance Spectrum and Equivalent-Circuit Concept Map
- Experimental Design, Repeatability, Noise, and Data-Quality Checklist

Day 4: Evaluate Industrial Applications

- Electrolysis, Current Distribution, Energy Demand, and Efficiency Model
- Electrodeposition, Coating Thickness, Adhesion, and Quality-Control Plan
- Corrosion Polarization, Protection, and Monitoring Decision Tree
- Battery, Fuel-Cell, and Hydrogen Conversion Comparison Matrix
- Water Treatment, Resource Recovery, and Process-Selection Framework

Day 5: Practice Process Scale-Up

- Suggested Exercise: Calculate Cell Voltage, Charge, and Material Conversion
- Suggested Exercise: Diagnose Polarization and Mass-Transport Limitations
- Suggested Exercise: Interpret Voltammetry and Impedance Evidence
- Suggested Exercise: Compare Scale-Up, Safety, Control, and Troubleshooting Options
- Capstone Exercise: Complete the Electrochemical Process Evaluation and Scale-Up Plan

Practical Exercises

The course uses suggested activities to connect electrochemical evidence with controlled engineering decisions.

- Suggested activity: reconcile cell reactions, potentials, charge, current efficiency, and material conversion
- Suggested activity: separate kinetic, ohmic, and mass-transport limitations from polarization evidence
- Suggested activity: interpret cyclic-voltammetry and impedance patterns against data-quality checks
- Suggested activity: screen an industrial application for scale-up, safety, monitoring, control, and troubleshooting needs

FAQs

Who suits electrochemical engineering applications training, and what does it assume?

Electrochemical engineering applications training suits chemical, process, materials, corrosion, energy, and laboratory teams. It assumes familiarity with engineering data, chemical calculations, and controlled technical work.

How does electrochemical engineering differ from a battery technology course?

Electrochemical engineering connects thermodynamics, kinetics, transport, measurement, electrolysis, deposition, corrosion, treatment, and energy conversion. Battery technology focuses on cell chemistries, packs, management, testing, and lifecycle performance.

How are electrode kinetics and polarization analyzed?

Electrode kinetics and polarization are analyzed through current-potential behavior, exchange current, Tafel relationships, reaction mechanisms, ohmic effects, mass transport, limiting current, and controlled comparison with operating evidence.

What do cyclic voltammetry and impedance measurements show?

Cyclic voltammetry and impedance measurements indicate reaction behavior, transport effects, time-dependent response, interfacial properties, resistance, capacitance, and changes that require validation against cell configuration and data quality.

How is an electrochemical process prepared for scale-up?

Electrochemical process scale-up compares electrode area, current distribution, transport, heat, materials, energy demand, product quality, control, safety, maintenance, waste, economics, and verification evidence.

Conclusion

Participants take back an Electrochemical Process Evaluation and Scale-Up Plan containing cell assumptions, kinetic and transport evidence, measurement findings, application screening, safety constraints, controls, and validation actions. The plan connects laboratory observations with process decisions. It supports traceable coordination across engineering, production, maintenance, and technical teams.

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