Petroleum Refining Processes: Refinery Units, Yields and Margin

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Paris - Right Bank business hotel



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Introduction:

Petroleum refining processes lose value when crude is bought without reading its assay, conversion units run at severities that no longer suit the crude slate and products are blended with costly giveaway. This Core Concept course takes refinery engineers from crude characterisation, configuration and complexity through distillation, reforming, isomerisation, hydrotreating and hydrocracking in week one. Week two moves to fluid catalytic cracking, coking and residue upgrading, alkylation, sulphur recovery, product blending and refinery margin. Participants build a Refinery Process Yield and Margin Assessment for a configuration of their own.

Course Objectives:

- Interpret a crude oil assay and predict how a change of crude slate shifts cut yields, sulphur load and downstream unit feed quality
- Classify a refinery by configuration and Nelson Complexity Index and explain how each process unit adds conversion and product value
- Diagnose yield and product quality problems in crude and vacuum distillation, catalytic reforming, isomerisation, hydrotreating and hydrocracking units
- Evaluate fluid catalytic cracking, coking and alkylation operating choices by their effect on conversion, light olefins, coke make and gasoline pool octane
- Assess sulphur recovery and amine treating performance and the utilities and emissions burden of a refinery configuration
- Build a product blend and a refinery yield and margin estimate using crack spreads and linear programming results to support crude and operating decisions

Target Audience:

- Process engineers accountable for the yields, severity and run length of refinery conversion and treating units
- Technical services engineers who monitor unit performance, catalyst condition and product quality against targets
- Planning and scheduling engineers who evaluate crude slates, run refinery models and set monthly operating plans
- Operations supervisors who run distillation, reforming, cracking and treating units on shift
- Product blending and oil movement engineers who certify gasoline, diesel and fuel oil batches against specifications
- Refinery project and licensing engineers who compare process options for new or revamped units

Course Outline:

Day 1: Crude Oil Characterisation, Assays and Refinery Configurations

- Crude Oil Assay Reading: API Gravity, Sulphur, TAN, Metals and Carbon Residue
- True Boiling Point Curve and Cut Yield Prediction by Fraction
- Hydrocarbon Families: Paraffins, Naphthenes, Aromatics and Their Product Value
- Refinery Configuration Types: Topping, Hydroskimming, Cracking and Coking
- Nelson Complexity Index Calculation from Unit Capacities and Complexity Factors

Day 2: Atmospheric and Vacuum Distillation

- Desalter Operation: Wash Water, Emulsion Breaking and Salt Removal Efficiency
- Crude Distillation Unit Flash Zone, Stripping Steam and Overflash Control
- Side Draw Cut Point Setting and Fraction Gap and Overlap Assessment
- Vacuum Distillation Unit Ejector System, Wash Bed and Gas Oil Recovery
- Vacuum Residue Quality: Metals, Asphaltenes and Downstream Feed Suitability

Day 3: Naphtha Upgrading: Catalytic Reforming and Isomerisation

- Naphtha Hydrotreater as Reformer Feed Protection Against Sulphur and Nitrogen Poisons
- Catalytic Reforming Reactions: Dehydrogenation, Dehydrocyclisation and Hydrocracking Losses
- Semi-Regenerative Versus Continuous Catalyst Regeneration Reformer Operation
- Reformer Severity, Octane, Hydrogen Yield and Reformate Aromatics Trade-Off
- Light Naphtha Isomerisation: Once-Through Versus Recycle Schemes and Octane Gain

Day 4: Hydrotreating and Hydrocracking

- Hydrodesulphurisation Chemistry: Sulphur Species Reactivity and Hydrogen Consumption
- Distillate Hydrotreater Catalyst Loading, Grading and Pressure Drop Behaviour
- Hydrotreater Temperature Programme, Catalyst Deactivation and End-of-Run Criteria
- Hydrocracker Flow Schemes: Single-Stage, Once-Through and Two-Stage Recycle
- Hydrocracker Conversion, Middle Distillate Selectivity and Refinery Hydrogen Balance

Day 5: Week-One Case: Crude Slate Change and Primary Unit Yields

- Case Data Pack: Two Crude Assays and a Hydroskimming Refinery Flowsheet
- Cut Yield Comparison for Light Sweet Versus Heavy Sour Crude Feed
- Reformer and Isomerisation Response to a Changed Naphtha Composition
- Distillate Hydrotreater Sulphur Load and Hydrogen Demand Under the New Slate
- Week-One Findings Review and Assessment Scope Setting for Each Participant Refinery

Day 6: Fluid Catalytic Cracking

- FCC Riser, Reactor and Regenerator Circuit and Catalyst Circulation
- Zeolite Catalyst Formulation, Equilibrium Catalyst Testing and Additives
- FCC Heat Balance: Coke Burn, Regenerator Temperature and Catalyst-to-Oil Ratio
- FCC Feed Quality Effects: Metals, Carbon Residue and Feed Pretreatment
- FCC Product Slate: Gasoline, Light Cycle Oil, Propylene and Butylene Yield Shifts

Day 7: Coking, Residue Upgrading and Alkylation

- Delayed Coker Drum Cycle, Furnace Outlet Temperature and Coke Yield
- Petroleum Coke Grades: Fuel, Anode and Needle Coke Quality Drivers
- Residue Upgrading Options: Visbreaking, Solvent Deasphalting and Residue Hydroprocessing
- Alkylation Chemistry: Isobutane to Olefin Ratio and Alkylate Octane
- Sulphuric Acid Versus Hydrofluoric Acid Alkylation Operating and Safety Comparison

Day 8: Sulphur Recovery, Amine Treating, Utilities and Environmental Overview

- Amine Treating Units: Solvent Selection, Rich Loading and Regenerator Stripping
- Sour Water Stripping and Ammonia Handling Ahead of Sulphur Recovery
- Claus Process Thermal and Catalytic Stages and Sulphur Recovery Efficiency
- Tail Gas Treating Options and Stack Sulphur Dioxide Emissions Overview
- Refinery Utilities Overview: Hydrogen Plant, Steam, Fuel Gas and Energy Intensity

Day 9: Product Blending, Specifications, Yields and Refinery Margin

- Gasoline Pool Blending: Octane, Vapour Pressure and Blending Index Methods
- Diesel and Jet Fuel Specification Control: Sulphur, Cetane, Flash and Cold Flow
- Blend Giveaway Measurement and Recipe Adjustment Against Specification Limits
- Crack Spread Benchmarks: 3-2-1 Margin and Gross Product Worth per Barrel
- Refinery Linear Programming Overview: Crude Valuation and Unit Severity Cases

Day 10: Capstone: Refinery Process Yield and Margin Assessment

- Capstone Build: Crude Slate and Configuration Profile for a Participant Refinery
- Capstone Build: Unit-by-Unit Yield Map from Distillation to Conversion
- Capstone Build: Product Blend Plan and Specification Risk Register
- Capstone Build: Margin Estimate and Ranked Crude and Severity Options
- Assessment Presentation to a Refinery Technical Review Panel

Skills You Will Gain:

- Crude Assay Interpretation
- Refinery Complexity Benchmarking
- Distillation Cut Point Control
- Reformer Severity Management
- Hydroprocessing Catalyst Monitoring
- FCC Heat Balance Analysis
- Sulphur Plant Performance Review
- Gasoline and Diesel Blending

Why Attend This Course:

- Return with a Refinery Process Yield and Margin Assessment built on the crude slate and units of your own site
- Progress from crude, distillation, reforming and hydroprocessing in week one to cracking, coking, alkylation, sulphur recovery, blending and margin in week two
- Question crude purchases, catalyst change-outs and severity targets with yield and margin evidence rather than habit
- Compare unit practice with refinery engineers working on simple and high-complexity configurations in several markets

Conclusion:

Refinery value depends on how each unit turns a changing crude slate into saleable products. Week one builds that understanding from crude assays and configuration through distillation, reforming, isomerisation, hydrotreating and hydrocracking, closing with a crude slate case. Week two adds fluid catalytic cracking, coking and residue upgrading, alkylation, sulphur recovery and amine treating, product blending, crack spreads and planning models. The final day produces a Refinery Process Yield and Margin Assessment ready for technical review.