Chemical Engineering - Refining - Petrochemicals
**Applied Chemical Engineering**

to Oil, Gas and Chemical fields

**AGENDA**

**Module 1: Fluid flow and rotating equipment**

**Fluid flow**
- Characteristics of the single-phase liquid and gaseous flows.
- Flow rate measurement with measuring devices.
- Determining pressure drops in sites, influence of the valves.
- Characteristic curve of a circuit, examples of typical circuits.
- Liquid-gas two-phase flow map.

**Pumping and compression**
- Functions and elements of the main rotating equipment.
- Operation of the centrifugal pumps and characteristic curves.
- Connections pump-circuit. Adjustment to the operating conditions: changes in the flow rate, the product, temperature, cavitation.
- Gas behavior during compression.
- Operation of reciprocating and centrifugal compressors.
- Adjustment to the operating conditions: change in the efficiency, operating limits.

**Module 2: Heat and energy transfer**

**Heat transmission**
- Reminders on thermodynamics in heat transfer.
- Conduction and convection: parameters that affect the exchange, means of calculation.
- Radiation: emission, absorption, application to furnaces and boilers, tube skin temperature.

**Exchangers - Furnaces and boilers**
- Function, classification and terminology of heat exchangers.
- Performances of the exchangers depending on the fluid circulation mode, evolutions depending on changes in the operating conditions.
- Design principle of the exchangers.

**Module 3: Distillation and preliminary design**

**Thermodynamics in liquid-vapor equilibria**
- Material and energy balances in continuous processes.
- Fluid properties, law of corresponding states, equations of state.
- Thermodynamic models applicable to hydrocarbon mixtures.
- Non ideal mixtures, water-hydrocarbon mixtures.

**Distillation**
- Operating parameters of industrial distillation columns: material balance, pressure, operation of the liquid-vapor contact material, heat balance, implementation of reboilers and condensers, liquid-vapor traffics, temperature and composition profiles.
- Distillation column control: basic control, sensitive tray, control of calculated variables, advanced control.

**Preliminary project**
- An application related to the study of an industrial site allows the implementation of the knowledge acquired corresponding to the different disciplines of chemical engineering presented over the three training weeks.

**Level:** Foundation

**Purpose**
- To provide more in-depth knowledge on the operation and operating conditions of the material and processes in refining, petrochemical and heavy chemistry sites.
- To provide a strong foundation in the use of process simulation software.

**Audience**
- Engineers and technicians whose activities are related to the operation of industrial sites: production, maintenance, plant projects, process control, laboratory, etc.
- Young engineers at the start of their career in refining, petrochemistry, heavy chemistry, engineering.

**Learning Objectives**
- To describe the main properties of fluids and phenomena in process engineering.
- To understand the operating conditions of equipment used in the process and to explain the reasons for controls implemented.

**Prerequisite**
- It is recommended that participants have notions of thermodynamics (the basics learnt during engineering studies are sufficient).

**Ways and Means**
- Specific and original documentation covering different topics from an applied angle.
- Numerous applications and case studies related to industrial situations.
- Data, diagrams, graphs, various correlations presented in one single ring binder for easy reference after the course.

**Coordinator:** Carole Le Mirronet
Applied Chemical Engineering for the Refining and Petrochemical Industries

Level: Foundation

PURPOSE
To provide a comprehensive understanding of the refining and petrochemistry chain involved and the equipment used in the refining and petrochemical industry.

AUDIENCE
Engineers interested in applied chemical engineering relating to oil and gas products, refining processes and polymers.

LEARNING OBJECTIVES
- To understand the structure of the refining and petrochemical industries, main characteristics of the different processes (objectives, operating conditions, quality requirements, safety), and the proper function of each unit within a coherent general production scheme.
- To grasp the fundamentals of chemical engineering, design equipment for separation, heat transfer and exchange as well as build process control schemes for industrial units and establish process flow diagrams and piping and instrumentation diagrams.
- To master the fundamentals of polymer chemistry, describe the main characterization methods and structure/properties relationships for polymeric materials.
- To identify the cost structure and acquire the basic elements for investment decisions and capital budgeting in the refining and petrochemical industries.

AGENDA

Chemical engineering fundamentals
- Thermodynamics applied to liquid-vapor equilibria.
- Hydrocarbon physico-chemistry.
- Fluid dynamics.
- Heat transfer.
- Industrial reactor design.

Petroleum products and refining processes
- Crude oil and petroleum products.
- Distillation (theory and dynamic simulation).
- Introduction to Provision simulation software (PROII) usage and application in a distillation project.
- Refining processes, process flow sheets and visit of a refinery.

Industrial equipment and instruments
- Materials and corrosion.
- Static equipment.
- Rotating machinery.
- Heat exchangers, furnaces and boilers.
- Introduction to HTRI software usage and application in a heat-exchanger project.

Monomers and polymers manufacturing
- Olefins and aromatics in petrochemistry.
- Polymer structure, conformation and characterization.
- Introduction to industrial polymer processes.
- Logistics and transportation of liquids and powders.
- Description of the main steps of a polymer project and methodology for organizing the sustainably safe and clean operation of petrochemical plants (HAZOP studies).
- Visits to a polymer research center, steamcracker, polymer units and transformers.

Economics
- Capital budgeting. Price and cost management.
- Economics of supply and refining operations.

Case studies
- Two projects based on conception, design and cost estimation of an industrial distillation column (with PROII) and different heat exchangers (with HTRI).
- These studies are carried out by trainees with instructor guidance.

WAYS AND MEANS
- Applications using process dynamic simulators (RSI IndissPlus simulator)
- Applications using static simulation software (PRO II).

NOTE
This training course is part of a 16-month Master degree program at IFP School. Two training sessions (5 days – 8 days) are organized between September and December in IFP Training centers.

Coordinator: Carole Le Mirronet

LANGUAGE | DATES | LOCATION | FEES | REGISTRATION CONTACT
---|---|---|---|---
EN | Sep 01 - Dec 18 | Rueil | 17,110 € | rc.rueil@ifptraining.com

For additional in-house courses, please see the In-house Training section page 114
Select Thermodynamic Models for Simulation

Level: Advanced

AGENDA

Physico-chemical properties and characterization of pure components
- Ideal gas behavior and equations of states; the corresponding states principle (ex: the Lee&Kesler method).
- Useful correlations for vapor pressure (ex: Antoine), liquid molar volume (ex: Rackett), heat capacity (ex: Aï & Lee), enthalpy of vaporization (ex: use of the Clapeyron equation).
- Group contribution methods (ex: Joback).
- Application: compute the normal boiling temperature, heat of vaporization and liquid molar volume of a complex compound.

Vapor-liquid equilibrium of ideal mixtures
- Phase diagrams (PT, isobaric, isothermal) and main laws (Raoult, Henry).
- Computation principles (ex: Rachford-Rice).
- Applications:
  - calculate LPG entrainment using a liquid solvent
  - calculate the process conditions in a distillation column, using bubble or dew temperatures.

Phase equilibrium of non-ideal mixtures
- Use of activity coefficient and significance of infinite dilution properties (relationship with Henry’s law).
- Azeotropy and its molecular significance.
- Parameter fitting using a simple model (ex: Margules).
- Application: hexane + acetone mixture.
- Liquid-liquid phase split with the example of water-hydrocarbon.
- Application: recognize and read binary phase diagrams.

Current and advanced thermodynamic models
- Definition of fugacity; homogeneous and heterogeneous models.
- Main activity coefficient models, their theoretical foundations and their parameters: Margules; Flory; Regular solutions; Flory-Huggins; NRTL, UNIQUAC, UNIFAC.
- Cubic equations of state, their parameters and limitations (PengRobinson, SoaveRedlichKwong): alpha functions and mixing rules.
- Some advanced models and their molecular significance.

Case studies for models selection
- Case-studies for chemistry and oil refining:
  - C4 distillation: comparison of the efficiency without and with a solvent (extractive distillation, butadiene or acetonitrile)
  - biofuels: esterification process and separations of alcohol/ester systems.

Return of experience of an operational engineer
- How to select and use a model for different applications?
- Emphasis on the compulsory need for a relevant model.

Note

Instructors are world-class experts in Thermodynamics from IFP Energies nouvelles and industry experts.

Coordinator: Mathilde Mercier

Purpose

To select and validate, through an efficient methodology, the right thermodynamic model for different processing conditions.

Audience

Experienced chemical or process engineers involved in process simulation or design of new processes.

Learning Objectives

- To gain a practical understanding of fluid behavior.
- To understand the link between molecular structures and fluid behavior.
- To identify and validate the best thermodynamic model applied to some of industry-based cases.

Prerequisite

Understanding of fluid phases behavior and process simulation.

Ways and Means

- Subjects are presented from a practical point of view.
- Specific data file including data, diagrams, charts and correlations used in the different technical areas of chemical engineering.
- Many practical applications based on real data.

3 Days

Level:

Advanced

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To select and validate, through an efficient methodology, the right thermodynamic model for different processing conditions.

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Note:

Instructors are world-class experts in Thermodynamics from IFP Energies nouvelles and industry experts.

Coordinator: Mathilde Mercier

For additional in-house courses, please see the In-house Training section page 114
Distillation

Optimization and Troubleshooting

Practical Simulator Training (RSI IndissPlus simulator)

AGENDA

Operating parameters: definition and significance
Material balance of the virtual column: cut point, separation quality and concept of fractionation capability.
Column pressure: pressure control and pressure profile along the column.
Heat balance. Reflux and reboiling ratio and selectivity evaluation.
Internal flow rates profiles, concentration and temperature profiles. Concentration peaks.

Separating power of an industrial distillation
Impact of the parameters related to the fractionation capability:
- Liquid-vapor internal flow rates, associated with reflux and reboiling ratios
- Number of theoretical stages and internal equipment efficiency
- Position of feedstock inlet related to feed characteristics.
Fractionation capability and decrease of energy consumption.
Each item is illustrated by practical exercises conducted by trainees on a dynamic simulator.

Process control parameters
The simulator scenario covers the different aspects of operation and control of columns.
It starts with a simple control system and implements increasingly sophisticated control systems on increasingly complex columns, such as a depropanizer, a debutanizer and a multiple draw-off column (crude oil distillation).
Survey of operating disturbances; origins and causes.
Process control strategy and optimization targets.
External or internal reflux control, reboiling control with flow rates or duty monitoring.
Material balance control: sensitive tray, temperature control systems.
Optimization of the heat balance: additional energy through the feed or the reboiler, low pressure operation and energy savings.
Implementation of control systems based on quality measurement.
Analysis of disturbances caused by the feed and systems for feed forward control.
Implementation of process control in multi-column trains.
Specific case of draw-off columns: quality tuning through material balance (temperature, flow rate or level control); heat balance monitoring (role of pumparounds and vaporizing refluxes, optimization of the fractionation capability).

Equipment technology and troubleshooting
Trays: technology, workings; high efficiency trays, performance and flexibility.
Packings and distribution systems: flooding, fouling, mechanical damage and remedies.
Reboilers and condensers: implementation and working principles, various control strategies, problems and related origins, possible solutions.

Level: Proficiency

PURPOSE
To provide a comprehensive understanding of efficient distillation columns operations.
To implement optimization strategies.

AUDIENCE
Engineers, process engineers, process control personnel and technical staff in the refining and petrochemicals industries.

LEARNING OBJECTIVES
- To learn about all parameters and profiles for the analysis of a distillation column operation.
- To master the concepts necessary to optimize the operation of a column.
- To identify the performances and limits of different control systems.
- To deepen knowledge of the detection and effects of deficiencies.

WAYS AND MEANS
- Highly efficient learning process using a dynamic simulator that models the main physical phenomena of distillation.
- Troubleshooting case studies to illustrate process control schemes.

Coordinator: Christian Tison

Can be tailored to your specific needs and made available at the location of your choice

For additional in-house courses, please see the In-house Training section page 114
Refining Processes and Petroleum Products

5 Days

AGENDA

Petroleum products

Energy and non-energy products and their main uses, CO₂ emissions and main regulated pollutants in the end use.

Principal components of petroleum products: general hydrocarbon classification and main impurities (sulfur, nitrogen, metals and asphaltene, etc.).

Quality requirements imposed on petroleum products in view of their utilization: quality specifications measured by standard tests, characteristics related to the product composition, origin and processing routes.

New trends in market structure and product characteristics to European and worldwide scale, post-combustion depollution systems, biofuels (nature, alternative fuel pathways for transport, strengths and weaknesses).

Refining processes

Crude oil fractionation

Origin, overall characteristics and classification of crude oils.

Yields and properties of straight-run cuts obtained by distillation, potential destinations.

Industrial units: atmospheric distillation, vacuum distillation, light-ends fractionation.

Typical process scheme, operating conditions, energy consumption.

Catalytic reforming and isomerization

Octane improvement of virgin naphthas.

Basis of processes, types of catalyst, product yields and hydrogen production.

Industrial units: process flow sheets, operating conditions, equipment, low pressure processes.

Hydrorefining processes

Main features of impurities removal by catalytic hydrogen treatment.

Main refining applications.

Example of ULSD hydrotreatment unit: operating principles, operating conditions.

Scrubbing treatments: amine washing, sulfur production, treatment of residual gases from Claus units.

Conversion units

Outline of conversion and various cracking processes.

Characteristics and origin of feeds for cracking.

Conversion by means of thermal cracking: visbreaker, various cokers.

Conversion by means of catalytic cracking: FCC and related units, gasoline sweetening and desulfurization, hydrotreatment, production of MTBE, ETBE and propylene, hydrocracker and related units, hydrogen production (SMR, POX).

Recent developments in hydroconversion and hydrogenation of heavy residues.

Hydrogen balance in the refinery, energy consumption per unit, CO₂ emissions at the outlet of the refinery.

Other processes for production of petroleum products: GTL, synthetic crude oils.

Manufacturing flowsheets

Main routes to major products.

Up to date refining schemes including the production of petrochemical intermediate products.

Impacts of the evolution of market demand and the quality of the products on manufacturing patterns.

Base lube oil manufacturing.

Main economic features of refinery operation

Prices of crude oils and products, operating costs, economic margin of a refinery.

Examples of flexibility in operation and its economic consequences.

Level: Discovery

Purpose

To provide broad technical information on refining processes and petroleum products, enabling a rapid immersion in the refining industry.

Audience

Professionals in the oil and gas industry or related sectors (in the technical, commercial, legal, finance, or HR departments) interested in oil refining.

Learning objectives

- To learn about the composition, main characteristics and new trends of petroleum products.
- To understand the role of various processing units in a refinery.
- To describe the main manufacturing schemes encountered in oil refining.
- To assess the economic environment of this industry.

Ways and means

- Detailed course material with a glossary of the main technical terms used in the refining industry.
- Active participation of trainees through interactive games and quizzes to grasp the key points of the course.

Coordinator: Carole Le Mirronet

Can be tailored to your specific needs and made available at the location of your choice. For additional in-house courses, please see the In-house Training section page 114.
Extra Heavy Crude Oil Upgrading

**AGENDA**

**Crude oil properties**
Main physical and chemical properties and standard tests of crude oils.
Extra heavy crude properties in contrast to classical crude oils.

**Upgrader principles and objectives**
Production, fluidification and transportation of extra heavy crude oils. Different ways to upgrade heavy crude oils. Overview of an upgrader, role and purposes of the different processes.

**Atmospheric and vacuum distillation**
Upgrader distillation units: principles of distillation, capacity, process flowsheets.
Atmospheric and vacuum distillation unit: operating conditions, material balance, energy consumption and heat recovery, tower and equipment characteristics.
Crude oil desalting unit: purpose, operating conditions, specific solutions to process heavy crude oils. Corrosion and corrosion prevention in atmospheric and vacuum distillation units.

**Upgrader hydrotreatments to process naphtha and distillate**
Origin of feeds and related characteristics.
Hydrotreatment chemical reactions and hydrogen consumption.
Hydrotreatment catalysts: composition, role and mode of action.
Hydrotreatment processes: process flow diagram, operating conditions, products characteristics.

**Upgrader hydrocracker (HCK) or mild hydrocracker (MHC)**
Main methods of cracking heavy cuts: thermal, catalytic and hydrocracking processes.
Specific hydrocracking chemical reactions: exothermicity, hydrogen consumption.
Hydrocracking catalysts: composition, main properties and poisons.
Mild hydrocracker (MHC) unit: process flow diagram, feed and products, material balance.

**Hydrogen manufacturing plants**
Different processes for hydrogen production (SMR and POX).
Steam methane reforming (SMR): material balance, feed and products, preliminary desulfurization and sulfur trap, chemical reactions, catalysts, process scheme, operating conditions.
Steam reforming furnace and steam production. CO conversion (operating conditions, catalyst). Hydrogen purification (principle of a PSA unit, flow diagram and performances).
Gasification process principle, material balance, simplified process flow sheet and operating conditions.
Soot trapping and ash management. Gas washing and purification, CO conversion.

**Thermal conversion units: visbreaking and delayed coking**
Heavy cuts thermal conversion processes.
Visbreaking; feed and products, product properties, process flow diagram, operating conditions; specific equipment: furnace, soaker, separation section, stability of heavy cracked fuel oils.
Delayed coking
General description of coking processes: chemical reactions, process performances.
Delayed coking process description: feed and products, material balance, product properties; process flow diagram, operating conditions; technology of furnace and coke drums; coke types and users; operation of a delayed coking unit: coking cycle, decoking cycle and switch management, coke handling.
Others coking processes: fluid coking, flexicoking.
Integration of flexicoking units in upgrading schemes of heavy crude.

**H₂S removal and sulfur recovery process**
Overview of sulfur removal and recovery.
Amine units: process flow scheme and operating conditions, safety issues.
Sulfur recovery units: process principle, chemical reactions, thermal stage, catalytic stages, sulfur recovery, tail gas incineration; process scheme, operating conditions, sulfur yield.
Tail gas treatment: Sulfincren, Clauspol, SCOT; principles and operating conditions.

**Other conversion processes**
Deasphalting units: vacuum residues structure and properties; deasphalting principles: different deasphalting solvents, overall flow sheet, operating conditions; integration of deasphalting units in conversion schemes.
Residue hydroconversion processes: examples of feed properties. Metals in catalytic hydroconversion processes, fixed bed technologies; ebulliated bed technologies.
Chemical Engineering - Refining - Petrochemicals

Petroleum Refining and Petrochemicals
Processes - Equipment - Safety

AGENDA

Level: Foundation

PURPOSE
To develop full competency in the processes, equipment, operation, safety, and economics aspects of petroleum refining and petrochemicals.

AUDIENCE
Engineers entering the refining and petrochemicals industry or professionals with limited experience in this industry wishing to broaden their capacity.

LEARNING OBJECTIVES

- To acquire a solid base in refining techniques.
- To select and design the main equipment of processing plants.
- To learn about the technology and operation of equipment.
- To understand the main refining processes, their fundamental aspects and operation.
- To be familiar with safety and environmental issues in refinery operations.
- To provide an introduction to economic issues of the industry.

WAYS AND MEANS

- Development of professional know-how.
- Case studies, applications related to industrial situations.
- Use of dynamic simulators (RSI IndusPlus simulators): equipment simulators, generic process units simulators.
- Project: design of a distillation column, using PROII/PROVISION.

AGENDA

Physico-chemical properties of hydrocarbons and petroleum cuts
Organic compounds, crude oil and petroleum products. Quality control - Standard tests - Blending rules.

Applied thermodynamics

Distillation course and project with PROII
Classical industrial column design, short cut methods. Operating parameters, optimization, process control parameters. Internal equipment. Practice of PROII/PROVISION, process simulation, simplified design of equipment, economic evaluation and optimization.

Crude oil and vacuum distillation
Typical distillation units: process diagrams, operating conditions, separation quality. Corrosion and desalting. Operation and control of multidraw-off columns; vacuum systems.

Processing of light cuts and middle distillates
Catalytic reforming, isomerization, hydrotreatment, sweetening of light cuts and sulfur recovery.

Processing of heavy cuts

Heat transfer equipment

Fluid flow - Rotating machinery
Characteristics of liquid and gas simple phase flow; gas compression laws, expansion. Technology and operation of pumps, compressors, steam turbines, gas turbines, electrical motors.

Instrumentation and process control
Instrumentation, controllers, valves, control loops implementation. PID tuning, monovariable control limits, multivariable control.

Safety in operations
Product and equipment related risks, safety in process operation. Hazard analysis in design and operation.

Production of olefins and aromatics
Sources, outlets and main industrial uses of olefinic and aromatic intermediaries. Steam cracking and treatment of the cuts produced. Fluid catalytic cracking (FCC) and production of aromatics. Economics of petrochemicals.

LANGUAGE DATES LOCATION FEES REGISTRATION CONTACT
EN May 18 - Jun 12 & Aug 17 - Oct 09 Rueil 23,710 € RRU rc.ruell@ifptraining.com

For additional in-house courses, please see the In-house Training section page 114
Light Cuts and Middle Distillates Processing

AGENDA

Petroleum products
Origin and characteristics of naphtha cuts.
Octane properties and hydrocarbon (HC) families. Quality requirements.
Gasoil and Diesel oil: cetane, cold flow and other properties.

Catalytic reforming
Refinery octane pool: processes for octane improvement-gasoline sources.
Role of catalysts - Types of catalysts - Activation, ageing, poisoning.
Industrial units: process flow scheme of SR and CCR, operating conditions, performances.
Operating variables (WABT, WHSV, H₂/HC ratio, recycle gas composition, pressure).
Management of hydrogen production: H₂ balance, impact of feed properties and operating conditions.
Shutdown, regeneration and startup.
Catalyst regeneration steps and control.

Isomerization of light gasolines
Integration in the gasoline production scheme. Isomerization reaction characteristics.
Different types of catalysts: properties, activation, poisons, operating conditions.
Industrial process: principle and specific constraints.
Downstream separation main types and impact of recycling.

Hydrorefining processes
Removal of impurities, hydrogenation of unsaturated compounds: chemical reactions and their characteristics.
Role and types of catalysts in relationship with feeds, hydrogen consumption and required results.
Operating conditions and main variables (temperature, WHSV, H₂/HC ratio, ppH₂, etc.).
Catalyst loading map; cycle length optimization.
Main refining applications and specific operating features, example of gasolines and middle distillates desulfurization.

Sweetening of light cuts
Role of sweetening process, basic chemical reaction, nature and efficiency of the catalyst.
Main applications for LPG's, naphtha's and kerosene cuts.
Operating conditions: temperature, caustic concentration, mixing efficiency, air injection, etc.

Sulfur recovery
Refinery sulfur balance. Importance of sulfur recovery chain processes.
Amine scrubbing: reversible chemical reactions and operating parameters.
Industrial process and operating parameters as air/H₂S ratio, steam production.
Sulfur recovery unit: Claus chemical reactions.
Process control and impact on environment: causes for sulfur emission increase.
Tail gas treatments: process principles, operating conditions.

Purposes:
- To link processing units operation to various constraints set by product specifications.
- To analyze operating parameters and their impacts.
- To acquire the basics for operating processing units.
- To be updated on the latest developments in these processes.

Languages:
- English: Sept 21 - 25 Rueil 2,460 € RR
- French Rueil@ifptraining.com

Coordinator: Corinne Mathieu

Can be tailored to your specific needs and made available at the location of your choice
For additional in-house courses, please see the In-house Training section page 114
Heavy Cuts Processing

Level: Foundation

PURPOSE
To provide comprehensive knowledge of refining processes available to upgrade heavy cuts into lighter ones.

AUDIENCE
Engineers and supervisors interested or involved in the processing of heavy cuts.

LEARNING OBJECTIVES
- To understand differences between refining conversion processes with regard to planning, operations and investment issues.
- To analyze the operating parameters of these conversion processes.
- To acquire the basics for operating cracking units.
- To be updated on the latest developments in heavy cuts processing.

AGENDA

Overview of conversion processes
Origins and characteristics of conversion unit feeds.
Different types of conversion processes (principles, performance, operating ranges, economics): thermal cracking processes, catalytic cracking without hydrogen, catalytic cracking with hydrogen.

Thermal conversion processes
Visbreaking and effects on quantity and stability of heavy fuel oils.
Delayed coking: process characteristics, process flow diagram, purification of the light products with hydrogen and end destination.
Management of coke drum switch and main steps of the decoking procedure, coke handling.
Flexicoking and fluid coker: principle, integration in the refinery and power generation schemes.

Catalytic cracking
Main fluid catalytic cracking processes.
Catcracking feed characteristics.
Mechanisms of catalytic cracking reactions and mode of action of FCC catalysts.
Yields and characteristics of FCC effluents with overview of purification treatments: propylene recovery, alkylation, ETBE and gasoline pool, LCO hydrotreatment.
Analysis of FCC operating balances.
Summary of operating parameters in the reaction section and in the regenerator.
FCC modifications to treat residues: R2R, HOC, etc.

Distillate hydrocracking
Different reactions of the hydrocracking process.
Catalysts: hydrotreating and hydrocracking; poisons and regeneration.
Hydrocracking processes: different types, process flow diagram, operating conditions.
Analysis of hydrocracking operating: parameters, hydrogen balance, sulfur balance.
Associated unit: hydrogen production, sulfur recovery.
Product yields and quality utilizations.

Residue hydrocracking
Overview of existing processes to upgrade vacuum residues: hydrotreatment, hydroconversion.
Associated units.
Refinery configurations with deasphalter.

Lube base stocks manufacture
Classification and required properties of base oils.
Main lube base stocks manufacturing schemes: vacuum distillation unit, deasphalting, extraction, dewaxing, hydrotreating.
Other products: white oils, paraffins, waxes.

WAYS AND MEANS
Numerous case studies based on real industrial situations.

Coordinator: Christian Tison

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<td>EN</td>
<td>Sep 28 - Oct 02</td>
<td>Rueil</td>
<td>2,460 €</td>
<td><a href="mailto:rc.rueil@ifptraining.com">rc.rueil@ifptraining.com</a></td>
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For additional in-house courses, please see the In-house Training section page 114

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Refining & Chemicals
Crude Oil and Vacuum Distillation

AGENDA

Impact of crude oil quality on products
0.5 d
Tuning of the volatility of petroleum fractions in view of their end-use: constraints and flexibility of cut points; principal problems related to quality.
Crude oils: properties (TBP analysis), product yields, related margins.
Main schemes for crude oil fractionation.

Operating conditions of an atmospheric and vacuum distillation units
2 d
Material balance: cut points, product characteristics, separation quality.
Top condensation and pressure in the column - Partial pressures.
Feed vaporization: inlet temperature, overflash.
Product stripping: steam stripping and heat stripping.
Heat balance of the column - Pumparound and heat integration.
Modern internals for crude oil distillation column.

Desalting and corrosion control
0.5 d
Corrosion by sulfur, naphthenic acids and mineral salts.
Crude oil desalting: purpose, functioning of the desalter, operating variables and troubleshooting.
Downstream neutralizing treatment: purpose, advantages and drawbacks.
Controlling corrosion at the head of tapping column and anti-corrosion techniques.

Safety and environmental concerns
0.5 d
Risks related to main equipment: furnace, pumps, vacuum system.
Heat recovery optimization and energy consumption.
Efficient and low energy consumption vacuum equipment (steam ejector vs liquid ring pump).

Process control, operation and troubleshooting of multi-draw-off columns
1 d
Different control systems in atmospheric and vacuum distillation columns, using flowrate, level or temperature control.
Cut point control: modification of flowrate of a cut and consequences on the column.
Impact of the preflash on the operation of the furnace and the atmospheric column.
Separation control: tuning of the separation selectivity, consequences on the column and on the heat recovery system.
Influence of pressure and pressure control.
Case studies on overall control setup of these two distillation columns and disturbances.
Maximizing the performances of the unit under constraints or limit conditions.
Start-up - Shutdown - Troubleshooting.

Disturbances and troubleshooting
0.5 d
Stripping shutdown.
Failure of one pumparound pump.
Loss of part of the feed, etc.

Purpose
To deepen understanding of the operating and monitoring of atmospheric and vacuum distillation units.

Audience
Engineers, senior operation personnel and technical supervisors interested or involved in the operation, optimization and monitoring of crude oil atmospheric distillation and residue vacuum distillation units.

Learning Objectives
- To grasp fundamental process control and the impact of each controller on the process and on the characteristics of the cuts produced.
- To analyze desalter operation and corrosion monitoring.
- To learn about potential deficiencies and troubleshooting.

Ways and Means
Applications, teamwork, case studies and interactive workshops based on typical real situations.

NOTE
Realizado en Español si requerido.
Der Vortrag kann auch auf Deutsch gehalten werden.

Coordinator: Corinne Mathieu

PROGRAM

5 Days

LANGUAGE

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<td>EN</td>
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<td>Rueil</td>
<td>2,350 €</td>
<td><a href="mailto:r.rueil@ifptraining.com">r.rueil@ifptraining.com</a></td>
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Can be tailored to your specific needs and made available at the location of your choice

For additional in-house courses, please see the In-house Training section page 114
Catalysts in Refining Processes

**Level:** Advanced

**AGENDA**

**Characteristics and properties of industrial catalysts**

Main types of catalytic processes and related catalyst markets in the refining and heavy petrochemical industries.

- Main features of catalysis
  - Thermodynamics in a chemical reaction. Kinetics in heterogeneous catalysis.
  - Quality requirements for an industrial catalyst, characterization of its properties.
  - Processes for catalyst synthesis and industrial production of catalysts.

**Operation and performance control of industrial catalysts**

The following items are presented for each process: process and chemical reaction characteristics, selection and developments of catalytic formula, catalyst implementation, process flow diagram, process performances and catalyst monitoring. The specific features for the corresponding type of catalyst are emphasized.

- Catalytic reforming catalysts
  - Precautions for start-up, monitoring and maintaining catalyst activity, incidents.
  - Regeneration steps.
  - Catalytic formulas for the regenerative process.
  - Solution for benzene removal.

- Isomerization catalysts
  - Different types of catalysts and process arrangement. Impact on the resulting octane number.
  - Influence of poisons on the catalytic activity and operational constraints linked to the type of catalyst.

**Precautions and life cycle of catalysts**

- Active phase structure, sulfiding at start-up.
- Specific issues in treating unsaturated cuts from coker, visbreaker and FCC.
- Evolution of catalytic formulas and processes for heavy cuts and residue hydrotreatment.
- Selective hydrogenation and hydrotreatment of FCC gasoline minimizing octane loss.
- Adaptation of catalytic formulas for heavy feedstock hydrocracking.
- Catalysts for Claus converter and tail gas treatment
  - Claus catalysts. Impact of sulfur deposition and temperature on conversion.
  - COS and CS₂ hydrolysis. Deactivation and regeneration.
  - Adaptation to tail gas treatment processes.

**Implementation and life cycle of catalysts**

- Precautions in the transport and the manipulation of catalysts.
- Follow-up of performances, from the start-up to the regeneration; metals recovery.

**Visit of IFP laboratories for catalyst characterization and pilot units**

Demonstration of the instruments and methods used to characterize the properties of the catalysts.

- Presentation of the successive steps of micro-pilot, pilot and semi-industrial scales.

**Coordinators:** Jean-Marie Devès

**WAYS AND MEANS**

- Visit of IFP pilot units and laboratories.
- Course conducted by world-class experts from IFP Energies nouvelles.

**PREPARATIVE**

It is recommended that participants be familiar with the contents of the "Refining Processes and Petroleum Products" course (refer to the corresponding training session) in order to benefit fully from this course.

**AUDIENCE**

Engineers and managers in the operations, process development or technical departments of refineries.

Project engineers, process engineers or technical assistance and commissioning personnel in engineering or licensing and catalyst suppliers.

**LEARNING OBJECTIVES**

- To grasp the role and the basic mechanism of a catalyst.
- To understand the issues related to industrial use (start-up, shutdown, regeneration, etc.).
- To learn the methods for performance monitoring.
- To analyze the influence of operating parameters on catalytic selectivity and stability.

**PREREQUISITE**

- Visit of IFP pilot units and laboratories.
- Course conducted by world-class experts from IFP Energies nouvelles.
Catalytic Reforming for Refining and Petrochemicals

AGENDA

The catalytic reformer within the refinery scheme
- Quality specifications of gasolines; reformulated gasoline and future trends.
- Octane improving processes, integration within the refining processes.
- Needs in hydrogen. Aromatic complex overview, need for benzene and xylenes.
- Influence of feedstocks origins and characteristics on the performances of the units: ISIF,BBP composition (N.A, etc.), physical properties, impurities content.
- Current yields and properties of the reformate in relation with severity.

Operating parameters of a catalytic reformer
- Process flow diagrams and operating parameters of a catalytic reforming unit: semi-regenerative and continuous regenerative. Main control loops.
- Semi-regenerative processes
  - Operating variables: WAT, WAT, H₂/H₂O ratio, flow rates, water and chlorine injection, recycle gas and hydrogen rich gas characteristics, flash drum conditions.
  - Main equipment and metallurgy: features of reactors, heat exchangers and furnace technology, corrosion issues.
- Low pressure technology: continuous regenerative processes
  - Low pressure equipment, recompression section, catalyt circulation: lifit, DP control, seal legs, nitrogen loops for regeneration, etc.
- Analyzers and process control.

Catalytic reforming reactions and catalysts
- Review of the characteristics of all the chemical reactions: thermodynamics and kinetics.
- Influence of the operating parameters on the production of aromatics, hydrogen, octane number, and other yields. Consequences for semi-regenerative and continuous regenerative processes.
- Catalyst properties: role of the acidic and metallic functions, of the support, of the different promoters and their impact on chemical reactions and yields. Water/chlorine balance and management.
- Catalyst composition and selectivity, poisons and ageing factors.
- Catalyst activity follow up and cycle length prediction for semi-regenerative units.
- Catalyst regeneration. Role of each step for an optimal activity. Operating parameters for CCR regeneration loops.

Operation and optimization for catalytic reforming
- Unit operation: monitoring the operating variables and optimization, for semi-regenerative and regenerative units. Operation case studies.
- Flexibility of the continuous process. Performance follow-up.
- Maximizing the performances of the unit under constraints or limit conditions.
- Main steps for start-up and shutdown.

Troubleshooting for catalytic reforming
- RUN or aromatic content decrease: causes, diagnostic and remedies.
- Moisture in the feed, sulfur peak, chlorine peak: diagnosis and remedies.
- Recycle or separation problems, recycle gas analysis.
- Reactor temperature run-off.
- Specific troubles of CCR units: catalyt circulation, regeneration loops, chilling system, nitrogen lift pollution.
- CCR operation with catalyst regeneration problems.

From a refining tool to a petrochemical tool
- Outlets and main use of BX (Benzene, Xylenes), ethylbenzene.
- Technical key points to manage with: catalytical, operating conditions in order to adapt the catalytic reforming unit.
- Basic scheme to upgrade benzene and paraxylene.
- Benzene recovery unit: implementation of an extractive distillation section. Solvents available.
- Economical aspects.
- Operating conditions. Main operating key points during start-up & shutdown.
- Main operating variables and parameters.
- Implementation of an aromatic loop: addition of an isomerization section to optimize the paraxylene recovery unit.
- Operating conditions. Main operating key points during start-up and shutdown. Main operating variables and parameters.

WAYS AND MEANS

Applications, teamwork, case studies and interactive workshops based on typical real situations.

AUDIENCE

Engineers, senior operations personnel or technical supervisory staff interested or involved in the operation, optimization and monitoring of hydrogen and aromatics production units.
Engineers from research centers and engineering companies involved in the different aspects of the operation and process control of these processes.

LEVEL OF PROFICIENCY

Level: Proficiency

Functional problems and technical solutions: catalyst regeneration. Role of each step for an optimal activity. Operating parameters for CCR regeneration loops.

NOTE

Der Vortrag über dieses Thema kann auch auf Deutsch gehalten werden.

Coordinator: Corinne Mathieu

LANGUAGE | DATES | LOCATION | FEES | REGISTRATION CONTACT
---|---|---|---|---
EN | Oct 19 - 23 | Rueil | 2,460 € | rc.rueil@ifptraining.com

Can be tailored to your specific needs and made available at the location of your choice. For additional in-house courses, please see the In-house Training section page 114.
Hydrotreatment Processes and ULSD

Application on RSI IndissPlus simulator

Level: Proficiency

PURPOSE
To deepen understanding of the operating, monitoring and optimizing of hydrotreatment units.

AUDIENCE
Engineers, senior operation personnel or technical supervisory staff interested or involved in the operation of hydrotreatment units.

Learning Objectives
- To grasp the essence of hydrotreatment processes.
- To analyze the operation and optimization of hydrotreatment units.
- To manage the hydrogen balance in relation with the hydrogen network.
- To learn about potential deficiencies and troubleshooting.
- To learn how to meet main breakthroughs for ultra-low desulfurization requirements.

WAYS AND MEANS
- Applications, teamwork, case studies and interactive workshops based on typical real situations.
- Use of a dynamic simulator.

AGENDA

Objectives of hydrotreatment processes
Impurities in petroleum cuts and products; their impact on health, environment and on other refining processes. Highly refractory compounds.
Recent regulations and future trends: quality specifications of petroleum products and fuels in relationship with concerns mentioned above.

The aim of the various treatments with hydrogen and integration in the refining scheme: hydropurifications of straight run cuts, stabilization or saturation of cracked cuts.

Chemical reactions and hydrotreatment catalysts
Characteristics of the chemical reactions involved: thermodynamic and kinetic aspects, consequences on the operation of units, side reactions and optimum operating conditions to deplete their evolution, specific features of reversion reactions.
Characteristics of the catalysts for hydropurification and for hydrogenation: effect of molybdenum, cobalt and nickel, importance of the substrate, selection criteria for a hydrotreatment problem. Top gradings.

Loading of the catalyst. Internals in the reactor.
Presulfiding procedures: role, steps and details of the different methods.

Operation of a distillate hydrotreatment unit
Operating conditions and compositions of the main streams; mass balance and yields, sulfur balance and hydrogen balance and consumption.
Significance of the operating variables and their influence on the process: mean temperatures and profile, pressures, partial pressure of hydrogen, recycle rate, quench ratio, feed flow rate and space velocity.
Advanced process control and optimization of the process.
Management of the hydrogen network in the refinery. Effect of feed composition and origin.
Catalyst follow up and cycle length optimization, ageing and deactivation.
Regeneration steps and monitoring.

Maximizing the performances of the unit under constraints or limit conditions.

Disturbances, incidents and troubleshooting
Causes of quality decrease and corresponding actions.
Main automatic safety systems.
Feed pump failure, heater failure.
Compressor failure: fresh gas or recycle, adapted reaction and safe shut down.

Performance of the various hydrotreatment units
For each of the following processes, the operating parameters and the specific operating features are explained.
Naphtha desulfurization for catalytic reformer and isomerization feed.
Cracked gasoline treatments, special hydrotreatments for the FCC gasoline.
Stabilization of the pyrolysis gasoline.
Hydroisomerization of the C₅ cut out of the FCC to feed alkylation unit.
Hydrotreatment of middle distillates: kerosene and gas-oil, LCO processing.
Desulfurization of vacuum gasoil to FCC units.
Residues demetallization processes.
Hydrotreatments in lube oil manufacturing.
Hydrogen manufacturing or enrichment processes.

Specific developments to meet the ultra-low desulfurization of gasoline and diesel fuels
High performance catalysts, grading materials, advantage of the dense loading, technology of the reactor and exchangers, operating conditions, recycle gas treatment, hydrogen purification, advanced process control.

NOTE
Der Vortrag über dieses Thema kann auch auf Deutsch gehalten werden.

Coordinator: Carole Le Mirronet

Can be tailored to your specific needs and made available at the location of your choice.
Production of Olefins and Aromatics

Level: Discovery

PURPOSE
To provide a technical overview of the main processes used to produce olefins and aromatics.

AUDIENCE
Professionals in the oil or petrochemicals industry interested in olefins and aromatics. Specifically for engineers and technical staff who are beginners in this industry, as well as subcontractors, traders, etc.

LEARNING OBJECTIVES
- To list the sources and outlets of olefinic and aromatic compounds.
- To review the manufacturing processes in the petrochemicals industry.
- To grasp the contours of the petrochemicals industry’s economic framework.

WAYS AND MEANS
- Detailed course material, with a glossary of the main technical terms used in the petrochemicals industry.
- Presentation of plastics sample from plants.
- Presentation of end uses application samples.

AGENDA

Sources, outlets and main industrial uses of olefinic and aromatic intermediaries
Main production processes: steam cracking, catalytic reforming, fluid catalytic cracking.
Outlets and main uses of:
- olefinic and diolefinic hydrocarbons: ethylene, propylene, butenes, butadiene
- aromatics hydrocarbons: benzene, toluene, ethylbenzene, xylenes.

Steam cracking and treatment of the cuts produced
Pyrolysis
Analysis of the steam cracking process of hydrocarbon feedstocks.
Implementation: furnaces, quench systems, primary separation.
Yields. Operating variables affecting the severity of treatment. Influence of the feedstock nature.
Compression and purification of the cracked gases
Implementation of compression.
H₂S and CO₂ removal by caustic washing.
Gas drying by adsorption.
Cooling: propylene and ethylene chilling cycles, cold box.
Separation and treatment of steam cracker effluents
Steam cracker effluent separation train, main characteristics of the cuts produced.
Specific impurities and particular constraints; acetylene removal from the C₂ cut, selective hydrogenation of MAC and propadiene in the C₃ cut.
Treatment of the C₄ cut, 1,3- butadiene, isobutene and 1- butene recovery.
Upgrading of pyrolysis gasoline production of motor fuels, benzene and other aromatics recovery.

Production of aromatics
Catalytic reforming and BTX production
Analysis of the process, the catalyst, yields, operating variables.
Characteristics of BTX reformate. Influence of the nature and cut points of the feeds.
Aromatics and non-aromatics separation processes: liquid-liquid extraction, extractive distillation.
Associated processes: hydrodealkylation, isomerization.
Aromatics separation processes: distillation, adsorption, crystallization, application to paraxylene.
Styrene production: benzene alkylation, ethylbenzene dehydrogenation; manufacturing conditions.

Coordinator: Philippe Bossennec

Language Dates Location Fees Registration Contact
EN May 27 - 29 Rueil 1,700 € RRU rc.rueil@ifptraining.com
EN Oct 06 - 08 Bahrain 1,850 € RRU rc.rueil@ifptraining.com

Can be tailored to your specific needs and made available at the location of your choice
For additional in-house courses, please see the In-house Training section page 114

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Base Chemicals and Polymers Manufacturing*

**PURPOSE**
To provide a comprehensive understanding of and practical expertise in monomer manufacturing, polymerization processes, storage and transport of products, with attention to environmental, safety, quality and economic issues.

**AUDIENCE**
Engineers interested in a foundation training on polymers.

* This program is the second part of a 16-month Master degree program at IFP school. It is highly recommended that participants be familiar with topics covered in the course "Applied Chemical Engineering for the Refining and Petrochemical Industries" (refer to GCA/ACE).

**LEARNING OBJECTIVES**
- To participate in studies involving the design, sizing and economics of processes used in the refining, petrochemicals, polymers and plastics sectors.
- To acquire the know-how for a position in production.
- To acquire a thorough knowledge of industrial incidents and related safety and environmental issues.
- To grasp the essence of the collaboration between R&D and Production departments.
- To analyze the quality of manufactured products.
- To understand the relations between suppliers and manufacturers in the plastic's chain.

**WAYS AND MEANS**
- Case studies based on industrial situations.
- Visits to industrial sites.

**AGENDA**

**Base chemicals and monomers manufacturing**
11 d
First and second generation monomers.
Chemical reaction fundamentals, description of industrial units, operating parameters, purification, polymer grades.
Technical visit of an industrial plant (if possible).

**Chemical engineering and basics for polymerization**
21 d
Macromolecular chemistry fundamentals, polymer structure, conformation and properties, characterization methods.
Polymers derived from the main monomers.
Chemistry of polymerization. Rheology. Chemical engineering of non-Newtonian viscous media.
Different types of industrial processes (batch or continuous polymerization).

**Polymer manufacturing**
5 d
Main polymerization reactions and processes, unit description, main operating parameters, technical evolution of processes, troubleshooting, main producers, market trends, economics.
Overview of polymer processes.
Technical visit of an industrial plant (if possible).

**From innovation to industrial reality**
10 d
A period of two weeks in Italy is organized with lectures, case studies and plant visits.
Development of a product (PP) and associated process, main characteristics of PP, industrial manufacturing process, main relations between the operating parameters and final characteristics of the product.

**Risk management**
6 d
Methodology for organizing a sustainably safe and clean operation of a petrochemical plant.
Reaction run-away and run-away prevention, powder explosions. How to handle toxic chemicals.
Life cycle analysis of products.

**Technical and economic study**
12 d
General economics, competitor analysis, benchmarking.
Conceptual study of a new petrochemical plant project.

**Overview of polymer processing**
15 d
Structure of polymer processing industry.
Various processing technologies.
Optimum technico-economical selection of material during final product development.
Resin specifications, process control and quality control.

(1) 5 days are spent at the “Institut Supérieur de la Plasturgie”, in Alençon - France (ISPA).

**NOTE**
Locations:
Rueil-Malmaison (Paris)
Ferrare (Italy)
Alençon (France)

Coordinator: Carole Le Mirronet

**LANGUAGE** | **DATES** | **LOCATION** | **FEES** | **REGISTRATION CONTACT**
--- | --- | --- | --- | ---
EN | Mar 02 - Jun 23 | Rueil | 17,280 € | RRU | rc.rueil@ifptraining.com

For additional in-house courses, please see the In-house Training section page 114
Production of Paraxylene - Aromatic Loop

Level: Proficiency

AGENDA

Sources, outlets and main industrial uses of aromatic intermediaries 0.25 d
Main sources: catalytic reforming, steamcracker, coke oven gases.
Outlet and main uses of: benzene, toluene, ethylbenzene and xylenes.

Aromatics complex schemes 0.25 d
Arrangements available related to downstream markets.
Naphtha to paraxylene typical scheme.
Alternate schemes.

High severity - Catalytic reforming for rings generation 0.25 d
Technologies available: semi-regenerative and regenerative.
Main differences.
Influence of feedstocks origins and characteristics on the performances of the units.
Constraints.
Current yields and properties of the reformate in relation with severity.

Operating parameters of a catalytic reformer 1 d
Process flow diagram and operating parameters of a continuous catalytic reforming unit. Main control loops.
Operating variables: WAST, WAIT, H₂/HC ratio, flow rates, water and chlorine injection, recycle gas and hydrogen rich gas characteristics, flash drum conditions.
Main equipment and metallurgy: features of reactors, heat exchangers and furnace technology, corrosion issues.
Specificities for low pressure technology:
Low pressure equipment, re contacting section, catalyst circulation: lifts, ΔP control, seal legs, nitrogen loops for regeneration, etc.
Analyzers and process control.

Catalytic reforming reactions and catalysts 0.5 d
Review of the characteristics of all the chemical reactions: thermodynamics and kinetics.
Influence of the operating parameters on the production of C6-C8 aromatics, hydrogen, octane number, and other yields. Consequences for the process.
Catalyst properties: role of the acidic and metallic functions, of the support, of the different promoters and their impact on chemical reactions and yields. Water/chlorine balance and management.
Catalyst composition and selectivity, poisons and ageing factors.
Catalyst regeneration. Role of each step for an optimal activity. Operating parameters for CCR regeneration loops.

Operation and optimization for catalytic reforming 0.5 d
Unit operation: monitoring the operating variables and optimization, for regenerative units.
Flexibility of the continuous process towards maximizing the yield in BTX. Performance follow up.
Maximizing the performances of the unit under constraints or limit conditions.
Main steps for start-up and shutdown.

Reformate separation train 0.25 d
Different schemes and purposes.
Focus on C8 cut treatment.
C8 cut composition ex reformate.

Paraxylene recovery unit 1.5 d
Technologies available: PAREX and ELUXYL processes.
Principles and details of an ELUXYL process.
Main operating parameters.
Main steps for start-up and shutdown.

Refining upgrading 0.5 d
Refining composition.
Catalytic isomerization reactions and catalysts.
Schemes available.
Operating conditions.
Main steps for start-up and shutdown.

Audience
Engineers, senior operations personnel or technical supervisory staff interested or involved in the operation, optimization and monitoring of hydrogen and aromatics production units. Engineers from research centers and engineering companies involved in the different aspects of the operation and process control of these processes.

LEARNING OBJECTIVES
- To assess the influence of operating parameters on a unit performance through an analysis of the catalyst’s activity.
- To optimize the process for achieving the targeted yield in BTX.
- To learn about potential deficiencies and troubleshooting.
- To acquire the best practices for unit start-up, normal operation and shutdown.

Ways and Means
Applications, teamwork, case studies and interactive workshops based on typical real situations.

Coordinator: Philippe Bossemerc
Petroleum Products

Level: Proficiency

PURPOSE
To deepen knowledge of petroleum products’ characteristics and improve skills in the production process.

AUDIENCE
Engineers, managers and commercial or technical staff whose activities are related to the production, storage, purchasing, marketing or use of petroleum products. Also suitable for engineers and managers in the refining industry interested in improving their knowledge of petroleum products.

LEARNING OBJECTIVES
- To learn about components of petroleum products.
- To grasp the main characteristics of petroleum products and their relevance for end-users.
- To identify recent changes and future trends.

WAYS AND MEANS
Up-to-date information on commodities thanks to close contacts with IFP Energies nouvelles experts.

AGENDA

Worldwide market - Price and cost management
World oil consumption: price variation, demand, production. Main petroleum products: worldwide demand, trading, consumption, prices and taxes. 0.5 d

Origin and composition of petroleum products
Composition and main characteristics of crude oils. Classification and characteristics of petroleum products. Principle of oil refining processes and of the formulation of commercial products: main properties of blending components, blending. Standard quality control tests: standards and testing organizations, test principles, accuracy of the methods, specifications. 0.5 d

Properties, characteristics and formulation of combustible products
For each major product (LPG, automotive gasoline, jet fuel, automotive diesel fuel, heating oil and heavy fuel oils), the following aspects are developed:
- Market trends - Volatility characteristics - Combustion properties - Behavior under cold conditions and flowing - Corrosiveness, effect on air pollution - Stability, storage behavior - Manufacturing schemes - Main additives incorporated in the refinery - Performance additives added at the terminal.
- In addition, in view of current trends, emphasis is placed on the following issues:
  - Automotive gasoline: octane numbers, catalytic converters, benzene and aromatics content, addition of oxygenated compounds, impact of the formulation on the engine emissions.
  - Automotive Diesel Oil:
    - problems raised by the huge increase of the diesel car population
    - efficient protection for injection systems; interest of agrofuels.
    - consequences of the new regulation (Euro 6): new post-treatment systems
    - impact of the specifications on the manufacturing schemes.
  - Heating oil: problems related to the increase of cracked Diesel fuels; differences of composition between ADO and HO.
  - Heavy fuel oils: stability of visbroken fuels, environmental constraints: sulfur and metals content, solid unburnt effluents.
3.25 d

Main non-energy products
Bitumen
- The different types of bitumen: pure, cutbacks, polymer-modified, emulsions, etc.
- The major standard tests: penetration, softening, ageing, etc.
- Manufacturing schemes.
Lube base oils
- Lube base oils manufacturing and composition of lubricants: base oils and additives
- Properties and characteristics of base oils: viscosity index, cold properties, oxidation stability, etc.
- Waxes: a high value by-product.
0.75 d

Co-ordinator: Thierry Soto

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For additional in-house courses, please see the In-house Training section page 114

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<td>EN</td>
<td>May 18 - 22</td>
<td>Rueil</td>
<td>2,650 €</td>
<td><a href="mailto:rc.rueil@ifptraining.com">rc.rueil@ifptraining.com</a></td>
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