CONCEPT

Ionic Liquids and Green Solvents: Deep Eutectics, Solvent Substitution and Techno-Economics

6 – 10 December 2026
Dammam - Eastern Province five-star



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Ref: 864_20754 **Date:** 6 – 10 December 2026 **Location:** Dammam - Eastern Province five-star **Fees:** 19500 SAR

Introduction:

Ionic liquids and green solvents promise lower emissions and safer plants, yet many substitution projects stall because volatile organic solvents are swapped on intuition, viscosity and cost surprise the pilot team, and toxicity or recycle losses appear only after scale-up. This Core Concept course gives process chemists and engineers a quantitative route from atom economy, E-factor and process mass intensity through ionic liquid and deep eutectic solvent design, supercritical CO2 and bio-based alternatives to recovery, recycle and life-cycle cost. Participants produce a Solvent Substitution and Techno-Economic Screening Report for a case process.

Course Objectives:

- Quantify the greenness of a synthesis or separation route using atom economy, E-factor, process mass intensity and reaction mass efficiency
- Rank candidate replacement solvents with solvent selection guide criteria covering health, safety, environmental and physical property scores
- Select ionic liquid cation and anion pairs or deep eutectic hydrogen bond donor and acceptor pairs to meet a target solubility, viscosity and stability window
- Evaluate ionic liquid, deep eutectic, supercritical CO2 and bio-based solvent options for extraction, gas absorption, biphasic catalysis, electrolyte and biomass duties
- Design solvent recovery and recycle loops and estimate make-up losses, ecotoxicity exposure and life-cycle burdens of each option
- Build a solvent substitution and techno-economic screening model that compares capital, operating and solvent inventory cost for a case process

Target Audience:

- Process chemists who develop synthesis routes and choose reaction and work-up media
- Chemical engineers who size extraction, absorption and solvent regeneration equipment
- R&D scientists who screen novel solvent systems at bench and pilot scale
- Scale-up and technology transfer staff who move solvent processes from laboratory to plant
- Sustainability and process safety specialists who assess solvent hazards, emissions and waste streams
- Technical service staff who troubleshoot solvent losses, degradation and product contamination

Course Outline:

Day 1: Green Chemistry Principles, Mass Metrics and Solvent Burden

- Twelve Principles of Green Chemistry Applied to Solvent Use
- Atom Economy, E-Factor and Process Mass Intensity Calculations
- Reaction Mass Efficiency, Carbon Economy and EcoScale Scoring
- Solvent Share of Process Waste: Mass Balance Baseline of a Case Route
- Volatile Organic Solvent Hazard Profile: Flammability, Exposure and Emissions

Day 2: Solvent Selection Guides, Ionic Liquid Chemistry and Deep Eutectic Solvents

- Solvent Selection Guide Rankings: Health, Safety, Environment and Property Scores
- Ionic Liquid Cation Families: Imidazolium, Pyridinium, Pyrrolidinium, Ammonium and Phosphonium
- Anion Choice: Tetrafluoroborate, Hexafluorophosphate, Triflimide, Acetate and Halides
- Property Tuning: Vapour Pressure, Viscosity, Miscibility, Thermal and Electrochemical Windows
- Deep Eutectic Solvent Types and Choline Chloride Hydrogen Bond Donor Pairs

Day 3: Industrial Duties for Ionic Liquids and Alternative Green Media

- Liquid-Liquid Extraction and Metal Recovery with Hydrophobic Ionic Liquids
- Physical and Chemisorption Gas Absorption for CO2 and Acid Gas Removal
- Biphasic Catalysis and Ionic Liquid Acid Catalysts for Alkylation
- Ionic Liquid Electrolytes for Batteries, Supercapacitors and Electrodeposition
- Cellulose Dissolution, Lignin Fractionation and Biomass Pretreatment Routes

Day 4: Supercritical CO2, Bio-Based Solvents, Recovery and Life-Cycle Risk

- Supercritical CO2 Extraction and Reaction Media: Critical Point, Density and Pressure Cost
- Bio-Based Solvents: 2-MeTHF, Ethyl Lactate, D-Limonene and Cyrene
- Solvent Recovery by Distillation, Membrane, Antisolvent and Back-Extraction Methods
- Ionic Liquid Ecotoxicity, Biodegradability, Corrosion and Thermal Degradation Failures
- Cradle-to-Gate Life-Cycle Assessment of Solvent Manufacture and Recycle

Day 5: Solvent Substitution Modelling Build and Techno-Economic Screening Report

- Case Process Brief: Mass Balance and Current Solvent Performance Data
- Candidate Shortlist Matrix Scoring Ionic Liquid, Eutectic and Bio-Based Options
- Techno-Economic Model: Solvent Inventory, Make-Up Loss, Energy and Equipment Cost
- Sensitivity Analysis on Solvent Price, Recycle Rate and Viscosity Penalty
- Solvent Substitution and Techno-Economic Screening Report Presentation and Peer Challenge

Skills You Will Gain:

- Green Metrics Calculation
- Solvent Hazard Ranking
- Ionic Liquid Design
- Eutectic Solvent Formulation
- Solvent Recycle Loop Design
- Solvent Ecotoxicity Appraisal
- Solvent Life-Cycle Assessment
- Techno-Economic Screening

Why Attend This Course:

- Leave with a Solvent Substitution and Techno-Economic Screening Report for a case process, challenged by peers from other plants and laboratories
- Stop replacing solvents on intuition by backing each proposal with mass metrics, hazard scores and a costed recycle loop
- Spot the viscosity, toxicity, degradation and price traps that stall ionic liquid projects before pilot money is spent
- Compare solvent practice with chemists and engineers from petrochemical, pharmaceutical, metals, battery and biorefining operations

Conclusion:

Solvent substitution succeeds when greener chemistry is proved with numbers rather than labels. The week moves from green chemistry principles and mass metrics, through solvent selection guides, ionic liquid cation and anion design and deep eutectic solvents, to extraction, gas absorption, biphasic catalysis, electrolytes and biomass processing, then supercritical CO2, bio-based solvents, recovery loops, ecotoxicity and life-cycle assessment. The final day applies this in a modelling build and produces a Solvent Substitution and Techno-Economic Screening Report.