Industrial Crystallization: Crystalliser Design, Operation and Product Quality Control

6 – 10 September 2027
Dubai - Five-star CBD venue



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Ref: 516_16918 **Date:** 6 – 10 September 2027 **Location:** Dubai - Five-star CBD venue **Fees:** 19500 SAR

Introduction:

Industrial crystallization sets the purity, crystal size and filterability of salts, fertilisers, minerals and active pharmaceutical ingredients, yet many crystallisers suffer fines, encrustation, off-specification size and short run lengths because supersaturation is not managed. This Core Concept course gives process engineers and operators the solubility basis, nucleation and growth kinetics, equipment choices and control strategies needed to run and design crystallisers with predictable product quality. Each participant selects and sizes a crystalliser for a case duty and writes a Crystalliser Sizing, Control and Troubleshooting Plan.

Course Objectives:

- Construct solubility curves and phase diagrams and calculate supersaturation, metastable zone limits and crystalliser yield from mass and energy balances
- Estimate nucleation and growth rates and relate them to crystal size distribution using population balance and MSMPR concepts
- Select among cooling, evaporative, vacuum, forced circulation, DTB, Oslo and melt crystallisers and set seeding and scale-up criteria for a duty
- Diagnose encrustation, impurity effects and polymorphic form changes and set measures that extend run length and hold product specification
- Specify instrumentation and control strategies for supersaturation, cooling rate and fines removal and match crystal properties to centrifuge, filter and dryer needs
- Size a crystalliser for a defined duty and prepare its operating control and product quality troubleshooting plan

Target Audience:

- Process engineering staff responsible for crystalliser design, performance monitoring and debottlenecking
- Panel and field operating staff responsible for running evaporative, vacuum and cooling crystallisation units
- Technical service and production support staff responsible for crystal size, purity and caking complaints
- Process control and instrumentation staff responsible for crystalliser control loops and in-line analysers
- Process development staff responsible for scale-up and polymorph control of crystallisation steps
- Maintenance planning staff responsible for wash-out, descaling and crystalliser turnaround scope

Course Outline:

Day 1: Solubility, Supersaturation and Phase Diagram Foundations

- Solubility Curves, Van't Hoff Plots and Solvent Selection Data
- Supersaturation Measures: Concentration Difference, Ratio and Relative Supersaturation
- Metastable Zone Width Measurement and the LaMer Diagram
- Binary and Ternary Phase Diagrams for Salt, Hydrate and Double Salt Systems
- Crystalliser Mass and Energy Balance: Yield, Mother Liquor and Solvent Removal

Day 2: Nucleation, Growth Kinetics and Crystal Size Distribution

- Primary Homogeneous and Heterogeneous Nucleation Mechanisms
- Secondary Nucleation From Crystal-Impeller and Crystal-Crystal Contact
- Crystal Growth Rate Models: Diffusion and Surface Integration Steps
- Crystal Size Distribution Metrics: Mean Size, Coefficient of Variation and Sieve Analysis
- Population Balance and the MSMPR Model at Overview Level

Day 3: Crystalliser Types, Equipment Selection, Seeding and Scale-Up

- Batch and Continuous Cooling Crystallisers With Jacketed and External Coolers
- Evaporative and Vacuum Flash Crystallisers With Multiple-Effect and Vapour Recompression Heating
- Forced Circulation, Draft Tube Baffle DTB and Oslo Fluidised-Bed Designs
- Melt Crystallisation: Suspension and Layer Processes at Overview Level
- Seeding Strategy and Scale-Up Rules: Tip Speed, Power per Volume and Residence Time

Day 4: Encrustation, Impurities, Polymorphism, Downstream Interface and Control

- Encrustation and Scaling on Heat Transfer Surfaces: Causes and Wash-Out Cycles
- Impurity Uptake, Crystal Habit Modification and Polymorph Form Control
- Downstream Interface: Centrifuge and Filter Cake Performance and Dryer Feed Quality
- Crystalliser Instrumentation: Slurry Density, Temperature and In-Line Particle Size Probes
- Control Strategies: Cooling Profiles, Supersaturation Control and Fines Destruction Loops

Day 5: Crystalliser Selection, Sizing and Troubleshooting Case Work

- Product Quality Troubleshooting Tree: Fines, Agglomerates, Caking and Off-Colour Crystals
- Case Study: Fertiliser Salt Evaporative Crystalliser With Encrustation and Excess Fines
- Case Study: Pharmaceutical Batch Cooling Crystallisation With a Polymorph Shift
- Crystalliser Selection and Sizing Workbook: Volume, Heat Duty and Circulation Rate
- Crystalliser Sizing, Control and Troubleshooting Plan Build and Peer Review

Skills You Will Gain:

- Solubility and Phase Diagram Interpretation
- Supersaturation Management
- Crystallisation Kinetics Estimation
- Crystal Size Distribution Analysis
- Crystalliser Equipment Selection
- Encrustation Control
- Polymorph Risk Assessment
- Crystalliser Process Control

Why Attend This Course:

- Leave with a Crystalliser Sizing, Control and Troubleshooting Plan for a real or case duty, reviewed by peers
- Trace fines, wide size spread and short run length back to supersaturation and equipment causes instead of adjusting set points by trial
- Work through fertiliser, mineral salt, chemical and pharmaceutical crystallisation cases side by side
- Discuss crystalliser options and performance data on equal terms with equipment vendors, development chemists and filtration and drying specialists

Conclusion:

A crystalliser delivers consistent product only when supersaturation, kinetics, equipment and controls are managed as one system. The course moves from solubility, phase diagrams and mass balances to nucleation, growth and crystal size distribution, then compares cooling, evaporative, vacuum, forced circulation, DTB, Oslo and melt designs with seeding and scale-up rules. Encrustation, impurities, polymorphism, downstream separation and control strategies follow, and the final day applies these methods in case work that produces each participant's Crystalliser Sizing, Control and Troubleshooting Plan.