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COURSE BROCHURE

# Advanced Process Engineering and Debottlenecking Training Course

18 – 29 April 2027
Muscat

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Registered in the United Kingdom and Saudi Arabia

# Advanced Process Engineering and Debottlenecking Training Course

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Advanced Process Engineering and Debottlenecking is a 2-week training course for process engineers, plant technical leads and process design specialists who must lift throughput from units already running, and it ends with a debottlenecking study setting out capacity limits, equipment ratings and improvement options. Owners now expect extra capacity from existing assets before approving new trains. Jupiter Prime Training runs this course for plant engineering groups.

## Why Process Engineering and Debottlenecking Matters Now

Three pressures meet in operating plants. Feedstock and product slates shift faster than units were designed for, so constraints move. Capital committees prefer incremental revamps to new plants, asking engineers to prove where the next limit lies. Energy costs and emissions targets also push heat recovery up the agenda. A site that guesses at its bottleneck spends money on the wrong column or exchanger, while one that rates every item finds cheap capacity first. The course rests on rigorous mass and energy balances, equipment rating methods, steady-state process simulation, pinch analysis for heat integration and hazard and operability study HAZOP thinking for every change.

## Who Gains Most from Process Engineering and Debottlenecking

- Engineers who own unit material and energy balances and monitor plant performance
- Leads who decide which revamp options reach the capital committee
- Specialists who rate columns, exchangers, drums and pumps against new duties
- Engineers who build and calibrate simulation models against plant measurements
- Energy coordinators who target heat recovery across a site

A process engineering department that sends its unit engineers and its design specialist together gains most, because rating and simulation results then feed one shared capacity picture.

## Process Engineering and Debottlenecking Capabilities

Participants leave able to locate the true limiting item in a unit and price the options for moving it.

- Calculate reconciled mass and energy balances from plant measurements — the baseline every revamp case starts from
- Assess column, exchanger and drum ratings at higher rates — decisions on which items limit capacity
- Build a calibrated simulation model of an operating unit — engineers testing feed and rate cases
- Apply pinch analysis to a heat exchanger network — energy coordinators setting recovery targets
- Weigh revamp options by cost, shutdown need and risk — capital committees choosing projects
- Communicate a ranked capacity case to operations and finance — approval of the preferred option

## Key Process Engineering and Debottlenecking Terms

- Debottlenecking — removing the equipment or operating limit that currently caps a unit's throughput so the next limit can be reached.
- Data reconciliation — adjusting measured flows and compositions so that mass and energy balances close within instrument uncertainty.
- Equipment rating — checking an existing item's performance at new conditions, as opposed to designing a new item.
- Pinch point — the temperature at which hot and cold composite curves are closest, setting minimum heating and cooling demand.
- Flooding — a column condition where liquid cannot descend against vapour flow, limiting tray or packing capacity.
- Capacity creep — gradual throughput gains from small changes to operating limits without major equipment replacement.

## Process Engineering and Debottlenecking Day by Day

## Day 1: Capacity Drivers in Operating Plants

- Constraint Mapping Across a Process Unit — Where Capacity Is Lost Today
- Feed Slate and Product Specification Shifts — Moving Limits in Existing Units
- Revamp Versus New Train Economics — When Incremental Capacity Wins
- Process Flow and Piping and Instrumentation Diagrams — Baseline Documents for a Study
- Operating Envelope Records — Separating Design Limits from Habit

## Day 2: Reconciled Mass and Energy Balances

- Component Mass Balances Across Reactors and Separators — Closing the Unit Picture
- Energy Balances with Enthalpy Methods — Locating Heat Duty Shortfalls
- Data Reconciliation and Gross Error Detection — Trusting Plant Measurements
- Test Run Planning and Sampling — Capturing Data at Maximum Rate
- Balance Closure Reports — Agreeing a Baseline with Operations

## Day 3: Thermodynamics and Physical Properties

- Equation of State and Activity Coefficient Choices — Property Accuracy for Each Service
- Vapour–Liquid Equilibrium Data Checks — Separation Predictions Engineers Can Defend
- Pseudo-Component Characterisation of Crude and Heavy Feeds — Refinery Model Fidelity
- Transport Property Estimation — Viscosity and Conductivity Effects on Rating
- Property Package Validation Against Plant Data — Choosing the Final Basis

## Day 4: Distillation and Absorption Rating

- Tray Hydraulics and Flooding Limits — Column Capacity at Higher Rates
- Packed Column Pressure Drop and Wetting — Packing Replacement Decisions
- Reboiler and Condenser Duty Checks — Thermal Limits on Column Throughput
- Gamma Scan and Pressure Survey Interpretation — Confirming Internal Damage or Fouling
- High-Capacity Trays and Structured Packing — Revamp Options Without New Shells

## Day 5: Heat Transfer Equipment Rating

- Shell-and-Tube Exchanger Rating — Duty Margin at New Flow Conditions
- Fouling Resistance Trends — Cleaning Intervals Versus Lost Throughput
- Air Coolers and Ambient Limits — Summer Capacity Constraints
- Fired Heater Duty and Tube Metal Temperature — Firing Limits on Feed Rate
- Exchanger Enhancement Devices — Inserts and Twisted Tubes as Low-Cost Revamps

## Day 6: Separation and Fluid Handling Limits

- Two- and Three-Phase Separator Sizing Checks — Residence Time and Carry-Over Limits
- Pump Curves, Net Positive Suction Head and Impeller Options — Hydraulic Capacity
- Compressor Performance Maps — Surge and Stonewall Margins at Higher Flow
- Line Sizing and Pressure Drop Surveys — Piping Constraints Hidden in Hydraulics
- Control Valve Capacity Checks — Valves Running Fully Open at Rate

## Day 7: Steady-State Process Simulation

- Flowsheet Building for an Existing Unit — Structure Matching the Real Plant
- Model Calibration Against Test Run Data — Tuning Efficiencies and Fouling Factors
- Case Studies on Feed Rate and Composition — Testing Where Limits Move
- Equipment Rating Inside the Simulator — Linking Hydraulics to the Flowsheet
- Model Documentation and Version Control — Reusable Basis for Later Studies

## Day 8: Pinch Analysis and Heat Integration

- Stream Data Extraction from the Flowsheet — Correct Inputs for Targeting
- Composite and Grand Composite Curves — Minimum Energy and Utility Targets
- Cross-Pinch Heat Transfer Diagnosis — Finding Wasted Recovery in Existing Networks
- Network Retrofit Options — Re-Piping, Added Area and Exchanger Resequencing
- Utility System Interaction — Steam Balance Effects of Heat Recovery Projects

## Day 9: Revamp Option Selection and Risk

- Debottlenecking Option Long List — Operating, Minor Modification and Capital Cases
- Hazard and Operability Study of Proposed Changes — Safety Effects of New Limits
- Relief and Flare Load Rechecks — Protection Capacity at Higher Throughput
- Cost Estimation and Shutdown Window Planning — Turnaround Fit for Each Option
- Option Ranking Matrix — Throughput Gain Against Cost and Risk

## Day 10: Practising the Debottlenecking Study

- Baseline Balance and Test Run Summary — Agreed Starting Point for the Unit
- Equipment Rating Table at Target Rate — Ranking Each Item by Margin
- Simulation Cases with Heat Integration Options — Capacity and Energy Together
- Risk Screening and Relief Checks — Filtering Options Before Approval
- Debottlenecking Study — Capacity Limits, Ratings and Recommended Options

## Applying Process Engineering and Debottlenecking After the Course

- Lead a test run on one unit and produce a reconciled mass and energy balance agreed with operations.
- Rate the three items closest to their limit at a higher feed rate and present the margin table to the plant technical lead.

## Process Engineering and Debottlenecking Questions FAQ

### What is process engineering and debottlenecking, and why does it matter now?

Process engineering and debottlenecking is the practice of finding and removing the limit that caps an operating unit's throughput. It matters now because owners want extra capacity and lower energy use from existing plants before funding new ones.

### Which roles gain most from advanced process engineering and debottlenecking training?

Unit process engineers, plant technical leads and process design specialists gain most. They are the people who reconcile plant data, rate equipment, build simulation models and recommend which revamp option reaches the capital committee.

## How does advanced process engineering and debottlenecking differ from a process engineering essentials course?

It starts where an essentials course ends. Rather than introducing unit operations, it rates existing equipment at new duties, calibrates simulation models to plant data, applies pinch analysis to real networks and ranks revamp options by gain, cost and risk.

## What do you bring back from process engineering and debottlenecking training?

You bring back a capacity study for a unit you know. It holds a reconciled baseline, an equipment rating table, simulation and heat integration cases, risk screening and a ranked list of options ready for discussion with your technical lead.

## Process Engineering and Debottlenecking: The Way Forward

The debottlenecking study first informs which item to tackle at the next turnaround and whether an operating change alone will release capacity. Plant technical leads and capital planners use it to sequence revamps. After its first use, revisit the property basis and fouling assumptions, because a new feed slate can move the limit to a different item.