2021 COURSE CATALOG

WR Training

Spread the wings of your knowledge

AVAILABLE

AVAILABLE

COMING SOON

COURSE TITLE :	EXPECTED DURATION :	PAGE :
10. Refinery Desulfurization : Principles, Operation & Design	7 h	-
11. Lubricant Base Oil & Wax Processing	6 h	-
12. Polymerization Processes : PE & PP Unipol Gas Phase Fluidized Bed Reactors	10h	-
13. Polymer Extruders : Principles, Operation & Design	10h	-

COMING SOON

OVERVIEW OF THE OIL & GAS INDUSTRY

Esso

bp

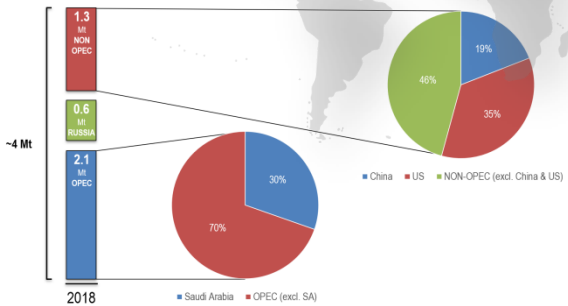
Mobil

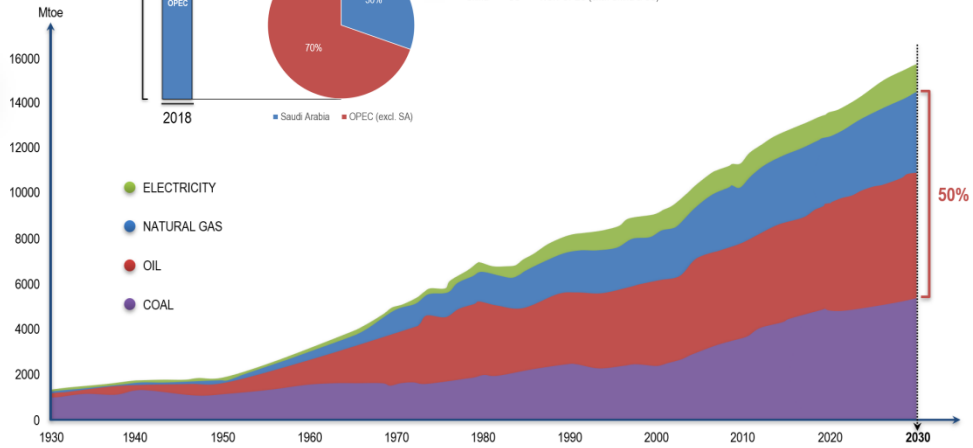
TOTAL

أرامكو السعودية
saudi aramco

Eni

中国石油天然气集团公司
CHINA NATIONAL PETROLEUM CORPORATION





WR Training
Spread the wings of your knowledge

COURSE DESCRIPTION :

This course is designed to give you a comprehensive picture of the international Oil & Gas industry : from its earliest development at the end of the 19th century to the current situation.

The course uses up-to-date global statistics and is organized into 3 parts :

1. The first part outlines the main characteristics of the petroleum industry, reviews the major events of its history and the associated geopolitics, analyses the place of oil among all energy sources and forecasts future prospects for oil production and demand

2. The second part outlines the roles of the main players within the petroleum industry: consumer countries, major companies and producing countries (OPEC and non-OPEC)

3. The third part provides a quick review of the scale of investments and profitability in the oil industry

THIS TRAINING COURSE WILL HIGHLIGHT :

- ✓ History of the Oil industry
- ✓ Up-to-date global statistics of Oil & Gas
- ✓ Energy resources : definition, characteristics, conversion factors…
- ✓ Energy demand and supply : evolution factors (reserves, technology, etc.) and scenarios
- ✓ Strategies of actors : producer and consumer countries, national, independent and international oil companies, international organizations (OPEC, IEA, etc.)
- ✓ Financial and political stakes, geographical and environment constraints
- ✓ Forecasts of future energy demand
- ✓ Investments and profitability of the oil industry

WHAT YOU WILL LEARN :

✓ Gain a broad perspective of the global oil and gas business

✓ Describe the different types of energy resources (conventional, unconventional, renewable & fossil)

✓ Interpret the evolution of the factors affecting the energy supply and demand (crude prices, technology, reserves, geopolitics, geography, environment, etc.)

✓ Identify the actors of the energy scene and their strategic guidelines

✓ Understand and appreciate the future energy challenges in terms of production and demand

COURSE CONTENT (1/2) :

1. INTRODUCTION

2. OIL IN OUR ECONOMIC LIFE
Oil in our economic life : Introduction
The role of oil in our economic life

3. THE CHARACTERISTICS OF THE OIL INDUSTRY
Centers of production and demand
Exploration risks
The importance of capital investment
Associations between companies
The concentration of production

4. A BRIEF HISTORY OF THE OIL INDUSTRY AND PETROLEUM REFINING
The beginnings of the oil industry
The Rockefeller era
The development of the oil industry
The world oil order before 1960
The formation of the OPEC and the 2 oil shocks
The consequences of the 2 oil shocks
The 1986 oil counter shock
The Gulf Crisis
The current situation

5. ENERGY, OIL AND ECONOMIC DEVELOPMENT
Energy equivalence
The world energy balance
Regional energy balances
Energy consumption and wealth
Energy consumption and price

6. ENERGY CONSUMPTION FORECAST

7. ENERGY RESOURCES

COURSE CONTENT (2/2) :

8. PRODUCTION OF OIL AND GAS
The historical development
The current position
Future prospects
The production of natural gas

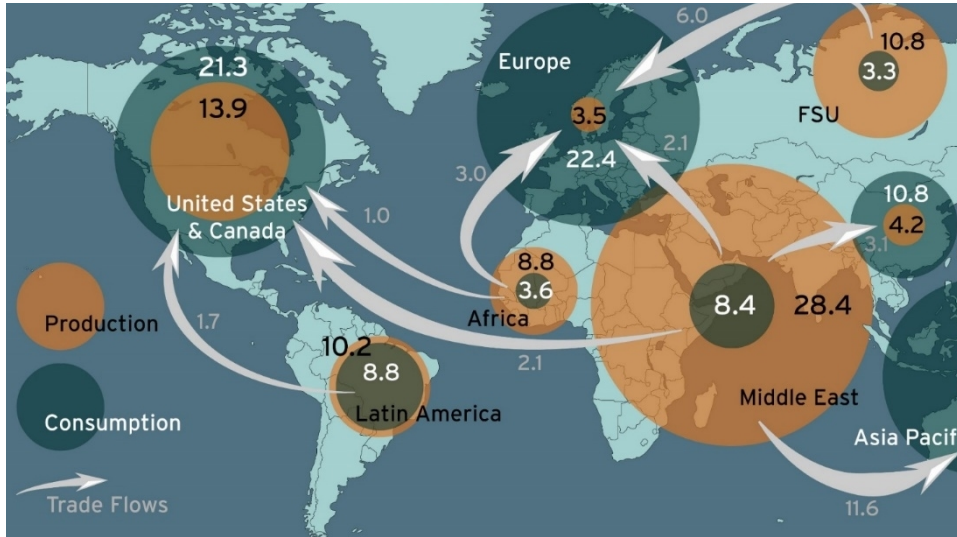
9. THE PLAYERS OF THE OIL SCENE
The consuming countries
OPEC
The major oil companies

10. INVESTMENTS

11. PROFITABILITY

12. CONCLUSION

OIL & GAS MARKET, TRADING & ECONOMIC FRAMEWORK



COURSE DESCRIPTION (1/2) :

This training course is designed to provide you with a complete understanding of the **physical and financial markets** for crude oil and petroleum products.
It is geared towards all personnel in the petroleum or associated industries needing to improve their knowledge and understanding of crude oil and petroleum products **trading** and **pricing mechanisms**.

The course uses **up-to-date global statistics** and is organized into 3 parts :

PART 1 : CRUDE & PETROLEUM PRODUCTS PHYSICAL TRADING
What is the value of a crude oil ?
Different types of contracts :

- Long term
- Spot
- Forward

Main oil markets and their features
Key benchmark crudes
The role of the Price Reporting Agencies (PRAs)
Links between Trading and Shipping
Products trading
Main provisions of a sale/purchase contract

COURSE DESCRIPTION (2/2) :

PART 2 : EXCHANGES & FUTURES TRADING

The concept of volatility

Definition of contract for crude oil and petroleum products

Exchanges and their organization :

- NYMEX
- ICE

Main Futures Markets

Hedging principles

Hedging imperfections and associated risks

Market structure :

- Contango
- Backwardation

PART 3 : DERIVATIVES

Options : principles, basics and characteristics

Interests and limits of options

Swaps : principles, basics and characteristics

Interests and limits of swaps

WHAT YOU WILL LEARN :

- ✓ Review the different oil trading markets by type of transaction
- ✓ Summarize the operation of the physical and financial oil markets
- ✓ Review the different types of contracts: long term, spot and forward
- ✓ Understand how crude oil and petroleum products are traded
- ✓ Understand the pricing mechanism of crude oil and petroleum products
- ✓ Analyze the parameters which influence prices of crude oil and prices of petroleum products
- ✓ Review the different exchanges and their organization: the cases of NYMEX and ICE
- ✓ Comprehend hedging techniques available for protection against fluctuations in prices
- ✓ Understand the principle of financial derivative products like Swaps and Options

COURSE CONTENT (1/2) :

1. INTRODUCTION

2. CRUDE OIL : A UNIQUE RAW MATERIAL
Introduction
A marker price
Different strategies

3. INTERNATIONAL OIL TRADE
Introduction
The 1970s : Long term contracts
The 1980s : The development of spot markets
The netback contracts
The 1990s : The development of financial markets

4. PRICES ON THE OIL MARKETS
Introduction
The different types of agreements
Crude oil price setting mechanism
Product price setting mechanism

5. TRADING ON THE OIL MARKETS
Barter agreements
Single cargo sales
Long term contracts

6. THE SPOT MARKETS
Definition
Spot markets in the world
Operators on the spot markets
The balance between crude oil and product prices

7. SPOT CRUDE OIL PRICES
Spot transactions
The Brent market
The Brent crude oil
Price transparency
Indexing crude oil prices : The adjustment factor
Indexing crude oil prices : Reference indices
Indexing crude oil prices : The price timing
The limitation of the system

COURSE CONTENT (2/2) :

8. PETROLEUM PRODUCTS PRICE SETTING MECHANISM
Example #1 : The Rotterdam products market
How prices are reported

9. THE PHYSICAL FUTURES MARKETS
The forward market
The principle of cover
Speculation
The players on the forward markets
Dated Brent and 15 Day Brent
The limitations of the forward markets

10. THE FINANCIAL FUTURES MARKETS
The historical development of the petroleum exchanges
Futures contracts
How the markets work : Generalities
How the markets work : The clearing house
How the markets work : The deposit
How the markets work : The margin call
The participants
Pricing structures : Backwardation and Contango
The limitations of the futures markets

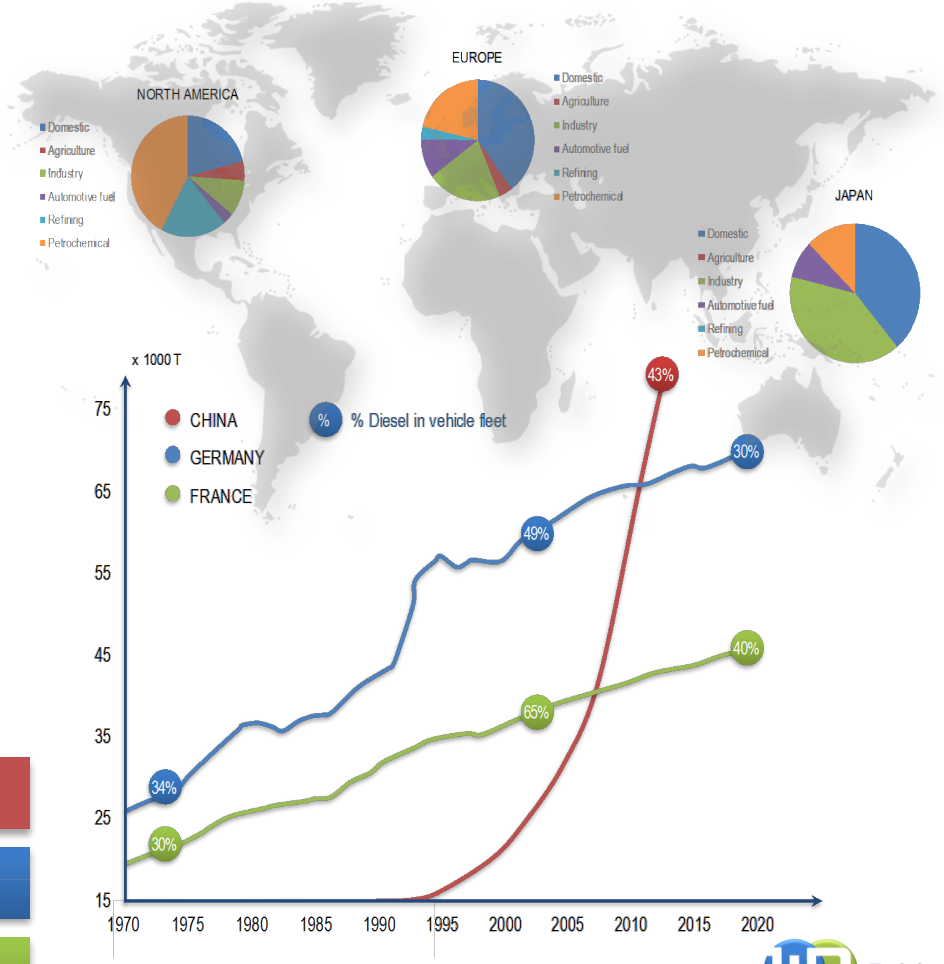
11. DERIVATIVE PRODUCTS : SWAPS AND OPTIONS
The definition of an option
Example of the use of an option : Call option
Example of the use of an option : Put option
The cost of an option
The definition of a swap
Example of the use of a swap

12. CONCLUSION

中国石油天然气集团公司
CHINA NATIONAL PETROLEUM CORPORATION

PETROLEUM PRODUCTS

- SPECIFICATIONS
- PRODUCTION
- DEMAND



WR Training
Spread the wings of your knowledge

COURSE DESCRIPTION (1/5) :

This course is designed to provide you with a deep knowledge of petroleum products' **properties**, **specifications**, **markets** and **demands**.

The petroleum products covered are the following :

- **LPG**
- **Automotive Gasoline**
- **Kerosene / Jet fuel**
- **Gas oil**
- **Heating oil**
- **Heavy fuel oil**
- **Naphtha**
- **Asphalts**
- **Lubricating oil**

The course also provides technical knowledge related to the **standard quality control tests** performed in refineries and petrochemical plants to ensure that the finished products are in line with commercial specifications.

COURSE DESCRIPTION (2/5) :

The course uses **up-to-date global statistics** and is organized into 4 parts.

For each petroleum product :

Part 1. Outlines its main characteristics and properties

Part 2. Reviews its main specifications and how these specifications evolved over time and for different countries

Part 3. Describes the standard quality control tests performed in refineries and petrochemical plants, highlights the tests significance and the accuracy of the methods

Part 4. Analyses the place of this particular petroleum product, the associated market trends and forecasts future prospects for production and demand

COURSE DESCRIPTION (3/5) :

The course includes **24 downloadable resources** in pdf format with **un**limited access. These resources cover 3 topics :

TOPIC 1. MAIN QUALITY STANDARDS AND SPECIFICATIONS OF PETROLEUM PRODUCTS

1. Volatility specifications for :
Automotive gasoline
Jet fuel
Diesel fuel
Heating fuel
Heavy fuel oil
Paraffinic base oils
Asphalts

2. Combustion specifications for :
Automotive gasoline
Jet fuel - Jet A1
Diesel fuel
Heating fuel
Heavy fuel oil

3. Cold condition behavior and flowing specifications for :
Jet fuel - Jet A1
Diesel fuel
Heating fuel
Heavy fuel oil

4. Pollution and corrosiveness specifications :
Sulfur content
Corrosiveness
Miscellaneous pollutants

5. Stability specifications :
Automotive gasoline
Jet fuel
Diesel fuel / Heating fuel
Heavy fuel oil

6. Asphalts specifications

7. Lube base oil specifications

COURSE DESCRIPTION (4/5) :

The course includes **24 downloadable resources** in pdf format with **un**limited access. These resources cover 3 topics :

TOPIC 2. STANDARD QUALITY CONTROL TESTS OF PETROLEUM PRODUCTS

1. Tests related to volatility :
ASTM distillation test
Reid vapor pressure
Flash point

2. Tests related to combustion :
Octane number of gasoline
Cetane number of diesel fuel
Smoke point for aviation turbine fuels
Standard test related to fuel combustion

3. Tests related to storage & flowing :
Viscosity measurements
Lubricating properties of diesel fuel
Cloud point
Pour point
Filterability limit
Freezing point

4. Tests related to air pollution :
Air pollution and corrosion due to sulfur
Sulfur measurements
Copper strip corrosion
Doctor test

5. Tests related to stability of gasoline, fuels & distillates :
Gum content
Induction period
Fuel stability
Oxidation stability of diesel fuel
Water and sediment
Asphaltene precipitation with normal heptane
Insoluble content test
Color and color stability tests

6. Tests related to asphalts :
Needle penetration
Softening point

COURSE DESCRIPTION (5/5) :

The course includes **24 downloadable resources** in pdf format with **un**limited access. These resources cover 3 topics :

TOPIC 3. SPECIFICATIONS OF PETROLEUM PRODUCTS BY COUNTRY

USA	BELGIUM	SAUDI ARABIA
FRANCE	BOLIVIA	SPAIN
CHINA	BRAZIL	SOUTH KOREA
INDIA	IRAN	VENEZUELA

WHAT YOU WILL LEARN :

- ✓ Grasp the main characteristics of petroleum products and their relevance for end-users
- ✓ List the key properties for automotive fuels (now and in the future)
- ✓ Identify recent changes and future trends for the petroleum products' specifications, markets and demand
- ✓ Identify the main trends of fuel evolution due to: new regulations and/or new motor technologies
- ✓ Understand how the main properties of each petroleum products are measured, checked and controlled using standard quality control tests
- ✓ Understand the tests significance and accuracy of the methods

COURSE CONTENT (1/2) :

1. INTRODUCTION

2. PETROLEUM PRODUCTS
Many products, many applications
Various classifications
Specifications

3. THE DEMAND FOR OIL PRODUCTS
Current consumptions
How consumption changed – Overview
How consumption changed by market sector
How consumption changed - Automotive fuels
Demand for automotive fuels
The automotive vehicle fleet
Gasoline or Gas Oil ?
Future demand for gasoline and gas oil
Consumption of automotive fuels - Income and price

4. GASOLINE
Octane number
Vapor pressure
Relative density
Various gasoline grades with # octane numbers
Unleaded gasoline
US oxygenated and reformulated gasolines
Europe : The Auto Oil Programme

5. GAS OIL
Main characteristics
Auto-ignition and Cetane Index
Cold temperature performance
Sulfur content
Appearance

COURSE CONTENT (2/2) :

6. HEATING GAS OIL
Generalities
The market for heating gas oil
Specifications

7. HEAVY FUEL OIL
Generalities
Heavy fuel oil consumption
Specifications

8. LIQUEFIED PETROLEUM GAS – LPG
Generalities
LPG production
The market for LPG

9. NAPHTHA AND PETROCHEMICAL FEEDSTOCKS

10. JET FUEL
Generalities
The market for jet fuel
Specifications

11. LUBRICATING OIL
The market for lubricating oil
Some technical aspects

11. BITUMEN
Generalities
Bitumen demand

12. CONCLUSION

COURSE DESCRIPTION :

This course is designed to give you a comprehensive picture of the international oil logistics : from transport of crude oil to refineries, to dispatch of commercial petroleum products.

The course is organized into 2 parts :

- The first part is an analysis of transport problems, particularly the transport of crude oil. We discuss : sea transport first, different types of tankers, different types of charters, costs and prices for this type of transport, the regulatory framework and operational matters. Then we consider transport by pipeline.

- The second part deals with the different ways of delivering finished products from a refinery : by water, pipeline, rail or road, and the different restrictions that apply to them. Finally, we review the various controls that apply to dispatch.

THIS TRAINING COURSE WILL HIGHLIGHT :

- ✓ Up-to-date global statistics of oil & gas
- ✓ Update you of the various methods and technologies used to transport oil, gas and their products
- ✓ Essentials of international oil and gas supply, economics and transportation
- ✓ Primary logistics – tanker freight costs and chartering
- ✓ Supply logistics – major international pipelines, shipping routes, and choke points

WHAT YOU WILL LEARN :

- ✓ Gain a broad perspective of the global oil and gas business : supply and transportation
- ✓ Understand logistics and supply principles and practices
- ✓ Use Worldscale reference to charter a ship and to calculate the profitability

AVAILABLE

COURSE CONTENT :

1. INTRODUCTION

2. THE DIFFERENT METHODS OF TRANSPORT

3. MARINE TRANSPORT
The different types of tankers
The different types of charters
The cost of marine transport
The price of marine transport
Prices and costs of marine transport
Regulations : National flag requirement
Flags of convenience
Operating aspects
Controls on loading
Administrative formalities
The reception of tankers

4. TRANSPORT BY PIPELINE

5. COMPARING TRANSPORT COSTS

6. STORAGE AND DELIVERY TO THE REFINERY

7. DISPATCH OF PETROLEUM PRODUCTS
Dispatch by pipeline
Dispatch by water
Dispatch by rail
Dispatch by road

8. CONTROLS AT DISPATCH
Quality
Quantities
Administrative accounting methods
Customs formalities

COURSE DESCRIPTION :

This course is designed to provide you with a complete understanding of the crude oil refining industry and breaks down for you all the major refining processes into **easily digestible concepts** using extensive graphics, process layouts and various manufacturing schemes.

You will first get a quick overview of the petroleum industry to put things into perspective before your journey begins. Then you will discover the **different types of crude oil**, their composition and the chemical properties of their hydrocarbon components and how refiners separate these molecules using a process called **distillation**.

You will also learn the **major conversion processes** used to upgrade petroleum cuts into better quality blending components for the production of gasoline, diesel, heating oil and heavy fuel.

These processes include :

1. Isomerization
2. Alkylation
3. Catalytic reformers
4. Hydrotreaters
5. Fluid catalytic crackers
6. Hydrocrackers
7. Delayed cokers

For each of these conversion processes, you will learn :

✓ Operating principles
✓ Process flow diagram
✓ Operating conditions
✓ Associated yields
✓ Catalysts used

Asphalts and **lubricating oils** are also covered in this course. You will learn how these products are made from crude oil and discover their associated manufacturing processes.

WHAT YOU WILL LEARN :

✓ Comprehend the basic differences between exploration, refining and petrochemicals

✓ Understand the basics of the various refining processes

✓ Learn what crude oils are made of and understand the chemical properties of their hydrocarbon components like paraffins, naphthenes, aromatics…

✓ Learn how the major refining processes work and interact with each other (distillation, isomerization, alkylation, catalytic reforming, hydrotreater, sulfur plant, fluid catalytic cracking, hydrocracking, delayed coking, asphalt/lube plant...)

✓ Understand how the main petroleum products are made (LPG, gasoline, kerosene, diesel fuel, heating oil, heavy fuel, asphalts, lubricants...)

✓ Appreciate that aromatics are important to the petrochemical industry even though refineries are trying to minimize these in gasoline due to their toxic properties

✓ Appreciate that olefinic and aromatic petrochemical precursors are specialty chemicals produced by the refining processes

COURSE CONTENT :

1. INTRODUCTION

2. OVERVIEW OF CRUDE OIL REFINING

3. PETROLEUM PROPERTIES
Crude oil : Composition and characteristics

4. DISTILLATION AND FRACTIONATION
Atmospheric distillation
Vacuum distillation
Light cut fractionation

5. CONVERTING PETROLEUM CUTS
Isomerization
Alkylation
Catalytic reforming

6. HYDROFINING PETROLEUM CUTS
Hydrotreating
Sulfur plant

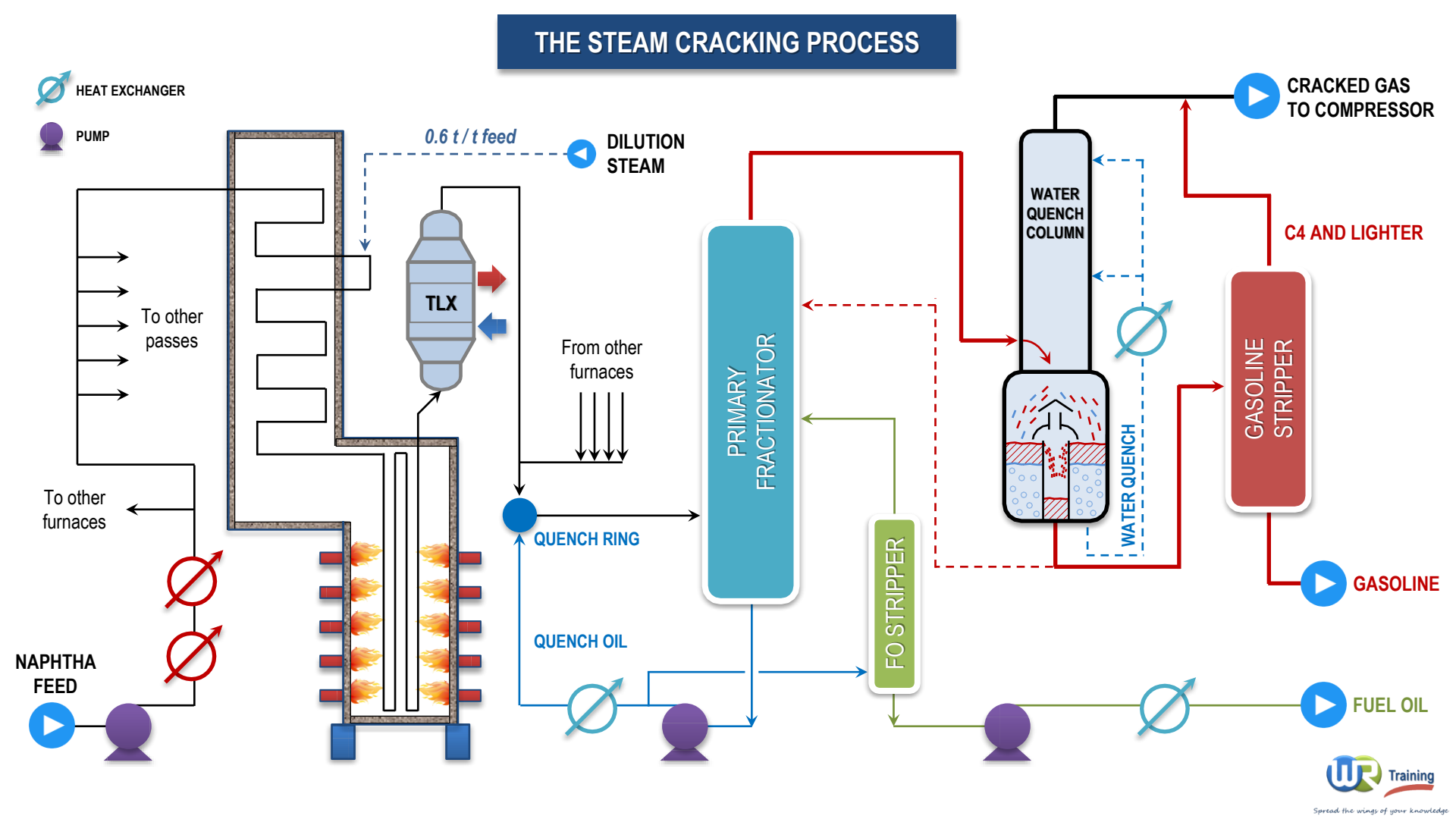
7. CRACKING HEAVY PETROLEUM CUTS
Fluid catalytic cracking
Hydrocracking
Delayed coking

8. BLENDING OPERATION

9. MAKING ASPHALTS

10. A TYPICAL REFINERY OPERATION

THE STEAM CRACKING PROCESS



COURSE DESCRIPTION :

This petrochemical training course is designed to give you an insight into the **chemical processes**, plant **operations** and **economics** of a **steam cracker plant**.

The training course examines the intricacies of a petrochemical steam cracker plant and breaks them down into core building blocks whose concepts will be explained in a **clear easy to understand language**.

So whether you are an operator, an engineer, a newly-hired or a support personnel working in a petrochemical plant or simply you are looking for a better understanding of this stimulating field, then you've come to the right place.

The course is organized into 6 sections :
- Petrochemical activities overview
- What you need to know about organic chemistry
- About steam cracking plants
- The steam cracking process
- Selective hydrogenation
- A typical steam cracking process

The course also contains notes that you can download and where you find the most important things to remember. It's like Cliff Notes for books, but for steam cracking. Everything you need to know about process schemes, layouts, feedstock characteristics and properties, products, economics and much more…

WHAT YOU WILL LEARN :

- ✓ Comprehend the basic differences between petroleum refining and petrochemicals
- ✓ Understand the basics of the steam cracker process
- ✓ Identify the basics of the different building blocks of petrochemicals

AVAILABLE

COURSE CONTENT :

1. INTRODUCTION

2. PETROCHEMICAL ACTIVITIES OVERVIEW
Petrochemical plants : location, possible feedstocks and main products

3. WHAT YOU NEED TO KNOW ABOUT ORGANIC CHEMISTRY
PONA : Paraffins, Olefins, Naphthenes and Aromatics

4. ABOUT STEAM CRACKER PLANTS
A little history
Cracking conditions
Feedstocks and yields
Investment and economics

5. THE STEAM CRACKING PROCESS
Introduction
The hot zone
The compression zone
The cold zone

6. SELECTIVE HYDROGENATION
Characteristics of hydrogenation
Hydrogenation of steam-cracked C2 cut
Hydrogenation of steam-cracked C3 cut
Hydrogenation of steam-cracked C4 cut
Hydrostabilization of steam-cracked gasoline

7. A TYPICAL STEAM CRACKER PROCESS
Process summary, production key figures and downstream units

INTRODUCTION TO :

PROCESS CONTROL

INSTRUMENTATION

COURSE DESCRIPTION :

Control in process industries refers to the regulation of all aspects of the process. Precise control of level, temperature, pressure and flow is important in many process applications.

This course introduces you to control in process industries, explains why control is important, identifies different ways in which precise control is ensured and illustrates the different set of instrumentations used to perform measuring tasks for temperature, pressure, flow and level.

The course includes extensive **graphics, cut sections, process schemes and 3D animations** to give you a virtual practical exposure on process control and instrumentation.

The objective of this course is twofold :

1. Break down for you all the process control and instrumentation principles into easily digestible concepts like feedback control, split range, controller tuning, transmitters, differential pressure gauges, etc...

2. Illustrate through 3D animations and cut-sections the main control instrument devices to measure temperature, pressure, flow and level like thermocouples, capacitive pressure gauges, Coriolis flowmeters, etc...

WHAT YOU WILL LEARN (1/2) :

✓ Learn the essentials of process control and instrumentation for a successful career in process industries

✓ Understand the main terms and parameters of process control (Process variable PV, Set point SP, Operating point OP, Error, Offset, Load disturbance...)

✓ Identify the different control loops and describe their main tasks

✓ Describe the basic function and method of operation for the main control loop components (Transducer, Converter, Transmitter, Indicator, Recorder, Controller...)

✓ Given a piping and instrumentation drawing (P&ID), correctly identify, interpret and label the instrument, location and signal type symbols

✓ Differentiate between discrete, multistep, and continuous controllers

✓ Describe the general goal of controller tuning

✓ Describe the basic mechanism, advantages and disadvantages of the following mode of controller action : Proportional, Integral and Derivative

WHAT YOU WILL LEARN (2/2) :

✓Identify the basic implementation of P, PI and PID control in the following types of loops : Pressure, Flow, Level and Temperature loops

✓ Differentiate feedback and feedforward control loops

✓ Diagram the process control loop using ISA symbology

✓ Explain the basic implementation process for each of the following types of control : Cascade, Split range , Batch, Ratio and Selective controls

✓ Understand through extensive 3D animation the techniques and methods used in process industries to measure temperature, pressure, flow and level

COURSE CONTENT (1/2) :

1. INTRODUCTION

2. THE IMPORTANCE OF PROCESS CONTROL
The process
Process control

3. CONTROL THEORY BASICS
The control loop
Process control terms

4. COMPONENTS OF CONTROL LOOPS AND ISA SYMBOLOGY
Primary elements / sensors
Transducers and converters
Transmitters
Signals
Indicators
Recorders
Controllers
Final control elements
Actuators
ISA symbology

5. CONTROLLER ALGORITHMS AND TUNING
Controller algorithms
Why controllers need tuning
Proportional mode (P)
Integral mode (I)
Derivative mode (D)
P, PI and PID control

6. PROCESS CONTROL LOOPS
Control loops : Feedback control
Pressure control loops
Flow control loops
Level control loops
Temperature control loops
Multi-variable loops

COURSE CONTENT (2/2) :

Feedforward control
Feedforward + Feedback
Cascade control
Split range control
Operations on control signals
Ratio control
Batch control
Selective control

7. INSTRUMENTATION : TEMPERATURE MEASUREMENT
Local indicators
Bulb instruments for remote transmission
Thermocouples
Resistance Temperature Detectors (RTDs)

8. INSTRUMENTATION : PRESSURE MEASUREMENT
Hydrostatic manometers
Bourdon tube pressure gauges
Bellows pressure gauges
Strain pressure gauges
Piezoelectric pressure gauges
Capacitive pressure gauges

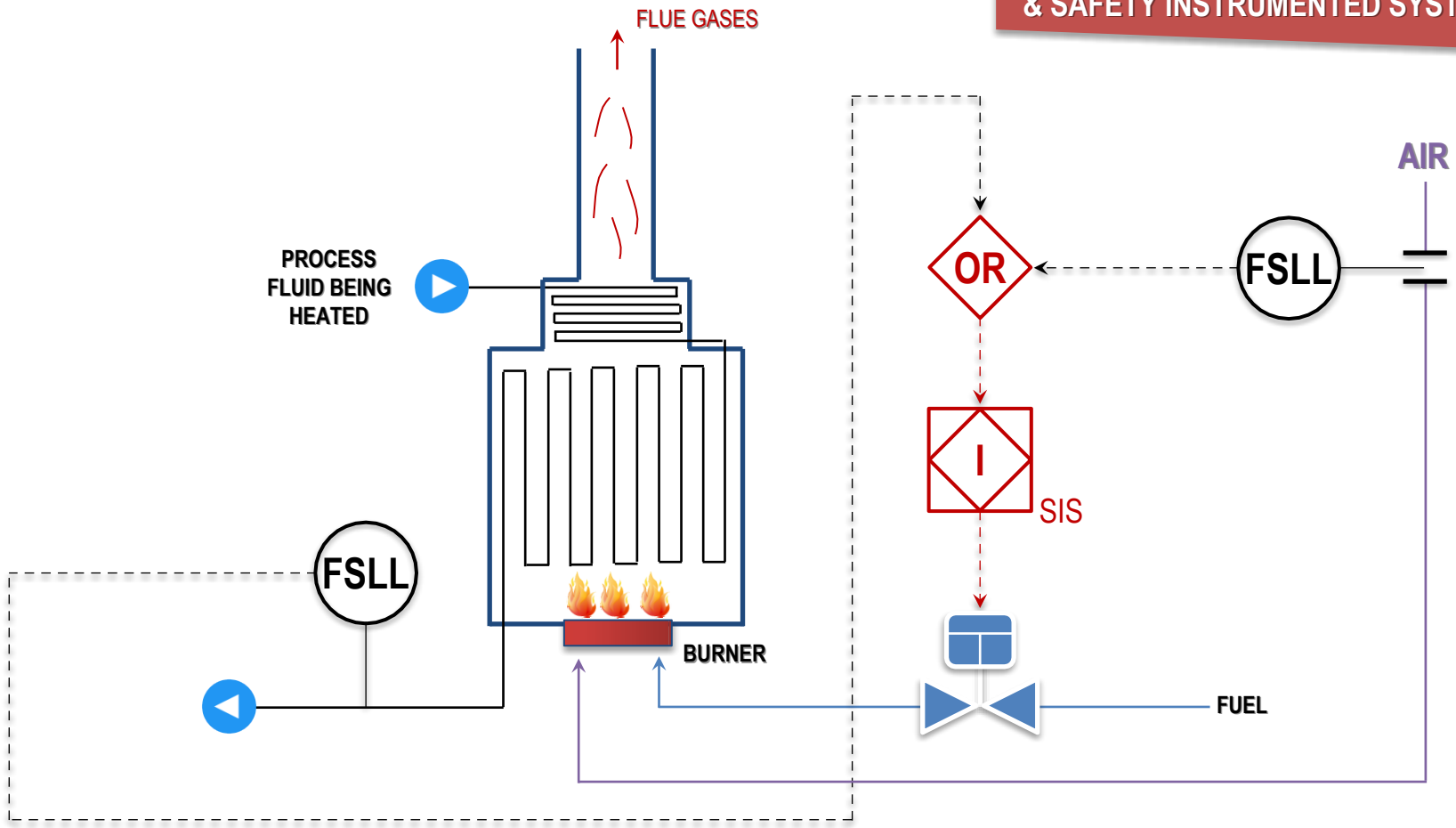
9. INSTRUMENTATION : FLOW MEASUREMENT
Orifice, Nozzles & Venturi tubes
Pitot tubes
Annular probes
Rotameters
Ultrasound flowmeters
Electromagnetic flowmeters
Coriolis mass flowmeters

10. INSTRUMENTATION : LEVEL MEASUREMENT
Glass level gauges
Float level gauges
Float switches
Reed chain float sensors
Magnetic level gauges

COURSE CONTENT (2/2) :

10. INSTRUMENTATION : LEVEL MEASUREMENT

Hydrostatic level gauges
Bubble tubes
Optoelectronic switches
Capillary systems
Ultarsonic sensors
Radars
Radiometric sensors



ADVANCED PROCESS CONTROL & SAFETY INSTRUMENTED SYSTEMS (SIS)

COURSE DESCRIPTION :

Control in process industries refers to the regulation of all aspects of the process. Precise control of level, temperature, pressure and flow is important in many process applications.

This course introduces you to advanced control in process industries, explains why control is important and identifies different ways in which precise control is ensured for main process equipment such as :

- Reactors
- Pumps
- Compressors
- Fired heaters
- Heat exchangers
- etc…

The course also introduces you to safety Instrumented Systems (SIS), alarm systems and Interlocks : their anatomy, their requirement, their functions and how they are represented in engineering drawings such as piping & instrumentation diagrams.

WHAT YOU WILL LEARN (1/3) :

✓ Understand the importance of process control and how it is displayed on your P&ID's

✓ Successfully interpret basic & advanced process control schemes

✓ Understand the different process control options and how they are displayed on your P&ID's (cascade control, split range control, ratio control, batch control, selective control…)

✓ Understand the control of pressure in a pipe and explain how it is displayed on your P&ID's

✓ Understand the control of flow in a pipe and explain how it is displayed on your P&ID's

✓ Understand flow merging control and explain how it is displayed on your P&ID's

✓ Understand flow splitting control and explain how it is displayed on your P&ID's

✓ Understand centrifugal pump control systems (discharge throttling, variable speed drive, minimum flow…) and explain how they are displayed on your P&ID's

WHAT YOU WILL LEARN (2/3) :

✓ Understand positive displacement pump control systems (recirculation pipe, variable speed drive, stroke adjustment…) and explain how they are displayed on your P&ID's

✓ Understand compressor control systems (capacity control, variable speed drive, anti-surge…) and explain how they are displayed on your P&ID ‘s

✓ Understand heat exchanger control systems (direct control, bypass control, back pressure control…) and explain how they are displayed on your P&ID‘s

✓ Understand reactor temperature control systems and explain how they are displayed on your P&ID‘s

✓ Understand fired heater control systems and explain how they are displayed on your P&ID‘s

✓ Understand container and vessel control systems and explain how they are displayed on your P&ID‘s

✓ Understand electric motor control systems (ON / OFF actions) and explain how they are displayed on your P&ID‘s

WHAT YOU WILL LEARN (3/3) :

✓ Know and understand the concept of Safety Instrumented Systems (SIS) and explain how safety instrumented functions are displayed on your P&ID‘s

✓ Know and understand the concept of Alarm Systems and explain how alarms are displayed on your P&ID‘s

✓ Identify safe operating limits based on system designs as displayed on your P&ID‘s

✓ Know and understand how Fire and Gas Detection Systems (FGS) are displayed on P&ID‘s

✓ Assess emergency situations and regulatory compliance issues using your P&ID's

COURSE CONTENT (1/2) :

1. INTRODUCTION

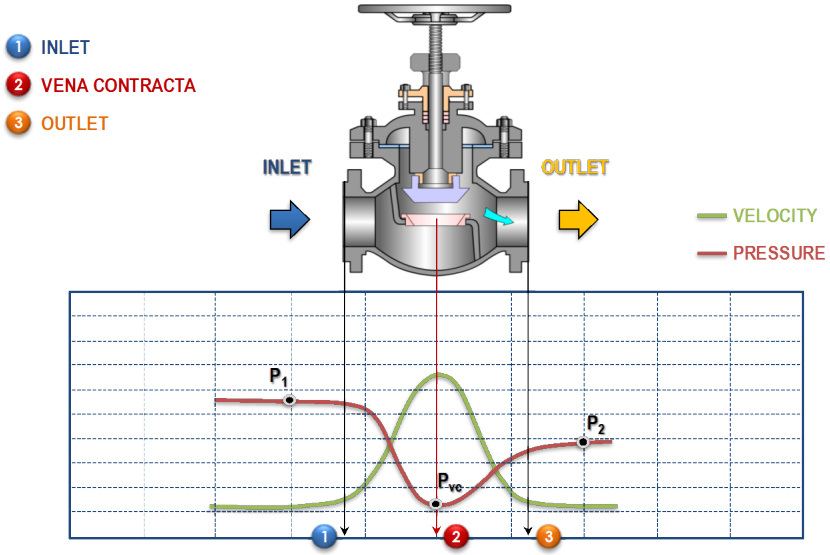
2. ADVANCED PROCESS CONTROL

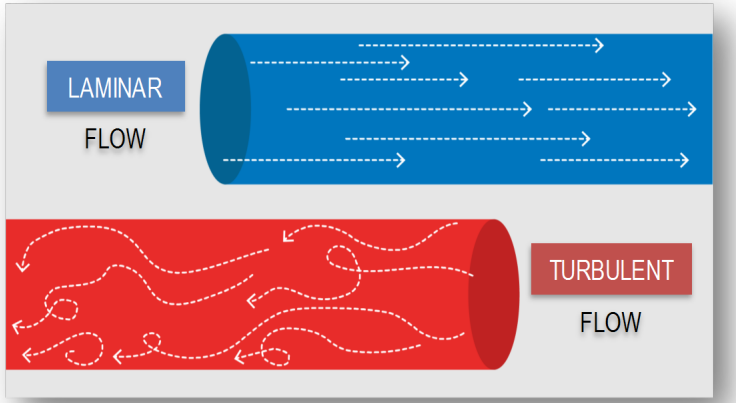
Do we need to control at all ?
Principles of equipment-wise control
Pipe control system
Control of a single pipe
Control of pressure in a pipe
Control of flow in a pipe
Flow merging
Flow splitting
Centrifugal pump control
Control valve vs Variable Frequency Drive (VFD) for centrifugal pumps
Minimum flow control for centrifugal pumps
Positive displacement pump control
Control by a recirculation pipe for PD pumps
Variable Speed Drive (VSD) control for PD pumps
Control by stroke adjustment for PD pumps
Compressor control system
Compressor capacity control
Compressor anti-surge control
Heat transfer equipment control
Heat exchanger direct control system
Heat exchanger bypass control system
Reactor temperature control
Air cooler control
Heat exchanger for heat recovery
Heat exchanger back pressure control
Basic fired heater control
Complex fired heater control
Container and vessel control
Container blanket gas control

COURSE CONTENT (2/2) :

3. SAFETY INSTRUMENTED SYSTEMS (SIS), INTERLOCKS AND ALARMS

Safety strategies
Concept of Safety Instrumented Systems (SIS)
SIS actions and types
SIS extent
SIS requirement
Anatomy of a SIS
SIS element symbols
SIS primary elements : Sensors
SIS final elements
Switching valve actuator arrangements
Valve position validation
Merging a switching valve and a control valve
SIS logics
Showing safety instrumented functions on P&ID's
Discrete control
Alarm system
Anatomy of alarm systems
Alarm requirements
Alarm system symbology in P&ID's
Concept of common alarms
Fire and Gas Detection Systems (FGS)
Electric motor control
P&ID representation of commands and responses
P&ID representation of inspection and repair
P&ID example of electro-motor control





H_1 : 22 ft

P_2 : ATM

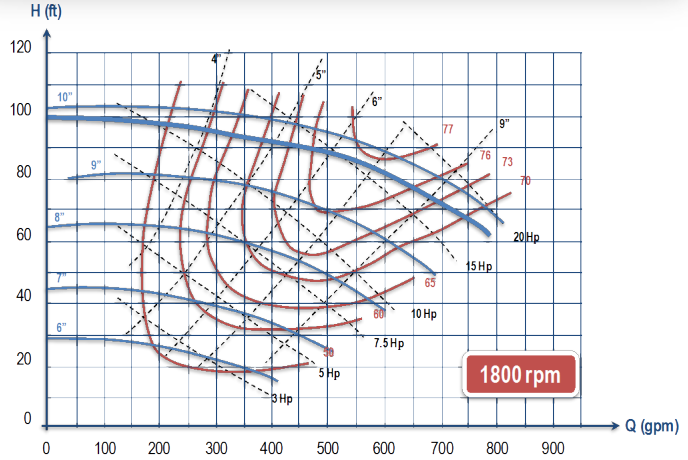
FLOW

200 gpm

60 °F

BALL VALVE
2 3/8 Φ seat

FLOW



FLOW OF FLUIDS THROUGH PIPING SYSTEMS

WR Training
Spread the wings of your knowledge

COURSE DESCRIPTION (1/2) :

The most diverse substances are transported and distributed in piping systems every single day. They include aggressive fluids in the chemical industry, hydrocarbons in petrochemistry or steam for energy transmission.

Chemical engineers who are designing these piping systems and specifying associated equipment like valves, pumps and flow meters probably face more fluid flow problems than any other. Pressure drop calculations help the engineer size pipes and ducts, determine performance requirements for pumps and fans, and specify control valves and flow meters. And although the underlying theory is rather simple, its practical application can be confusing due to the empirical nature of important correlations, multiple methods for expressing parameters, many variable inputs, and alternative units of measurement.

Designed around a series of **practical examples** which we work through to a solution, this unique training course is an essential guide to understanding the flow of fluids through pipe, valves and fittings. This understanding is a prerequisite for a **successful design & flawless operation** of your plant and piping system.

COURSE DESCRIPTION (2/2) :

The course features 5 major items :
1- An in-depth information on physical properties of fluids (weight density, specific gravity, viscosity, vapor pressure...) and how to calculate them using *Flow of Fluids Excel Workbook**
2- An in-depth information on compressible and **in**compressible fluid flow through piping systems, valves, pumps & flow meter devices (Orifice plates, Flow Nozzles & Venturi Meters) and how to calculate them using *Flow of Fluids Excel Workbook**
3- An iterative method for sizing flow meters and valves
4- An in-depth discussion on cavitation and choking in control valves
5- A flow problem section with **15 concrete examples** to help you practice and reinforce your understanding

Many images, equations, graphs, 3D animations and solved flow problems can be found throughout, increasing the value of this course as an educational tool and industrial reference for personnel involved in the fluid handling industries.

So this course is not only of use to practicing and professional engineers to whom a knowledge of the behavior of fluids is of crucial importance in **cost-effective design** and **efficient operation** of process plants and piping systems but also intended as a **study guide** for **undergraduates** in process, chemical, petrochemical & petroleum engineering disciplines.

** The Flow of Fluids Excel Workbook is **not included** in this course and is sold **separately**. If you are interested in this product, it is also available on our website.*

WHAT YOU WILL LEARN (1/2) :

- ✓ Understand the main physical properties of fluids (viscosity, vapor pressure, specific gravity, weight density...)
- ✓ Understand the theory of flow in pipe : Laminar vs Turbulent flow
- ✓ Understand and learn how to use the Bernoulli Theorem for pressure drop, head loss or flow velocity assessment
- ✓ Learn how to calculate the pressure drop "dP" and the head loss "hL" through any piping system
- ✓ Learn how to determine the friction factor "f" of any piping system
- ✓ Learn how to calculate the flow of compressible and incompressible fluids in pipe
- ✓ Learn how to calculate the resistance coefficient "K" of any piping component (pipes, valves, bends, reducers, Tees, Wyes...)
- ✓ Learn what the flow coefficient "Cv" of a control valve means and how to use it in assessing flows and pressure drops
- ✓ Know what a control valve is and its main components

WHAT YOU WILL LEARN (2/2) :

- ✓ Understand the theory of regulating flow with control valves
- ✓ Understand the concepts of cavitation and choking in control valves through graphics and 3D animations
- ✓ Learn how to size and select a control valve when designing and operating any piping system for both gases and liquids
- ✓ Understand the theory of flow measurement using differential pressure meters such as Orifice Plates, Flow Nozzles and Venturi Meters
- ✓ Learn how to calculate the flow of compressible and incompressible fluids through Orifice Plates, Flow Nozzles and Venturi Meters
- ✓ Learn how to size and select a flow meter when designing and operating any piping system for both gases and liquids

COURSE CONTENT (1/4) :

1. INTRODUCTION

2. PHYSICAL PROPERTIES OF FLUIDS
Viscosity
Kinematic viscosity
PRACTICE SESSION : Determining viscosity using Flow of Fluids Excel Workbook
Weight density of liquids
PRACTICE SESSION : Weight density of liquids using Flow of Fluids Excel Workbook
Specific volume
Weight density of gases and vapors
PRACTICE SESSION : Weight density of gases using Flow of Fluids Excel Workbook
Specific gravity
PRACTICE SESSION : Specific gravity using Flow of Fluids Excel Workbook
Vapor pressure
PRACTICE SESSION: Determining vapor pressure using Flow of Fluids Excel Workbook
More charts and diagrams - The Chemical Engineer's Reference Folder

3. NATURE OF FLOW IN PIPE : LAMINAR AND TURBULENT FLOW
Mean velocity of flow
PRACTICE SESSION : Velocity of flow using Flow of Fluids Excel Workbook
Reynolds number (Re)
PRACTICE SESSION : Reynolds number using Flow of Fluids Excel Workbook

4. BERNOULLI'S THEOREM

5. MEASUREMENT OF PRESSURE

COURSE CONTENT (2/4) :

6. HEAD LOSS AND PRESSURE DROP THROUGH PIPE
Friction factor
Friction factor using the Colebrook equation
Explicit approximations of Colebrook
PRACTICE SESSION: Friction factor using Flow of Fluids Excel Workbook
Hazen-Williams formula for flow of water
PRACTICE SESSION: Hazen-Williams using Flow of Fluids Excel Workbook
Effect of age and use on pipe friction

7. COMPRESSIBLE FLOW IN PIPE
Definition of a perfect gas
Speed of sound and Mach number
Approaches to compressible flow problems
Application of the Darcy equation to compressible fluids
Complete isothermal equation
Simplified isothermal gas pipeline equation
Other commonly used equations for compressible flow in long pipelines
Comparison of equations for compressible flow in pipelines
Modifications to the isothermal flow equation
Limiting flow of gases and vapors
PRACTICE SESSION: Expansion factor "Y" & ΔP using Flow of Fluids Excel Workbook

8. FLOW OF FLUIDS THROUGH VALVES AND FITTINGS
Types of valves used in piping systems
Types of fittings used in piping systems
Pressure drop attributed to valves and fittings
Relationship of pressure drop to velocity of flow
Hydraulic resistance
Causes of head loss in valves and fittings
Equivalent length "L/D“
Resistance coefficient "K“
Resistance coef. K for pipelines, valves and fittings in series and in parallel
Flow coefficient "Cv“

COURSE CONTENT (3/4) :

Use of flow coefficient "Cv" for piping and components
Flow coefficient Cv for pipelines, valves and fittings in series and in parallel
Laminar flow conditions
Contraction and enlargement
PRACTICE SESSION: Contraction & enlargement using Flow of Fluids Excel Workbook
Valves with reduced seats
PRACTICE SESSION: Valve resistance coef. "K" using Flow of Fluids Excel Workbook
Resistance of bends
PRACTICE SESSION: Resistance of bends using Flow of Fluids Excel Workbook
Hydraulic resistance of Tees and Wyes
Hydraulic resistance of Tees and Wyes : Converging flow
Hydraulic resistance of Tees and Wyes : Diverging flow
PRACTICE SESSION: Resistance of "T" and "Y" using Flow of Fluids Excel Workbook
Discharge of fluids through valves, fittings and pipe

9. REGULATING FLOW WITH CONTROL VALVES
Valve components
Inherent characteristic curve
Installed characteristic curve
Pressure, Velocity and Energy profiles through a control valve
Cavitation, Choked Flow and Flashing
Sizing and selection
Sizing for INcompressible flow
Sizing for compressible flow
Conversion of Cv to Kv

10. MEASURING FLOW WITH DIFFERENTIAL PRESSURE METERS
Orifice plate
Limits of use of orifice plates
Flow nozzle
Limits of use of flow nozzles
Venturi meter
Limits of use of Venturi meters

COURSE CONTENT (4/4) :

11. LIQUID FLOW THROUGH ORIFICES, NOZZLES AND VENTURI

Differential pressure and pressure loss
Pressure loss coefficient
Rate of flow and flow coefficient "C“
Discharge coefficient "Cd" : Definition
Discharge coefficient "Cd" : Orifice plates
Discharge coefficient "Cd" : Flow nozzles
Discharge coefficient "Cd" : Venturi meters
PRACTICE SESSION: Discharge coefficient "Cd" using flow of fluids excel workbook

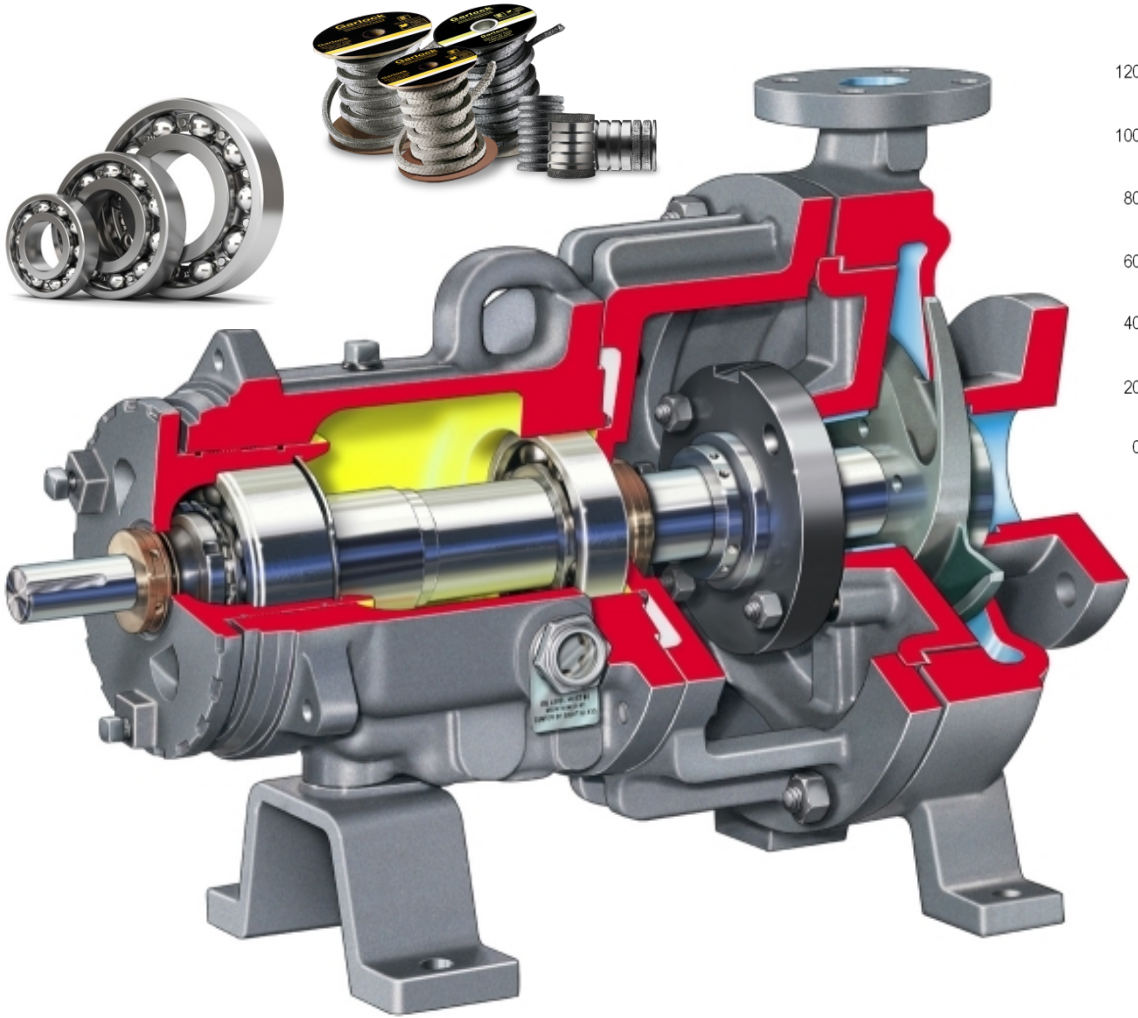
12. COMPRESSIBLE FLOW THROUGH ORIFICES, NOZZLES AND VENTURI

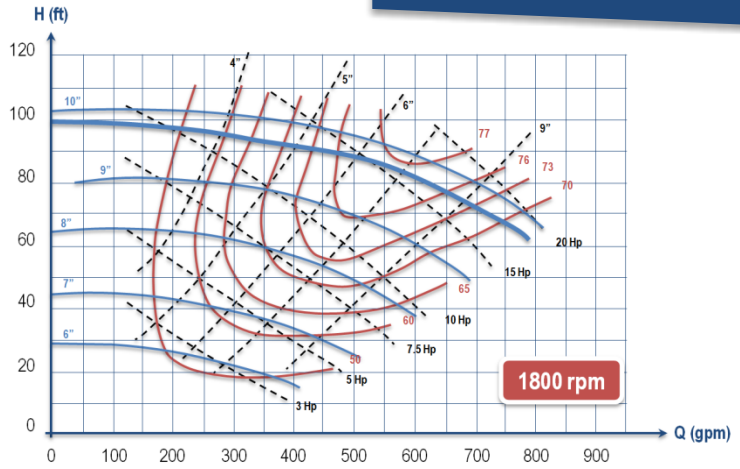
Flow of gases and Net Expansibility Factor "Y“

13. FLOW PROBLEMS - LET'S GET SOME PRACTICE

Example #1 : Determining Reynolds Number (Re) and Friction Factor (f)
Example #2 : Y pattern valve resistance coefficient & equivalent lengths
Example #3 : Globe valve resistance K, equivalent lengths & flow coefficient Cv
Example #4 : Gate valve resistance coef. "K" & equivalent lengths "L/D" & "L"
Example #5 : Sizing lift check valves
Example #6 : Fluid velocity and rate of discharge through a ball valve
Example #7 : Laminar flow in valves, fittings and pipe #1
Example #8 : Laminar flow in valves, fittings and pipe #2
Example #9 : Determining pressure drop in a piping system
Example #10 : Sizing an orifice for a given pressure drop and fluid velocity
Example #11 : Bernoulli's Theorem - Pressure drop and fluid velocity
Example #12 : Process air - Pressure drop and velocity
Example #13 : Sizing a centrifugal pump for oil pipelines
Example #14 : Flow of natural gas through pipelines
Example #15 : Water discharging from a reservoir
Example #16 : Gas flow at sonic velocity through pipe

CENTRIFUGAL PUMPS





WR Training

Spread the wings of your knowledge

COURSE DESCRIPTION :

Centrifugal pumps of various designs and applications are encountered nowadays throughout refining, petrochemical and process industries as well as in power generation and environmental engineering.

This course is designed to provide you with a complete understanding of **construction details** and **functioning** of centrifugal pumps. This understanding is a prerequisite for **successful operation of your plant and piping system**.

The course includes extensive **graphics**, **3D animations** and **cut sections** to give you a virtual practical exposure on centrifugal pumps.

The objective of this course is threefold :

1. Break down for you all the centrifugal pump operating principles into easily digestible concepts like cavitation, performance curves, head, etc

2. Illustrate through 3D animations and cut-sections the main pump mechanical components like impellers, shafts, bearings, packing, mechanical seals, etc…

3. Provide guidelines and best practices for operation, maintenance and troubleshooting

WHAT YOU WILL LEARN :

- ✓ Understand centrifugal pumps working principles for successful operation of your plant and piping systems
- ✓ Understand centrifugal pumps construction details (impeller, volute, shaft, bearings, packing, mechanical seals, etc)
- ✓ Lear how to read and interpret your pump curves
- ✓ Learn how to determine and interpret your piping system curve
- ✓ Optimize the operation efficiency of your pumping systems
- ✓ Analyze the problems in operation related to packing, mechanical seals, bearings and flow control
- ✓ Apply the best practices and guidelines for maintenance, problem solving and troubleshooting

COURSE CONTENT (1/3) :

1. INTRODUCTION

2. BASIC PUMP PRINCIPLES
How do pumps work
Pressure measurement
Pump head

3. NET POSITIVE SUCTION HEAD – NPSH
NPSH required
NPSH available

4. CAVITATION
Vapor pressure
What cavitation is all about
The effect of vapor pressure on pump performance
Vaporization cavitation
Internal re-circulation
The vane passing syndrome
Air aspiration
Turbulence cavitation
Preventing cavitation

5. THE AFFINITY LAWS

6. USEFUL WORK AND PUMP EFFICIENCY
Useful work from a pump
Flow determination
Pump efficiency

7. PUMP CLASSIFICATION
Positive displacement pumps
Centrifugal pumps
Conceptual difference between centrifugal and PD pumps
Centrifugal volute pumps
Types of centrifugal pumps
Pump impellers 1/2
Suction specific speed, Nss
Pump impellers 2/2

COURSE CONTENT (2/3) :

Wear bands
Specific speed, Ns

8. UNDERSTANDING PUMP CURVES
Pump performance curves
Head vs Pressure
The Head-Capacity curve (H-Q curve)
The efficiency curve
The energy curve (BHp curve)
The pump minimum requirement curve (NPSHr curve)
Overview of the 4 curves
Pump family curves

9. UNDERSTANDING THE SYSTEM CURVE
Total dynamic head, TDH
Determining the static head, Hs
Determining the pressure head, Hp
Determining the friction head (Hf) and the velocity head (Hv)
The Hazen and Williams formula
The Darcy and Weisbach formula
The Bachus and Custodio formula
The dynamic system
Dynamic pressure
Resistance changes

10. SHAFT DEFLECTION
60° and 240° radial loads
Operation, design and maintenance
Tight tolerances in centrifugal pumps
Signs of shaft deflection : Interpreting the evidence
The sweet zone
The dual volute pump

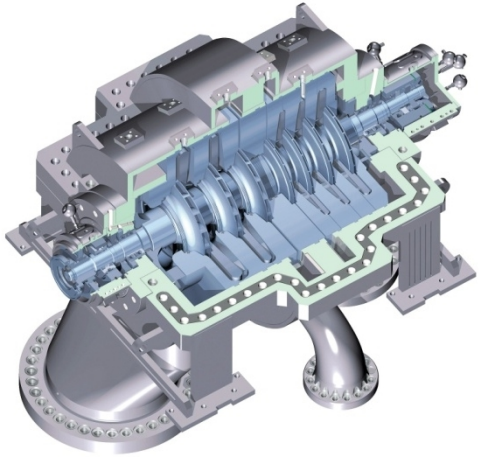
COURSE CONTENT (3/3) :

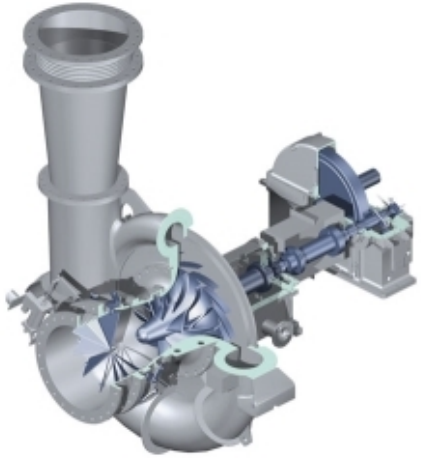
11. BEARINGS
What is a bearing ?
Bearing lubrication
Bearing failure
Bearing maintenance
Bearing seals

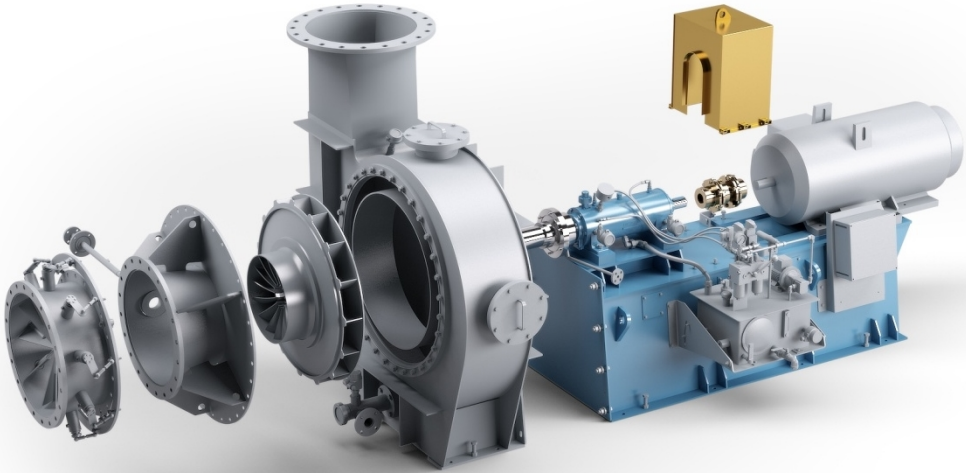
12. SHAFT PACKING
What packing is all about
Packing leakage
Stages in the life of packing

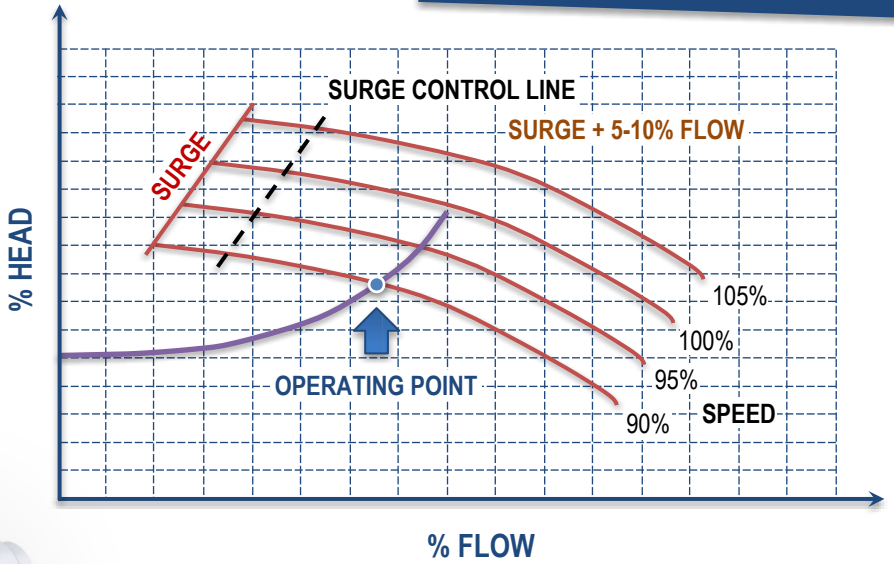
13. MECHANICAL SEALS
The mechanical seal
The single unbalanced inside mounted mechanical seal
The single unbalanced outside mounted mechanical seal
The single balanced internal mechanical seal
The single balanced external mechanical seal
O-rings
The balance effect : advantages and mathematical explanation
The cartridge mechanical seal
Double seals
The tandem dual seal
The back to back double seal
The face to face double seal
Support system for dual seals

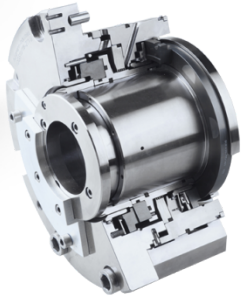
CENTRIFUGAL COMPRESSORS











Training

Spread the wings of your knowledge

COURSE DESCRIPTION :

Centrifugal compressors of various designs and applications are encountered nowadays throughout refining, petrochemical and process industries as well as in power generation and environmental engineering.

This course is designed to provide you with a complete understanding of **construction details** and **functioning** of centrifugal compressors. This understanding is a prerequisite for **successful operations of your plant and piping system**.

The course includes extensive **graphics**, **cut sections** and **3D animations** to give you a virtual practical exposure on centrifugal compressors.

The objective of this course is threefold :
1. Break down for you all the centrifugal compressors operating principles into easily digestible concepts like compressor head, performance curve, system resistance, surge, stonewall, etc
2. Illustrate through 3D animations and cut-sections the main compressor mechanical components like impellers, shafts, bearings, seals, etc
3. Provide guidelines and best practices for operation, maintenance and troubleshooting

This course also covers other types of compressors like **axial** compressors, **rotary screw** compressors, **reciprocating** compressors just to name a few. The objective is to observe the similarities in both performance and mechanical aspects of various types of compressors.
So after enrolling in this course, you will **not only** learn valuable information on centrifugal compressors **but also** a great deal on other types of compressors.

WHAT YOU WILL LEARN :

- ✓ Understand centrifugal compressors working principles for successful operations of your plant and piping system
- ✓ Understand centrifugal compressors construction details (impeller, volute, shaft, inlet guide vane, bearings, mechanical seals, etc)
- ✓ Lear how to read and interpret your compressor curves
- ✓ Optimize the operation efficiency of your compressors
- ✓ Analyze the problems in operation related to bearings, mechanical seals and flow control
- ✓ Apply the best practices and guidelines for maintenance, problem solving and troubleshooting

COURSE CONTENT (1/5) :

1. INTRODUCTION

2. ROTATING EQUIPMENT OVERVIEW
Definition of rotating equipment
Classifications of rotating equipment
Performance and mechanical design similarities
The equipment train
Important fundamentals

3. COMPRESSOR TYPES AND APPLICATIONS
Positive displacement compressors : Rotary lobe
Positive displacement compressors : Rotary vanes
Positive displacement compressors : Rotary screw
Positive displacement compressors : Reciprocating
Dynamic compressors : Centrifugal single stage
Dynamic compressors : Centrifugal multi-stage
Dynamic compressors : Axial

4. COMPRESSOR CHARACTERISTICS
Positive displacement compressors
Actual, standard and mass flows
Dynamic compressors

5. OPERATION OF A COMPRESSOR IN A SYSTEM
Defining the process system
The system resistance curves
The operating point
A positive displacement compressor in the process system
A dynamic compressor in the process system

6. THE CONCEPT OF FLUID HEAD
Defining the fluid head
The head required
The head produced
Paths of compression
The different types of gas head
Dynamic compressor curves format

COURSE CONTENT (2/5) :

7. PERFORMANCE RELATIONSHIPS
Satisfying the objective
Gas characteristics
Compression head
Impeller types and specific speed
Compressor efficiency
Compressor horsepower
The fan laws

8. WHAT DETERMINES THE CENTRIFUGAL COMPRESSOR CURVE SHAPE
The compressor stage
Impeller with side plate removed
Impeller discharge velocities
Blading types : Backward lean and radial vanes

9. SURGE AND STONEWALL
Surge and stonewall : Introduction
Surge facts
Limits of the compressor curve
What causes surge
What causes stonewall

10. COMPRESSOR INDIVIDUAL STAGE AND OVERALL PERFORMANCE
The stage curve
The overall curve
Determining section performance

COURSE CONTENT (3/5) :

11. THE EFFECT OF GAS DENSITY CHANGE ON COMPRESSOR PERFORMANCE
The factors involved
The effect on pressure ratio
The effect on compressor head
The effect on system resistance
The effect on flow rate
The effect on power

12. THE EFFECT OF FOULING ON COMPRESSOR PERFORMANCE
The mechanism of fouling
The effect of fouling on the operating point
The causes of fouling
Detecting fouling by condition monitoring
Preventing and correcting fouling

13. COMPRESSOR CONTROL OVERVIEW
Your duties
Adjusting the compressor to system changes
Adjusting the compressor performance curve
Compressor protection

14. SURGE CONTROL SYSTEMS
System objectives
Available options
System design considerations
A history of surge system types

COURSE CONTENT (4/5) :

15. COMPRESSOR MECHANICAL DESIGN

The casing
The inlet guide vanes (IGV)
The rotor
The diaphragms
Inter-stage seals
About shaft end seals
Labyrinth seals
Restrictive ring seals
Liquid film floating ring seals
Liquid film cone seals
Dry gas seals
Why do compressors need bearings
Journal bearings
Thrust bearings

16. COMPRESSOR CASINGS AND STATIONARY INTERNALS

Casing functions
Casing types
Casing fabrication options
Casing stresses and deflections

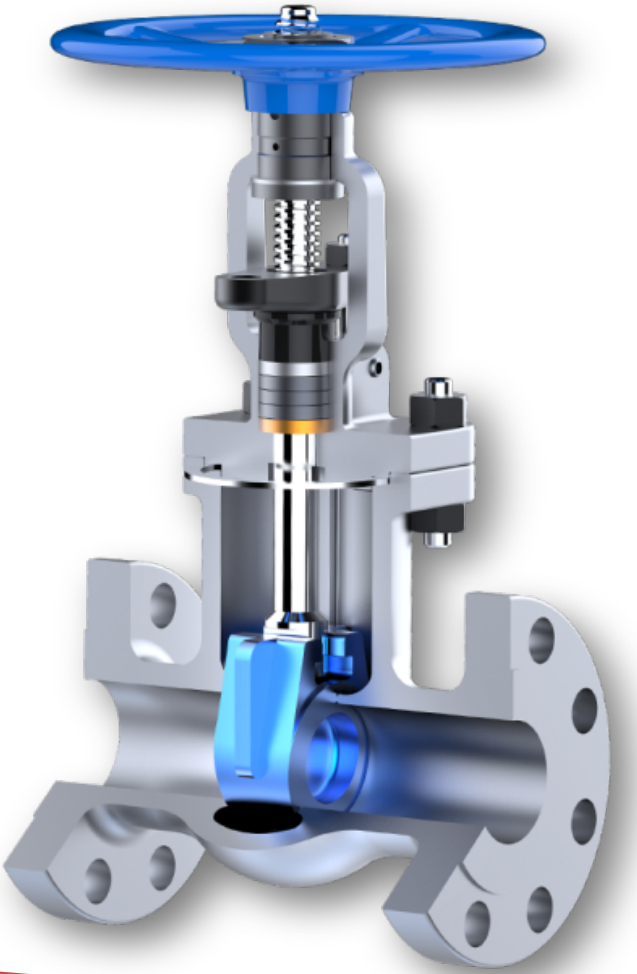
17. COMPRESSOR ROTOR DESIGN

Shaft end design
Shaft stiffness
Rotor configuration
Rotor assembly
Rotor balance

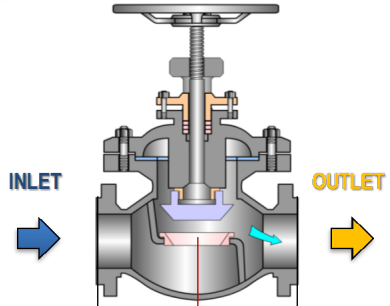
COURSE CONTENT (5/5) :

18. FLEXIBLE COUPLING DESIGN, INSTALLATION AND OPERATION

Coupling functions
Coupling types
Gear couplings
Flexible couplings
Couplings with elastomer inserts
The coupling system
Coupling installation and removal
Gear coupling 3D animation
Flexible couplings 3D animation
Jaw and spider coupling 3D animation

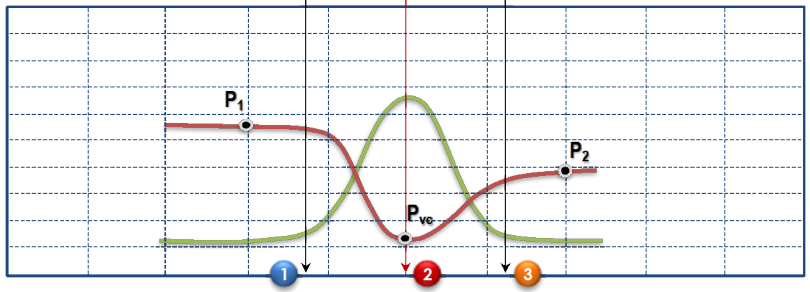


1. INLET
2. VENA CONTRACTA
3. OUTLET



VELOCITY

PRESSURE



VALVES

WR Training

Spread the wings of your knowledge

COURSE DESCRIPTION :

Valves of various designs and applications are encountered nowadays throughout petroleum refining, petrochemical and process industries as well as in power generation and environmental engineering.

This course is designed to provide you with a complete understanding of **construction details** and **functioning** of valves. This understanding is a prerequisite for **successful operation of your plant and piping system**.

The course includes extensive **graphics**, **3D animations** and **cross-sectional views** to give you a virtual practical exposure on valves.

In this course, you will :

1. Discover the major types of valves used in the process industry

2. Learn their components, their function & their operation

3. Have the opportunity to **dismantle** many valves and **assemble** them using **3D models**, **cross-sectional views** and **3D animations**

Also included in this course, an in-depth discussion on **actuators** and **control valves**. You will learn how control valves are used to regulate the flow of a fluid.

WHAT YOU WILL LEARN :

- ✓ Understand valves and control valves working principles for successful operation of your plant and piping systems
- ✓ Understand valve construction details (bonnet, stem, disk, seat, packing, body, etc)
- ✓ Know the characteristics and applications for each valve type (ball, plug, gate, pinch, butterfly, diaphragm, check, needle...)
- ✓ Know how to choose the correct valve for a certain application
- ✓ Know how to dismantle and assemble all types of valves using 3D and 2D models
- ✓ Identify and know the principles of operation of common valve actuators (pneumatic, hydraulic, electrical, etc)
- ✓ Understand how single acting and double acting pneumatic actuators work through graphics and 3D animations
- ✓ Understand the principle of fail open (FO) and fail close (FC) actuators
- ✓ Know how to convert a single acting spring return actuator to a double acting actuator and vice versa
- ✓ Know how to convert a fail close actuator to a fail open actuator and vice versa

COURSE CONTENT (1/3) :

1. INTRODUCTION

2. VALVES FUNCTIONS AND BASIC PARTS

Valve body
Valve bonnet
Valve trim
Disk and seat
Stem
Valve actuator
Valve packing
Introduction to the types of valves

3. TYPES OF VALVES

Gate valves
Gate valves : 3D dismantling
Gate valves : 2D dismantling
Gate valves : Disk design
Gate valves : Stem design
Gate valves : Seat design
Globe valves
Globe valves : 3D dismantling
Globe valves : 2D dismantling
Globe valves : Z-body design
Globe valves : Y-body design
Globe valves : Angle design
Globe valves : Disk design
Globe valves : Disk - Stem connections
Globe valves : Seat design
Globe valves : Direction of flow
Ball valves
Ball valves : Components
Ball valves : 3D dismantling
Ball valves : 2D dismantling
Ball valves : Actuators
Ball valves : Pros & Cons
Ball Valves : Port pattern
Ball valves : Valve materials
Ball valves : Stem design
Ball valves : Valve position

COURSE CONTENT (2/3) :

Plug valves
Plug valves : Valve components
Plug valves : 3D dismantling
Plug valves : 2D dismantling
Plug valves : Numerous designs
Plug valves : Plug designs
Plug valves : Multiport plug designs
Plug valves : Lubricated design
Plug valves : Non-Lubricated design
Plug valves : Gland design
Diaphragm valves
Diaphragm valves : 3D dismantling
Diaphragm valves : 2D dismantling
Diaphragm valves : Straight through & weir types
Diaphragm valves : Diaphragm construction
Diaphragm valves : Bonnet design
Pinch valves
Pinch valves : Body design

Butterfly valves
Butterfly valves : 3D dismantling
Butterfly valves : Seat design
Butterfly valves : Disk & Stem assembly
Needle valves
Needle valves : 3D dismantling
Needle valves : Valve applications
Needle valves : Body design
Needle valves : Stem packing
Check valves
Check valves : Swing
Swing check valves : 3D dismantling
Swing check valves : 2D dismantling
Assembling a swing check valve - 3D model
Tilting disk check valves
Lift check valves
Lift check valves : 3D dismantling
Lift check valves : 2D dismantling

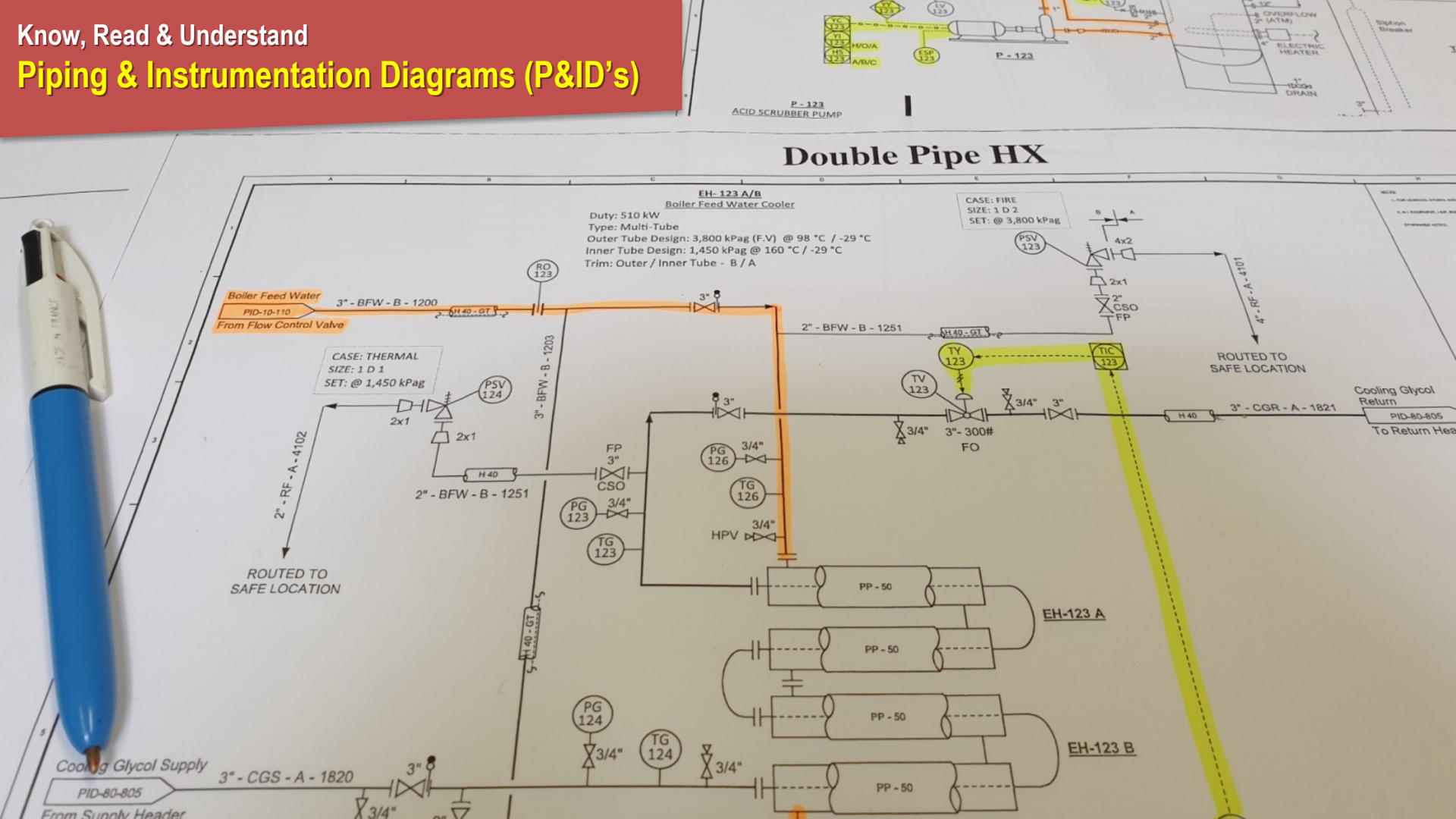
COURSE CONTENT (3/3) :

Piston check valves
Butterfly check valves
Stop check valves
Relief and Safety valves
Safety valves
Safety valves : Pressure setting
Safety valves : 3D dismantling
Safety valves : 2D dismantling
Relief valves
Relief valves : Valve operation in 2D cross-sectional view
Relief valves : 3D dismantling
Relief valves : 2D dismantling
Control valves
Control valves : Trim arrangement
Control valves : Direction of action
Control valves : 3D dismantling
Control valves : 2D dismantling

4. VALVE ACTUATORS
Manual actuators
Electric motor actuators
Pneumatic actuators
Example 1 : Single acting / spring return actuators : Components & Operation
Example 2 : Single acting / spring return actuators : Components & Operation
Example 3 : Double acting actuators : Components & Operation
Example 4 : Double acting actuators : Components & Operation
From single acting to double acting actuator
From fail close (FC) to fail open (FO) single acting actuator
Hydraulic actuators
Self-actuated valves
Speed of power actuators
Valve position indication

Know, Read & Understand

Piping & Instrumentation Diagrams (P&ID's)



COURSE DESCRIPTION (1/3) :

Piping and Instrumentation Diagrams commonly referred to as P&ID's are encountred nowadays throughout all process industries such as Oil & Gas, chemical, pharmaceutical or food industries.

These engineering drawings are used **worldwide** in design, construction, commissioning, operation and maintenance of industrial plants. They provide clear information on processes, equipment, control systems and how the plant should handle emergency situations.

As a potential actor in these industries, it is therefore vital that you have a **thorough understanding of P&ID's components and construction**.

Piping and Instrumentation Diagrams don't have to be a complicated ! It isn't rocket science ! This course will make you a **P&ID expert** and you will know how to **read**, **interpret** and **successfully understand** :

- all of those many lines
- symbols
- process control schemes
- and safety instrumented functions you see in your plant drawings

COURSE DESCRIPTION (2/3) :

The knowledge gained in this course will help you to **understand all P&ID's** so that you can draw the correct information from them. This will set you apart from your peers, whether you are an operator, engineer, or manager and will give you **an edge over your competitors** when seeking employment at one of these industrial facilities.

Moreover since Piping and Instrumentation Diagrams are used in the planning and risk assessment of tasks to identify hazards, process flows and isolation points, then by ensuring that these drawings are properly drawn and understood, **you contribute to the safety of your facility, your fellow workers and yourself**.

This training course starts by initiating you to basic blueprint reading (which is also used in electrical, hydraulic and mechanical fields of expertise), then moves on to familiarize you with simple to complex process flow features, such as :

- instrument loops
- advanced process control systems
- safety instrumented functions
- and alarm systems

COURSE DESCRIPTION (3/3) :

Symbols are also discussed thoroughly with all the **P&ID's standards**, **conventions** and **designation codes** that apply to them according to the **ISA symbology**. These include :

- valves (gate, globe, ball, butterfly...)
- actuators (pneumatic, hydraulic, solenoid, single acting spring return, double acting...)
- process equipment (pumps, compressors, heat exchangers, reactors...)
- instrumentation (flow meters, temperature transmitters, pressure gauges...)
- piping and fittings
- lines
- signals (pneumatic, hydraulic, electric...)

Included in the course are access to numerous **downloadable resources**, **real industrial examples of P&ID's** and the **keys to interpret them** in high quality video lectures. You will be able to practice and become even **more proficient** with these **bonus items** that you will find throughout the course.

WHAT YOU WILL LEARN (1/5) :

✓ Understand and evaluate the purpose, content, and importance of P&ID's to the construction, commissioning, safe operation and maintenance of a process plant

✓ Learn how to read, interpret and successfully understand ALL P&ID's through numerous real industrial examples

✓ Identify the 5 key sections of your P&ID (title block, grid system, revision block, notes and legend, engineering drawing block)

✓ Know and identify valve symbols on your P&ID's (gate, globe, ball, butterfly, needle…)

✓ Know and identify valve actuator symbols on your P&ID's (pneumatic, hydraulic, electric, single acting spring return, double acting…)

✓ Know the standards and conventions for valve status (open, closed, throttled)

✓ Identify valve position and failure mode on your P&ID's (LO, LC, FO, FC, FAI…)

✓ Know and identify process equipment symbols on your P&ID's (pumps, compressors, heat exchangers, columns, furnaces, reactors, vessels, containers, mixers…)

WHAT YOU WILL LEARN (2/5) :

✓ Know and identify piping symbols on your P&ID's (process, pneumatic, electric, hydraulic…)

✓ Determine specific information about a process piping including type of material in the line, line size, line number and type of insulation when applicable

✓ Know and identify pipe fitting symbols on your P&ID's (flanges, reductions, caps, spool pieces, unions…)

✓ Know and identify the P&ID symbols of safety devices that are used to safely isolate, vent & drain process equipment for ease of maintenance (spectacle and spade blinds, double block and bleed valves…)

✓ Know and identify pneumatic, electric, hydraulic and instrument signal lines on your P&ID's

✓ Know and identify instrumentation symbols on your P&ID's (flow meters, temperature transmitters, pressure gauges…)

✓ Know and identify the location of instruments, recorders, modifiers and controllers on your P&ID's (field mounted, board mounted, inaccessible…)

✓ Know the lettering and numbering standards based on ISA symbolgy for piping, instruments and equipment designation on your P&ID's

WHAT YOU WILL LEARN (3/5) :

✓ Trace the flow of a process stream into your P&ID, through the pipes and equipment, and out of the P&ID

✓ Understand the importance of process control and how it is displayed on your P&ID's

✓ Successfully interpret basic process control schemes on your P&ID's

✓ Understand the different process control options and how they are displayed on your P&ID's (cascade control, split range control, ratio control, batch control, selective control…)

✓ Define the term Flow Control and explain how it is displayed on your P&ID's

✓ Define the term Temperature Control and explain how it is displayed on your P&ID's

✓ Define the term Pressure Control and explain how it is displayed on your P&ID's

✓ Define the term Level Control and explain how it is displayed on your P&ID's

✓ Understand the control of pressure in a pipe and explain how it is displayed on your P&ID's

WHAT YOU WILL LEARN (4/5) :

✓ Understand the control of flow in a pipe and explain how it is displayed on your P&ID's

✓ Understand flow merging control and explain how it is displayed on your P&ID's

✓ Understand flow splitting control and explain how it is displayed on your P&ID's

✓ Understand centrifugal pump control systems (discharge throttling, variable speed drive, minimum flow…) and explain how they are displayed on your P&ID's

✓ Understand positive displacement pump control systems (recirculation pipe, variable speed drive, stroke adjustment…) and explain how they are displayed on your P&ID's

✓ Understand compressor control systems (capacity control, variable speed drive, anti-surge…) and explain how they are displayed on your P&ID's

✓ Understand heat exchanger control systems (direct control, bypass control, back pressure control…) and explain how they are displayed on your P&ID's

WHAT YOU WILL LEARN (5/5) :

- ✓ Understand reactor temperature control systems and explain how they are displayed on your P&ID's
- ✓ Understand fired heater control systems and explain how they are displayed on your P&ID's
- ✓ Understand container and vessel control systems and explain how they are displayed on your P&ID's
- ✓ Understand electric motor control systems (ON / OFF actions) and explain how they are displayed on your P&ID's
- ✓ Know and understand the concept of Safety Instrumented Systems (SIS) and explain how safety instrumented functions are displayed on your P&ID's
- ✓ Know and understand the concept of Alarm Systems and explain how alarms are displayed on your P&ID's
- ✓ Identify safe operating limits based on system designs as displayed on your P&ID's
- ✓ Know and understand how Fire and Gas Detection Systems (FGS) are displayed on P&ID's
- ✓ Assess emergency situations and regulatory compliance issues using your P&ID's

COURSE CONTENT (1/5) :

1. INTRODUCTION

2. ABOUT P&ID's
What's a P&ID ?
Why is a P&ID so important ?
Who uses P&ID's ?
How do P&ID's look like ?

3. INTRODUCTION TO P&ID READING
Introduction
Anatomy of a P&ID
The title block
The drawing scale
The grid system
The revision block
Changes
Notes and legends

4. BASIC P&ID SYMBOLS
Valve symbols
Valve actuator symbols
Control valve designations
Standards and conventions for valve status
Process equipment symbols
Piping symbols
Pipe fitting symbols
Isolating, venting & draining symbols for ease of maintenance
Instrumentation
Sensing devices and detectors
Location symbols
Modifiers and transmitters
Indicators and recorders
Controllers

COURSE CONTENT (2/5) :

5. LET'S GET SOME PRACTICE : BASIC P&ID SYMBOLS
Example #1 : Identifying process equipment and flow paths
Example #2 : Identifying valve position and failure mode
Example #3 : Identifying the symbols

6. P&ID DESIGNATION CODES
Piping designation code
Equipment designation code
Instrument designation code
Miscellaneous designation codes

7. THE IMPORTANCE OF PROCESS CONTROL
The process
Process control

8. CONTROL THEORY BASICS
The control loop
Process control terms

9. BASIC PROCESS CONTROL SYSTEMS (BPCS)
Control loops : Feedback control
Pressure control loops
Flow control loops
Level control loops
Temperature control loops
Multi-variable loops
Feedforward control
Feedforward + Feedback
Cascade control
Split range control
Operations on control signals
Ratio control
Batch control
Selective control

COURSE CONTENT (3/5) :

10. ADVANCED PROCESS CONTROL

Do we need to control at all ?
Principles of equipment-wise control
Pipe control system
Control of a single pipe
Control of pressure in a pipe
Control of flow in a pipe
Flow merging
Flow splitting
Centrifugal pump control
Control valve vs Variable Frequency Drive (VFD) for centrifugal pumps
Minimum flow control for centrifugal pumps
Positive displacement pump control
Control by a recirculation pipe for PD pumps
Variable Speed Drive (VSD) control for PD pumps
Control by stroke adjustment for PD pumps
Compressor control system
Compressor capacity control
Compressor anti-surge control
Heat transfer equipment control
Heat exchanger direct control system
Heat exchanger bypass control system
Reactor temperature control
Air cooler control
Heat exchanger for heat recovery
Heat exchanger back pressure control
Basic fired heater control
Complex fired heater control
Container and vessel control
Container blanket gas control

COURSE CONTENT (4/5) :

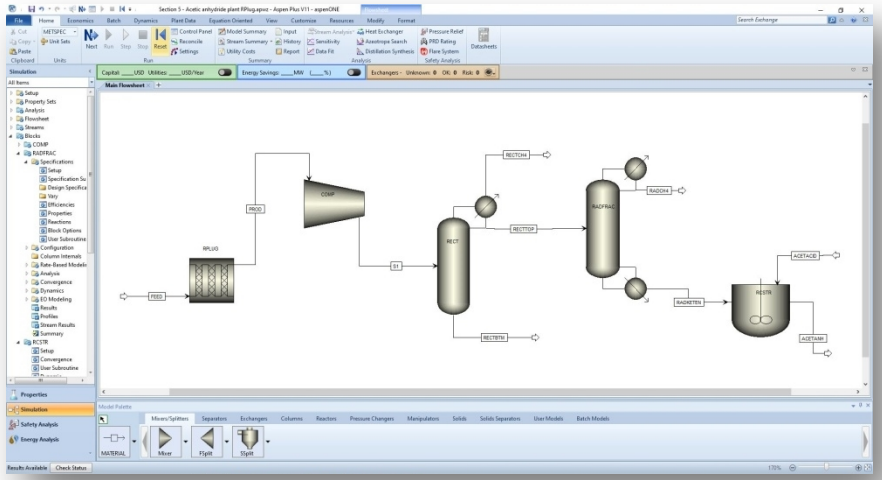
11. SAFETY INSTRUMENTED SYSTEMS (SIS), INTERLOCKS AND ALARMS

Safety strategies
Concept of Safety Instrumented Systems (SIS)
SIS actions and types
SIS extent
SIS requirement
Anatomy of a SIS
SIS element symbols
SIS primary elements : Sensors
SIS final elements
Switching valve actuator arrangements
Valve position validation
Merging a switching valve and a control valve
SIS logics
Showing safety instrumented functions on P&ID's
Discrete control
Alarm system
Anatomy of alarm systems
Alarm requirements
Alarm system symbology in P&ID's
Concept of common alarms
Fire and Gas Detection Systems (FGS)
Electric motor control
P&ID representation of commands and responses
P&ID representation of inspection and repair
P&ID example of electro-motor control

COURSE CONTENT (5/5) :

12. P&ID EXAMPLES : LET'S GET SOME PRACTICE

P&ID example #1 : Legend and specifications
P&ID example #2 : Hydrogen delivery station
P&ID example #3 : Acid system
P&ID example #4 : Centrifugal pump
P&ID example #5 : Utility station
P&ID example #6 : Waste water filter
P&ID example #7 : Steam separator
P&ID example #8 : Flare knock-out drum
P&ID example #9 : Centrifugal compressor
P&ID example #10 : Hydrogen production from shale gas
P&ID example #11 : Fired heater



INTRODUCING ASPEN PLUS V11

GETTING STARTED

Training

Spread the wings of your knowledge

COURSE DESCRIPTION (1/2) :

Aspen Plus is a powerful engineering simulation software that you can use to model a wide range of chemical processes.
It is widely used in engineering universities and in the industry, in research, development, modeling and design.

Aspen Plus serves as the engineering platform for modeling processes from Upstream through Gas Processing to Petroleum Refining, Petrochemicals, Chemicals and Pharmaceutical processes.

This online course is designed for chemical and process engineers **new to Aspen Plus** and who need **basic training to get started**.
The course will introduce you to the basic structure of the software and leads you through a hands-on introduction to the various features of Aspen Plus, designed to facilitate the set up of simple problems.

Features such as the material balance, access to Aspen Plus documentation, the “Next” button, menu navigation, Properties and simulation environments, and the report function are introduced.

COURSE DESCRIPTION (2/2) :

In just about **3 hours**, this online course will :

✓ Show you the benefits of process simulation using Aspen Plus

✓ Familiarize you with Aspen Plus graphical user interface and organizational structure

✓ Provide you with the basic concepts necessary for creating simulations in Aspen Plus such as :

- ✓ How to enter necessary elements to define a fluid package
- ✓ How to select the appropriate property method for your application
- ✓ How to define material streams and connect unit operations to build a flowsheet
- ✓ How to run the simulator
- ✓ How to use the Report Manager to create custom unit operation and stream reports to view and analyze the results of your simulation

✓ Finally, this course will also show you the basic steps to use Aspen Plus in thermodynamic instruction for property analysis of pure components and mixtures

The knowledge gained in this course will prepare you to take our **Aspen Plus Masterclass** and **Aspen Plus Dynamics®** courses in order to become an Aspen Plus **advanced user** if that is what you like and persist to be.

WHAT YOU WILL LEARN (1/2) :

- ✓ Identify the benefits of process simulation using Aspen Plus
- ✓ Describe the capabilities of Aspen Plus
- ✓ Familiarize yourself with Aspen Plus graphical user interface and organizational structure
- ✓ Learn the basic concepts necessary for creating simulations in Aspen Plus
- ✓ Enter necessary elements to fully define a Fluid Package
- ✓ Select the appropriate property method for your application
- ✓ Define material streams and connect unit operations to build a flowsheet
- ✓ Modify and set desired units of measure
- ✓ Review stream analysis options

WHAT YOU WILL LEARN (2/2) :

- ✓ Add and connect unit operations to build a flowsheet
- ✓ Use the Report Manager to create custom unit operation and stream reports
- ✓ Use Aspen Plus to perform property analysis of pure components and mixtures
- ✓ Use Aspen Plus in thermodynamics instruction for Vapor-Liquid, Liquid-Liquid and Vapor-Liquid-Liquid Equilibrium calculations
- ✓ Be prepared to take our Aspen Plus Masterclass to become an Aspen Plus advanced user if that is what you like and persist to be

COURSE CONTENT (1/2):

1. INTRODUCTION

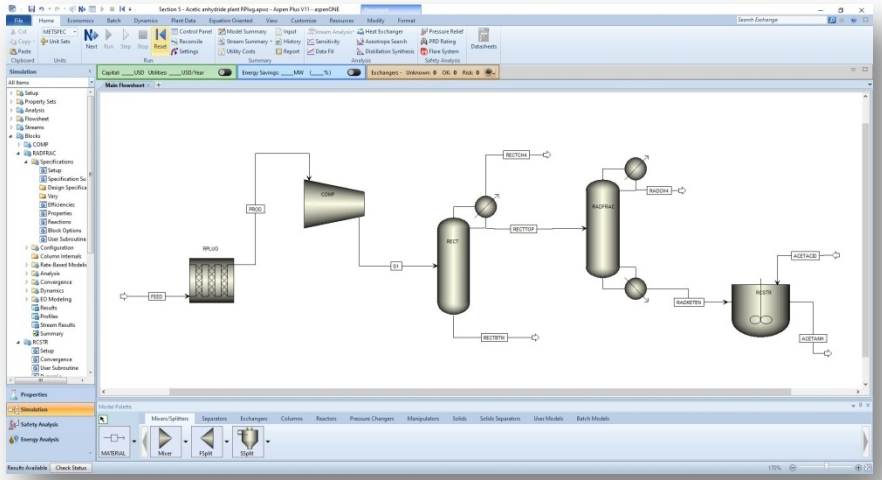
2. ABOUT ASPEN PLUS
What is Aspen Plus ?
Why is Aspen Plus so important ?
Who uses Aspen Plus ?
How to translate a chemical process into Aspen Plus ?

3. INTRODUCING ASPEN PLUS
Starting up Aspen plus
Preparing to begin a simulation
Search, find, select and enter your components
Specify the most relevant property method for your process
Improving the accuracy of a property method
Save your file and learn about the different formats
A couple of advices
Practice session #1
Creating a new case, entering and renaming compounds
Checking the binary interactions
Entering the simulation environment
Adding a process equipment
Adding a material stream
More Aspen Plus features
Entering stream properties
Aspen Plus report options
Running the simulation
Discussing the results and viewing the report general settings
How the different recommended property methods impact the simulation results
Objectives of the next videos
Resetting the simulator
Modifying a property set
Displaying stream properties on your process flowsheet
Printing from Aspen Plus
Viewing your results summary
Generating your report

COURSE CONTENT (2/2) :

Generating your report
Stream analysis : Stream properties
Stream analysis : Additional features
Adding a flash separation unit
Specifying input data for a flash separation process
Running the simulation and checking the results

AVAILABLE



ASPEN PLUS V11 MASTERCLASS

14 HOURS TRAINING WITH INDUSTRIAL PROCESS APPLICATIONS

WR Training

Spread the wings of your knowledge

COURSE DESCRIPTION (1/3) :

Aspen Plus is a powerful engineering simulation software that you can use to model a wide range of chemical processes.

It is widely used in engineering universities and in the industry, in research, development, modeling and design.

Aspen Plus serves as the engineering platform for modeling processes from Upstream through Gas Processing to Petroleum Refining, Petrochemicals, Chemicals and Pharmaceutical processes.

Online courses about Aspen Plus are difficult to find and when you find them they are either expensive or not professional.

This unique online course is designed around a series of **chemical process examples** which we work through to a model solution. It is an essential guide to understanding the principles, features and functions of Aspen Plus.
This understanding is a prerequisite for a **successful design**, **simulation**, **rating** & **optimization** of your plant and process equipment.

This unique online course leads you through a process that becomes continuously more difficult, challenging and enriching. When the course content and practice sessions have been completed, we expect that you will have become a **competent** and **advanced user** of Aspen Plus.

COURSE DESCRIPTION (2/3) :

The course is built with over 8 sections, each tackling a different chemical process and a different aspect of Aspen Plus.

The first section explains the basic structure of the software and leads you through a hands-on introduction to the various features of Aspen Plus, designed to facilitate the set up of simple problems.

Features such as the material balance, access to Aspen Plus documentation, the “Next” button, menu navigation, “Properties” and “Simulation” Environments, and the report functions are all introduced.

The remainder of the course is organized in a series of sections that focus on particular types of operations and processes, for example : chemical reactors, heat exchangers or piping systems.

Each section describes the process being modeled, the way it is modeled, the equations being solved, the various limitations, the potential sources of error, and a set of workshops containing exercises that you should solve to gain experience with the particular subject.

COURSE DESCRIPTION (3/3) :

In just about **14 hours**, this unique online course will make you an **advanced Aspen Plus user** and you will know how to :

✓ Build, navigate and optimize **steady state** simulation models using Aspen Plus

✓ Utilize a wide variety of unit operation models and calculation tools to model your process equipment such as distilling columns, reactors, pumps, compressors and piping systems just to name a few

✓ Then Evaluate the performance of your existing equipment by leveraging the equipment rating capabilities of Aspen Plus

✓ Perform Case Studies to determine the optimum operating points for your process

✓ Use the Model Analysis Tools to run sensitivity analysis and optimize your process

✓ And finally Use Aspen Plus in thermodynamics instruction for property analysis of pure components and mixtures

The knowledge gained in this course will **set you apart** from your peers, whether you are a graduate student, a practicing chemical engineer, or a manager and will give you **an edge over your competitors** when seeking employment at industrial plants.

WHAT YOU WILL LEARN (1/6) :

- ✓ Identify the benefits of process simulation using Aspen Plus
- ✓ Describe the capabilities of Aspen Plus
- ✓ Familiarize yourself with Aspen Plus graphical user interface and organizational structure
- ✓ Learn the basic concepts necessary for creating simulations in Aspen Plus
- ✓ Enter necessary elements to fully define a Fluid Package
- ✓ Select the appropriate property method for your application
- ✓ Define material streams and connect unit operations to build a flowsheet
- ✓ Modify and set desired units of measure
- ✓ Review stream analysis options

WHAT YOU WILL LEARN (2/6) :

- ✓ Add and connect unit operations to build a flowsheet
- ✓ Use the Report Manager to create custom unit operation and stream reports
- ✓ Use Aspen Plus to perform property analysis of pure components and mixtures
- ✓ Use Aspen Plus in thermodynamics instruction for Vapor-Liquid, Liquid-Liquid and Vapor-Liquid-Liquid Equilibrium calculations
- ✓ Build, navigate and optimize steady state simulation models using Aspen Plus
- ✓ Utilize a wide variety of unit operation models and calculation tools to model process equipment
- ✓ Evaluate the performance of existing equipment by leveraging the equipment rating capabilities of Aspen Plus
- ✓ Perform Case Studies to determine the optimum operating points for a process
- ✓ Design, revamp and debottleneck process equipment

WHAT YOU WILL LEARN (3/6) :

- ✓ Use the Model Analysis Tools to run sensitivity analysis and optimize your process
- ✓ Calculate process performance and thermophysical data with user subroutines in Fortran
- ✓ Investigate reasons why a simulation may produce poor results or errors
- ✓ Use suggested tips to debug a variety of simulations
- ✓ Understand best practices and learn how to troubleshoot simulations
- ✓ Identify and explain the various classes of distillation and separations models available in Aspen Plus
- ✓ Gain the skills and knowledge to model distillation, separation and extraction processes
- ✓ Reduce process design time by using advanced features of RadFrac distillation columns
- ✓ Use column analysis tools to optimize the feed location and number of stages and improve energy utilization for distillation columns

WHAT YOU WILL LEARN (4/6) :

- ✓ Add and manipulate column specifications to meet process objectives
- ✓ Construct, run, manipulate and analyze a distillation column
- ✓ Specify required parameters in order to execute flash calculations and fully define material streams
- ✓ Identify and explain the various classes of reactor models available in Aspen Plus (PFR, CSTR…)
- ✓ Model Plug Flow, Continuous Stirred Tank and Fluidized Bed Reactors
- ✓ Enter reaction stoichiometry and kinetic dats for simple (POWERLAW) and complex (LHHW) reaction types
- ✓ Use the Model Analysis Tools to run sensitivity analysis and optimize the operating conditions of a chemical reactor
- ✓ Use the Model Analysis Tools to run sensitivity analysis and optimize the selectivity of a given chemical reaction
- ✓ Identify and explain the various classes of piping system models available in Aspen Plus (pipes, valves, pumps, compressors)

WHAT YOU WILL LEARN (5/6) :

- ✓ Model piping components (pipes, fittings, valves...)
- ✓ Model fluid movers (pumps, compressors)
- ✓ Model piping systems
- ✓ Mitigate the risk for cavitation or choked flow using Aspen Plus
- ✓ Learn how to economically optimize your piping system
- ✓ Compare and contrast the applicability and operation of different heat exchanger models available in Aspen Plus
- ✓ Learn the fundamentals of producing an optimized shell & tube heat exchanger design
- ✓ Implement Aspen **E**xchanger **D**esign & **R**ating (EDR) for rigorous heat exchanger calculations within Aspen Plus
- ✓ Use the Activated Exchanger Analysis feature for continuous heat exchanger study and design

WHAT YOU WILL LEARN (6/6) :

✓ Design and rate a shell and tube heat exchanger using the EDR interface inside Aspen Plus

✓ Identify and explain the various classes of solids and solids separator models available in Aspen Plus

✓ Gain the practical skills and knowledge to begin modeling new and existing solids processes (crushers, fluidized beds, dryers, crystallizers…)

✓ Learn practical techniques for building and troubleshooting solids models

✓ Familiarize yourself with the Aspen **Safety Analysis** Environment

✓ Size and rate Pressure Safety Valves (PSVs)

COURSE CONTENT (1/5) :

1. INTRODUCTION

2. ABOUT ASPEN PLUS
What is Aspen Plus ?
Why is Aspen Plus so important ?
Who uses Aspen Plus ?
How to translate a chemical process into Aspen Plus ?

3. INTRODUCING ASPEN PLUS
Starting up Aspen plus
Preparing to begin a simulation
Search, find, select and enter your components
Specify the most relevant property method for your process
Improving the accuracy of a property method
Save your file and learn about the different formats
A couple of advices
Practice session #1
Creating a new case, entering and renaming compounds
Checking the binary interactions
Entering the simulation environment
Adding a process equipment
Adding a material stream
More Aspen Plus features
Entering stream properties
Aspen Plus report options
Running the simulation
Discussing the results and viewing the report general settings
How the different recommended property methods impact the simulation results
Objectives of the next videos
Resetting the simulator
Modifying a property set
Displaying stream properties on your process flowsheet
Printing from Aspen Plus
Viewing your results summary
Generating your report

COURSE CONTENT (2/5) :

Generating your report
Stream analysis : Stream properties
Stream analysis : Additional features
Adding a flash separation unit
Specifying input data for a flash separation process
Running the simulation and checking the results

4. FLASH SEPARATION & DISTILLATION
Adding a second mixer and a flash separation unit
Design specifications / Sensitivity analysis
Distillation column options
"DSTWU" distillation column
"Distl" distillation column
"RadFrac" distillation column
Some interesting graphic features

5. LIQUID-LIQUID EXTRACTION PROCESSES
Selecting a property method for extraction processes
Setting-up our model for a single stage extraction unit
Defining a new property set
Property methods vs experimental data using sensitivity analysis
Multistage extraction columns
Checking for azeotropic conditions using the triangle diagram

6. CHEMICAL REACTORS
Chemical process description
Reaction kinetic in Aspen Plus environment
Entering components and property method
Reactor options in Aspen Plus
Adding a Plug Flow reactor
Setting-up the reactor model for a Plug Flow Reactor
Running the RPlug model and discussing the results

COURSE CONTENT (3/5) :

Adding a compressor and a rectifying column
Running the Reactor + Compressor + Column model and discussing the results
Pure component analysis
Adding a RadFrac distillation column
Analyzing the results
Adding the RCSTR reactor
Running the global model and discussing the results
Complex reactor kinetics
LHHW type reaction
Specifying the driving force for a non-reversible reaction
Specifying the driving force for a reversible reaction
Specifying the adsorption term
Determining kinetic parameters for the methanol reaction
Determining kinetic parameters for the water-gas shift reaction
Methanol process description
Entering components and selecting a property method
Entering input parameters
Entering kinetic parameters for the methanol reaction
Entering kinetic parameters for the water-gas shift reaction
Running the RPlug model and discussing the results
Determining the reactor's optimum operating temperature a pressure

7. PIPING SYSTEMS
Piping system description
"STEAMNBS"
Setting the flowsheet
Entering piping system specifications
Pipe results
Pump results
Valve results
Tank results
Determining the onset of cavitation and valve choking

COURSE CONTENT (4/5) :

8. ECONOMIC OPTIMIZATION OF PIPING SYSTEMS

Piping system description
Setting the flowsheet
Entering piping system specifications
The Optimization tool
The Sensitivity tool

9. HEAT EXCHANGERS

Process description
Heat Exchanger models
The "Heater" model
The "HeatX" model
The Exchanger Design & Rating (EDR)
The EDR Exchanger Feasibility Panel
Useful EDR Exchanger features
The "HeatX" rigorous mode for heat exchanger design

10. SOLIDS HANDLING

Solids unit operations models
Solids separators models
Crusher process description - Example #1
"Solids" template and defining a solid material
Solids classification
Defining a solid material using different conventions
Adding the crusher unit
About stream classes
About substream classes
About Particle Size Distribution (PSD) in Aspen Plus
Defining the Particle Size Distribution (PSD)
Calculating the outlet PSD using the "Select equipment" method (1/2)
About solids results in Aspen Plus
Calculating the outlet PSD using the "Select equipment" method (2/2)
Calculating the outlet PSD using the "Communition power" method

COURSE CONTENT (5/5) :

Calculating the outlet PSD using the "Specify outlet PSD" method
Results summary for each PSD calculation method
Fluidized bed : Introduction
Fluidized bed representation in Aspen Plus
Fluidized bed modeling in Aspen Plus
Fluidized bed reactor : Process description - Example #2
Fluidized bed reactor : Entering components and selecting the property method
Fluidized bed reactor : Setting the process flowsheet
Fluidized bed reactor : Entering input data for the streams and compressor unit
Fluidized bed reactor : Entering input data for the fluidized bed reactor
Fluidized bed reactor : Viewing and discussing the results
Dryer operation : Process description - Example #3
Dryer operation : Setting the flowsheet
Dryer operation : Analyzing the results
Crystallizer operation : Process description - Example #4
Crystallizer operation : Setting the flowsheet

11. BONUS : INTRODUCING ASPEN PLUS SAFETY ENVIRONMENT
Process description
Preparing the flowsheet for the “Safety Analysis” Environment
The Aspen Plus “Safety Analysis” Environment
Sizing & rating a Pressure Safety Valve (PSV)

DISTILLATION :
PRINCIPLES, OPERATION & DESIGN

WR Training
Spread the wings of your knowledge

COURSE DESCRIPTION :

Distillation columns of various designs and applications are encountered nowadays throughout petroleum refining, petrochemical, chemical and process industries.

This course is designed to provide you with a complete understanding of **construction details** and **functioning** of distilling columns. This understanding is a prerequisite for **successful operation** of your plant.

The course features 5 major items :
1. Vapor Liquid Equilibria
2. Industrial Distillation Practices
3. Industrial Distillation Equipment
4. Assessing Distilling Column Performance Using Aspen Plus
5. Solved Problems

Many **images**, **cross sectional views**, **graphs** and **animations** can be found throughout, increasing the value of this course as an educational tool and industrial reference for personnel involved in distilling operations.

So this course is not only of use to practicing engineers and operators to whom a knowledge of the distillation process is of crucial importance in **efficient operation** of distilling columns but also intended as a **study guide** for **undergraduates** in process, chemical, petrochemical & petroleum engineering disciplines.

WHAT YOU WILL LEARN :

- ✓ Understand the thermodynamics of Vapor Liquid Equilibria for pure components and mixtures
- ✓ Know, understand and master the concepts necessary to optimize the operation of your distillation column
- ✓ Know about all parameters and profiles for the analysis of your distillation column operation
- ✓ Detect deficiencies in the operation of your distilling column, find their origin and solutions
- ✓ Know and understand the operating variables and process control systems used for your distillation column
- ✓ Know the different types of internals, how they operate and how you can optimize them
- ✓ Use the Aspen Plus simulation results to understand and predict the performance of a distillation column

COURSE CONTENT (1/3) :

1. INTRODUCTION

2. ABOUT THE DISTILLING PROCESS
What is distillation ?
Types of distillation processes
Limits of distillation
Concept of volatility
Distillation practices
Distillation column operation in 3D

3. VAPOR LIQUID EQUILIBRIA OF PURE COMPONENTS
Introduction
Vapor Liquid Equilibrium
Vaporization of a pure component at constant pressure
Condensation of a pure component at constant pressure
Boiling point
Vaporization and Condensation of a pure component at different pressures
Vapor pressure curve
Vapor pressure curve : The case of water
More on vapor pressure curves
Flash vaporization
Heat of vaporization
Critical point
VLE : What you need to know for pure components
Enthalpy diagram for a pure component 1/3
Enthalpy diagram for a pure component 2/3
Enthalpy diagram for a pure component 3/3
Problem #1 : Ethylene / Ethane fractionator
Problem #2 : Reboiler operation

4. VAPOR LIQUID EQUILIBRIA OF MIXTURES
Vaporization of a hydrocarbon mixture at constant pressure
What do we learn ?
Vapor - Liquid Equilibrium of mixtures
Vapor pressure of mxitures

COURSE CONTENT (2/3) :

Raoult's law
Dalton's law
Concept of Equilibrium Coefficient
Scheibel and Jenny Chart
Concept of Relative Volatility
Relative volatility : Industrial applications
Relative volatility : Effect of pressure
VLE : What you need to know for mixtures
Problem #3 : Flash Separator
Problem #4 : The vaporization curves
Problem #5 : Distillation Column Overhead Operation
Problem #6 : Cut Point & Separation Line

5. DISTILLATION PRACTICES

A typical distillation column
Industrial application : The depropanizer (Steam Cracking Process)
Industrial application : The depropanizer Material Balance
Reflux drum pressure
Pressure profile
Simple pressure control
Complex pressure control
Overhead composition control
Alternative control strategies
Overall thermal balance
Condenser thermal balance
Optimum Reflux Ratio
Flow rate profile
Concentration and temperature profiles - Binary distillation
Concentration profiles - Complex mixtures
Temperature profile - Complex mixtures

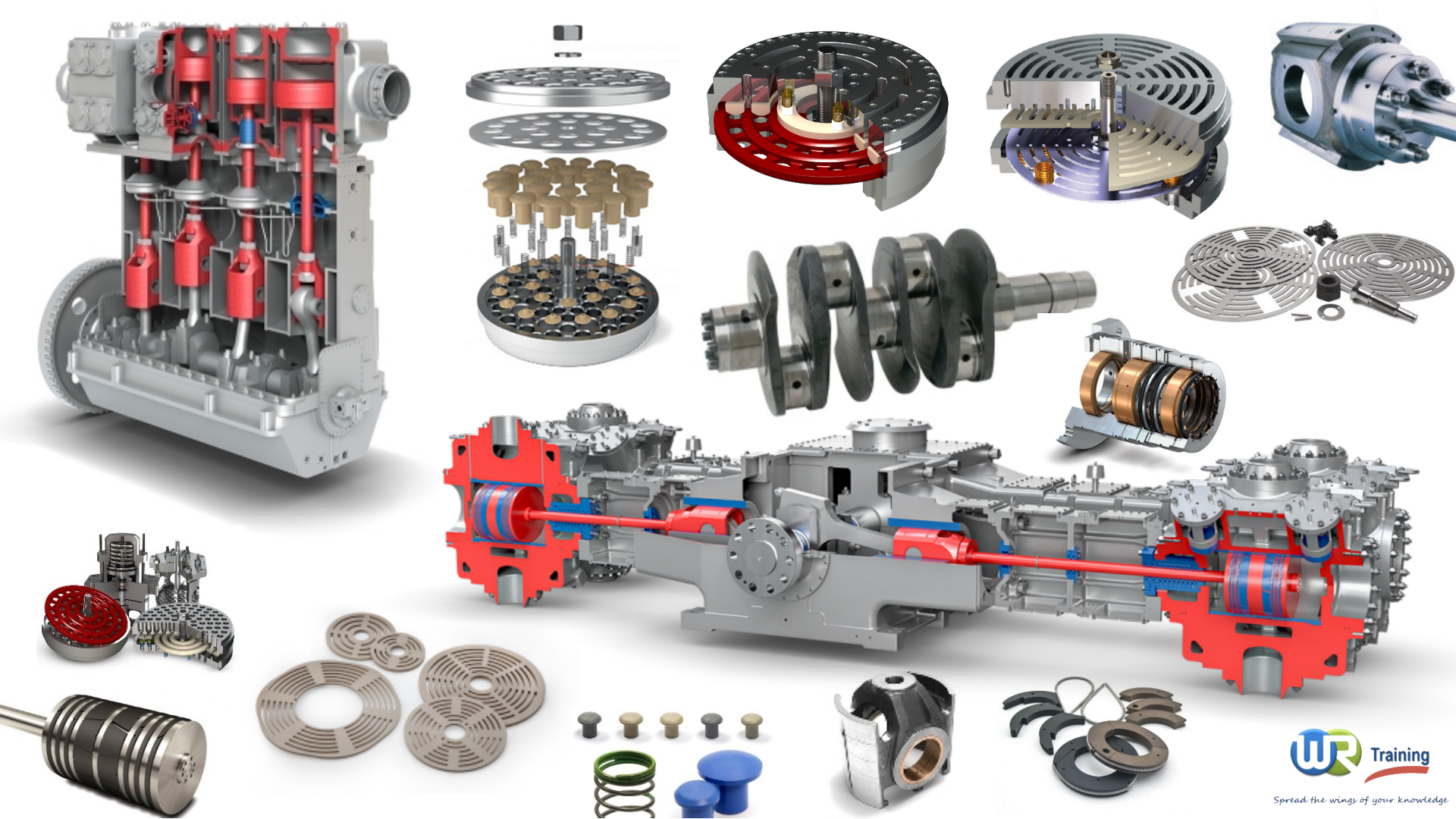
6. DISTILLATION EQUIPMENT

Introduction
The shell
The trays
Tray arrangements

COURSE CONTENT (3/3) :

Tray types
Packings
Packing support
Liquid distributors
Collector trays
Packing restrainers
Combined Tray / Packed distilling column
The reboiler
The condenser

7. ASSESSING DISTILLING COLUMN PERFORMANCE USING ASPEN PLUS
The base case
Effect of reflux ratio
Effect of feed stage location
Effect of feed temperature


WR Training
Spread the wings of your knowledge

COURSE DESCRIPTION :

Reciprocating compressors of various designs and applications are encountered nowadays throughout refining, petrochemical and process industries as well as in power generation and environmental engineering.

This course is designed to provide you with a complete understanding of **construction details** and **functioning** of reciprocating compressors. This understanding is a prerequisite for a successful operation of your plant and piping system.

The course includes **extensive graphics**, **3D animations** and **cross-sectional views** to give you a **virtual practical exposure** on reciprocating compressors.

The objective of this course is threefold :

1. Break down for you all the reciprocating compressor operating principles into easily digestible concepts like gas compression, capacity control, pulsation control, compressor lubrication and cooling...

2. Illustrate through 3D animations and cross-sectional views the main compressor mechanical components, state their function and operating limits, like bearings, packings, crossheads, pistons, valves...

3. Provide guidelines and best practices for operation, maintenance and troubleshooting of reciprocating compressors in accordance with the API 618 standard

WHAT YOU WILL LEARN (1/2) :

✓ Understand the working principles of reciprocating compressors for a successful operation of your plant and piping system

✓ Understand the construction details of reciprocating compressors for a successful maintenance and troubleshooting (crankshafts, bearings, crossheads, connecting rods, pistons, packings, rings, valves, unloaders...)

✓ Perform various calculations to size and assess compressor performance (head, discharge temperature, inlet capacity, piston displacement, volumetric efficiency…)

✓ Understand what affects the selection and design of reciprocating compressors (process conditions, gas characteristics, foundation needs, power supply, interstaging, altitude…)

✓ Know how you can adapt your compressor capacity to your system demand changes using various techniques (intake valve unloading, clearance pocket, variable volume valve, 5 step control…)

✓ Understand the concept of pulsation, how it can affect your compressor performance and how to control it according to the API 618 standard

✓ Know how to size suction and discharge volume bottles to control reciprocating compressor pulsation

WHAT YOU WILL LEARN (2/2) :

- ✓ Understand the importance of compressor lubrication
- ✓ Discover the various compressor lubrication systems and how they operate (splash, splash and flood, full pressure circulation…)
- ✓ Understand the importance of compressor cooling, intercooling and aftercooling
- ✓ Discover the various compressor cooling systems and how they operate (series flow, parallel flow, closed systems…)
- ✓ Analyze the problems in operation related to compressor valves, pulsation control, capacity control…

COURSE CONTENT (1/4) :

1. INTRODUCTION

2. COMPRESSOR OVERVIEW

3. THEORY OF RECIPROCATING COMPRESSORS

Reciprocating compressors : Simplified 3D animation
Pressure - Volume diagram
Piston displacement
Volumetric efficiency
Inlet capacity
Piston speed
Discharge temperature
Compressor head
Power
Valve loss
Clearance loss
Piston ring leakage
Valve slip
Effect of multistaging
Interstage pressures
Effect of altitude
Brake horsepower

4. CHARACTERISTICS OF RECIPROCATING COMPRESSORS

Classifications
Automatic valves
Useful terminology

5. COMPRESSOR TYPE SELECTIONS

Considerations in selection
Selection possibilities
Selection of AIR compressors
Selection of PROCESS compressors

COURSE CONTENT (2/4) :

6. RECIPROCATING VS CENTRIFUGAL
Reciprocating compressors in a process system
Centrifugal compressors in a process system

7. MECHANICAL DESIGN OF RECIPROCATING COMPRESSORS
Crankcase
Distance piece
Cylinders
Cylinder arrangements
Cylinder materials
Cylinder liners
Pistons
Piston dismantling
Piston materials
Piston to piston rod connections
Piston rods
Piston rod materials
Piston rod to crosshead connections
Crossheads
Crankshafts
Crankshaft - Rod - Crosshead - Piston Assembly
Piston rings and rider bands
Piston rod packings
Packing rings
Packing ring arrangements : Single acting
Packing ring arrangements : Double acting
Packing ring arrangements : Pressure breaker
Piston rod packing assembly
Oil wiper packing

8. COMPRESSOR VALVES
What is a compressor valve ?
Basic requirements
Basic function
Valve types
Ported plate valves

COURSE CONTENT (3/4) :

Ported plate valves - 3D animation
Concentric ring valves
Concentric ring valves - 3D animation
Disc valves (poppet)
Rectangular valves
Suitability of valves
Valve materials
Valve failure analysis
Troubleshooting valve problems
How to install and remove a compressor valve

9. PULSATION CONTROL
Pulsation control
Sizing a compressor volume bottles

10. CAPACITY CONTROL
Intake valve unloading
Intake valve unloading - Hand operated valves
Intake valve unloading - Air operated valves
5 step control
Clearance pocket
Clearance pocket - Hand operated valve
Clearance pocket - Air operated valve
Clearance pocket - Variable volume valve
Intake valve unloading combined with clearance pocket

11. LUBRICATION OF RECIPROCATING COMPRESSORS
Crankcase / Bearings lubrication methods
Lubrication Method #1 : Splash lubrication
Lubrication Method #2 : Splash and flood lubrication
Lubrication Method #3 : Full pressure circulation lubrication
Factors affecting bearing lubrication
Cylinder and packing lubrication
Method of application
Pumps with a sight glass
Pumps with a pressurized supply

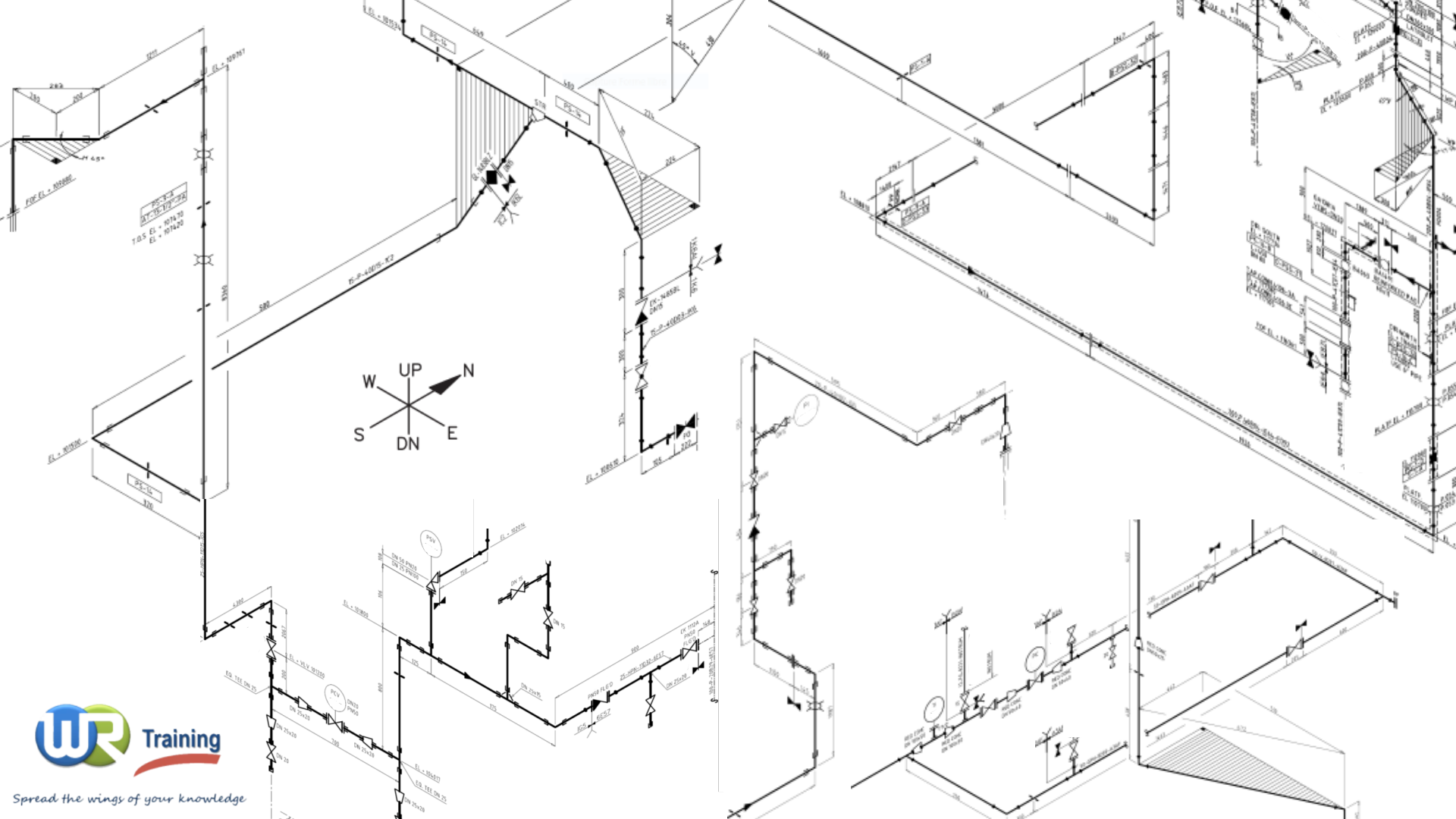
COURSE CONTENT (4/4) :

12. COMPRESSOR COOLING

Over cooling

Cooling systems

AVAILABLE



WR Training

Spread the wings of your knowledge

COURSE DESCRIPTION (1/2) :

Piping Isometrics, commonly referred to as “isos”, are encountred nowadays throughout all process industries such as Oil & Gas, chemical, pharmaceutical or food industries.

These engineering drawings are used worldwide in design, construction, commissioning, operation and maintenance of industrial plants. They provide clear information on the configuration and routing of piping systems.

As a potential actor in these industries, it is therefore vital that you have a thorough understanding of Piping Isometric components and construction.

Piping Isometrics don’t have to be a complicated ! It isn’t rocket science !

This course will make you a Piping Isometric expert and you will know how to **read**, **interpret** and **successfully understand** all of those many lines and piping symbols.

The knowledge gained in this course will help you to understand **all isos** so that you can draw the correct information from them.

This will set you apart from your peers, whether you are an operator, engineer, or manager and will give you an edge over your competitors when seeking employment at one of these industrial facilities.

COURSE DESCRIPTION (2/2) :

This training course starts by initiating you to basic blueprint reading (which is also used in electrical, hydraulic and mechanical fields of expertise), then moves on to familiarize you with simple to complex isometric features, such as **isometric offsets**

Symbols are also discussed thoroughly with all the isometric standards, conventions and designation codes that apply to them.

These include :

- Valves (gate, globe, ball, butterfly...)
- Process equipment (pumps, compressors, heat exchangers, reactors...)
- Instrumentation (flow meters, temperature transmitters, pressure gauges...)
- Piping and fittings
- ...

Included in the course are access to numerous downloadable resources, real industrial examples of Piping Isometrics and the keys to interpret them in high quality video lectures. You will be able to practice and become even more proficient with these bonus items that you will find throughout the course.

WHAT YOU WILL LEARN (1/2) :

- ✓ Understand and evaluate the purpose, content, and importance of Piping Isometrics to the construction, commissionning, safe operation and maintenance of a process plant
- ✓ Learn how to READ, INTERPRET and successfully UNDERSTAND ALL Piping Isometrics through numerous real industrial examples
- ✓ Learn how to DRAW your own Piping Isometrics through numerous real industrial examples
- ✓ Download our valuable sizing tables and dimensioning charts, essential to properly draft and issue your own Piping Isometrics
- ✓ Identify the 5 key sections of your Piping Isometrics (title block, grid system, revision block, notes and legend, engineering drawing block)
- ✓ Know and identify valve symbols on your Piping Isometrics (gate, globe, ball, butterfly, needle…)
- ✓ Know the standards and conventions for valve status (open, closed, throttled)
- ✓ Identify valve position and failure mode on your Piping Isometrics when applicable (LO, LC, FO, FC, FAI…)
- ✓ Know and identify process equipment symbols on your Piping Isometrics when applicable

WHAT YOU WILL LEARN (2/2) :

- ✓ Determine specific information about a process piping including type of material in the line, line size, line number and type of insulation when applicable
- ✓ Know and identify pipe fitting symbols on your Piping Isometrics (flanges, reductions, caps, spool pieces, unions…)
- ✓ Know and identify the Piping Isometric symbols of safety devices that are used to safely isolate, vent & drain process equipment for ease of maintenance (spectacle and spade blinds, double block and bleed valves…)
- ✓ Know and identify instrumentation symbols on your Piping Isometrics (flow meters, temperature transmitters, pressure gauges…)
- ✓ Know and identify the location of instruments, recorders, modifiers and controllers on your Piping Isometrics when applicable (field mounted, board mounted, inaccessible…)
- ✓ Know the lettering and numbering standards for piping, instruments and equipment designation on your Piping Isometrics
- ✓ Trace the flow of a process stream into your Piping Isometrics, through the pipes and equipment, and out of the Piping Isometrics

COURSE CONTENT (1/2) :

1. INTRODUCTION

2. ABOUT PIPING ISOMETRICS
What is an isometric ?
Why is an isometric so important ?
How do isometrics look like ?
Intro to isometric piping symbols
Isometric orientation

3. INTRODUCTION TO ISOMETRIC READING
Anatomy of a piping isometric drawing
The title block
The drawing scale
The grid system
The revision block
Changes
Notes and legend

4. BASIC ISOMETRIC SYMBOLS
Valve symbols
Valve actuator symbols
Control valve designations
Standards and conventions for valve status
Process equipment symbols
Piping symbols
Pipe fitting symbols
Isolating, venting & draining symbols for ease of maintenance
Instrumentation
Sensing devices and detectors
Location symbols

5. PIPING ISOMETRIC CODES
Piping designation code
Equipment designation code
Instrument designation code
Miscellaneous designation codes

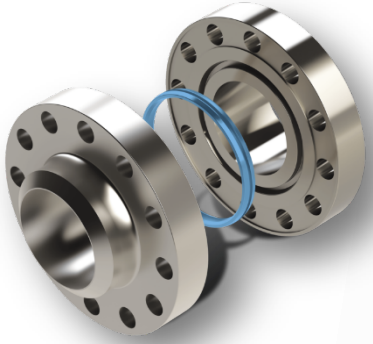
COURSE CONTENT (2/2) :

6. THE DRAWING PROCEDURE
The drawing procedure
Isometric coordinates
Dimensions, notes and callouts
Isometric offsets
Dimensioning offsets
Multi-angle offsets
Rolling offsets
Dimensioning rolling offsets
Simplifying the calculations

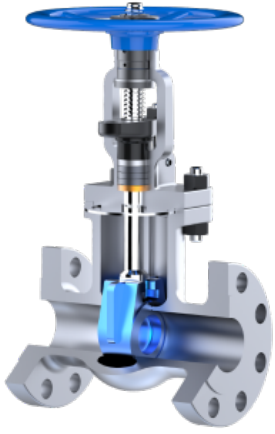
7. PRACTICE SESSION
Piping isometric example #1
Piping isometric example #2
Piping isometric example #3
Piping isometric example #4
Piping isometric example #5












WR Training
Spread the wings of your knowledge

COURSE DESCRIPTION (1/2) :

The productivity of a process plant depends as much on the piping system as it does on all other plant equipment. As a result it is essential that the design of your piping system be optimized, properly maintained, and when required, repaired in an effective and timely manner.

This course is designed to provide you with a complete understanding of design, manufacturing and construction of piping systems and their basic components, such as fittings, flanges, valves and pipe supports in addition to the codes and standards that apply to them.

The course includes extensive graphics, cross-sectional views, sizing tables and 3D animations. This will give you a virtual practical exposure on piping systems and their accessories.

The course also includes numerous practice sessions and most importantly will present a step-by-step piping design method. We will show you how to design a piping system from scratch. This valuable and proven piping design method is actually what we use at our petrochemical complex to design a new piping system or to modify an existing one. This design method is presented at the end of the course. For this reason, we do highly recommend starting the course from the beginning and navigating through all the sections in the order we have established so that you will be in a better position when tackling the design section.

COURSE DESCRIPTION (2/2) :

The objective of this course is threefold :

1. Break down for you all the piping system design and construction principles into easily digestible concepts like joining technologies, welding methods, pipe expansion handling, calculation of distances between piping supports and dimensioning of pipe guides and anchors…

2. Illustrate using 3D animations and cross-sectional views the main piping components, state their function, their operating limits, their material of construction and their installation procedures such as pipes, flanges, fittings and valves...

3. Provide proven guidelines and best practices for design, construction, installation and maintenance of piping systems in accordance with the codes and standards defined by the ASME & ANSI. The concept of Piping Specifications and Piping Classes will discussed in exquisite detail with numerous practical examples

WHAT YOU WILL LEARN (1/2) :

- ✓ Learn a valuable step-by-step Piping Design Method and start designing your piping systems from scratch (we actually use this proven method at our petrochemical complex to design a new piping system or to modify an existing one)
- ✓ Download our valuable sizing tables and dimensioning charts, essential to properly design your piping system
- ✓ Download our valuable technical booklets covering Flanges & Valves
- ✓ Build a strong understanding of piping design and construction principles for both metallic and nonmetallic piping systems
- ✓ Explain the various pipe manufacturing and joining methods
- ✓ Identify the different types of fittings and their application
- ✓ Identify the different types of flanges, gaskets, and bolting materials
- ✓ Identify the different types of valves, their basic parts and functions
- ✓ Identify the different types of control valves, their basic parts and functions

WHAT YOU WILL LEARN (2/2) :

- ✓ Identify the different types of piping accessories (anchors, dummy and channel supports, spring hangers, hanger rods…)
- ✓ Gain guidance for selecting the most appropriate pipe specification and material for your application
- ✓ Gain guidance for selecting the most appropriate pipe spacing and arrangement to mitigate thermal expansion and successfully design your piping support systems
- ✓ Explain the process of pipe identification
- ✓ Appreciate the various piping classes based on the design and application
- ✓ Know and familiarize yourself with international and national pipe standards and specifications (ASME, ANSI, AFNOR…)

COURSE CONTENT (1/4) :

1. INTRODUCTION

2. PIPE
Pipe materials
Manufacturing methods
Sizing of pipe
Wall thickness
More on the schedule system
Pipe selection
Methods of joining pipe
Cast iron pipe
Joining cast iron pipe
Plastic pipe
Joining plastic pipe
Drawing pipe

3. FITTINGS
90° elbows
Long-radius elbows
Short-radius elbows
Reducing elbows
Mitered elbows
45° elbows
Weld tee
Stub-in
Stub-in reinforcements
Coupling
Reducers
Weld caps
Use of fittings
Screwed and socket-weld fittings
Unions
Plugs
Pipe nipples
Swage nipples
Flanged fittings

COURSE CONTENT (2/4) :

4. FLANGES
Rating flanges
Flange facings
Flat Face flanges (FF)
Raised Face flanges (RF)
Ring-Type Joint flanges (RTJ)
Flange types
Weld neck flanges
Slip-on flanges
How to fit and weld slip-on flanges
Lap-joint flanges
Threaded flanges
Socket-weld flanges
Reducing flanges
Blind flanges
Orifice flanges
Bolts
Gaskets

5. VALVES FUNCTIONS AND BASIC PARTS
Valve body
Valve bonnet
Valve trim
Disk and seat
Stem
Valve actuator
Valve packing

6. TYPES OF VALVES
Numerous sizes, styles and pound ratings
Gate valves
Globe valves
Ball valves
Plug valves
Diaphragm valves
Pinch valves
Butterfly valves

COURSE CONTENT (3/4) :

Needle valves
Check valves
Relief and Safety valves
Safety valves
Relief valves
Control valves

7. VALVE ACTUATORS
Manual actuators
Electric motor actuators
Pneumatic actuators
Hydraulic actuators
Self-actuated valves

8. STANDARD PIPING DETAILS
Piping rack spacing
Pipe flexibility
Heat expansion
Pipe anchors
Pipe insulation shoes
Pipe guides
Pipe spans
Pipe supports
Field supports
Dummy supports
Hanger rods

9. PIPING CODES AND SPECIFICATIONS
Piping codes
Specifications
Scope
Code requirements
Drawing
Piping
Instruments
Vents & drains

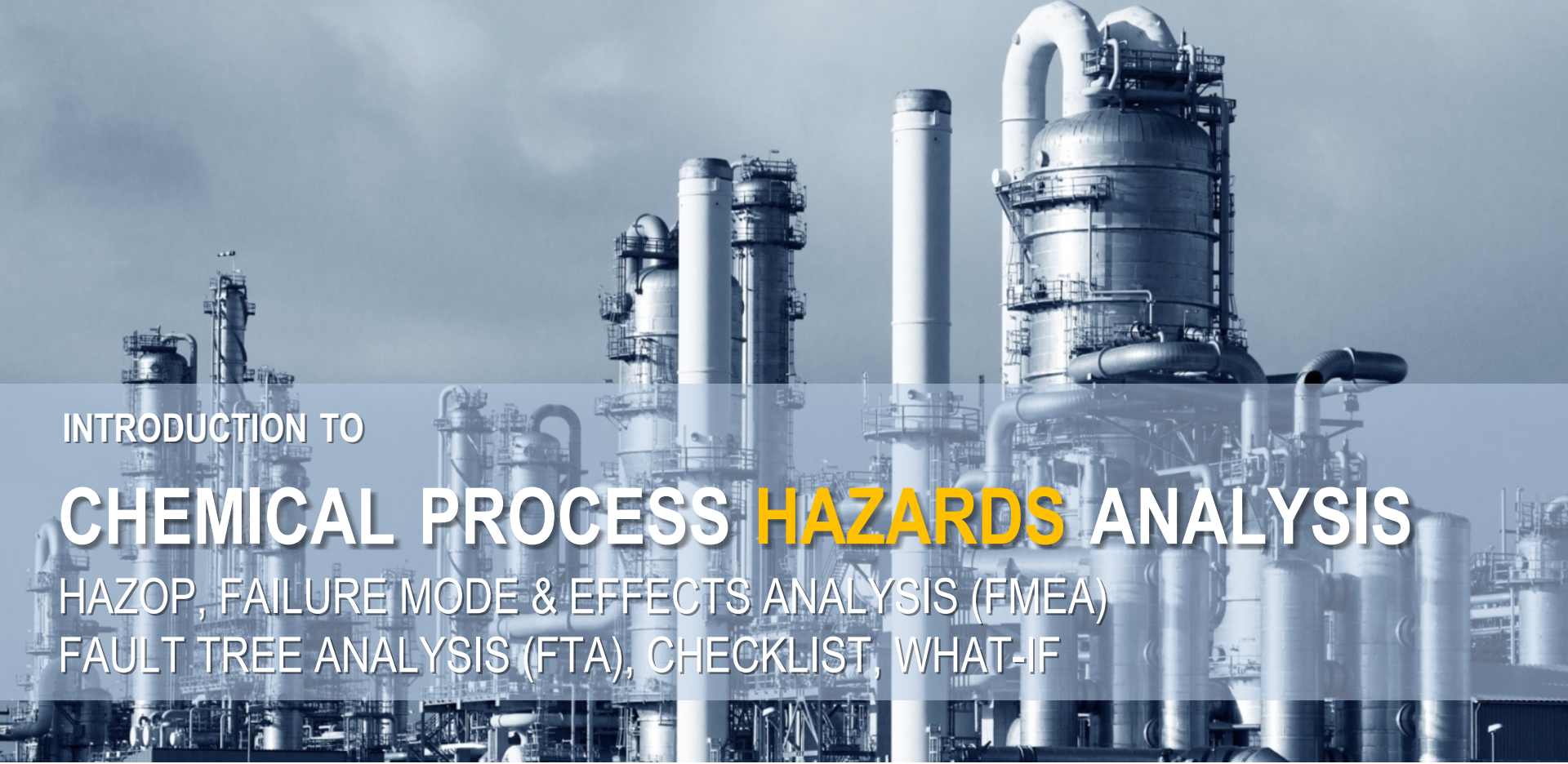
COURSE CONTENT (4/4) :

Orifices
Clearance & spacing
Insulation & painting
Fabrication tolerances
Shipping lengths
Piece marking & painting
Testing
Pipe labeling and color codes
Piping specification classes
Concrete example of a piping class

10. PIPING SYSTEM DESIGN PROCEDURE
Problem set-up
A set by step guide

11. INTRODUCTION TO MECHANICAL EQUIPMENT
Horizontal vessels
Vertical vessels

Ladders, Cages & Platforms
Pumps : Overview
Pumps : Nozzle arrangement
Pump drivers
Compressors : Overview
Heat Exchangers : Overview
Shell & Tube
Double pipe
Reboilers
Air fans
Cooling towers
Furnaces
Storage tanks



INTRODUCTION TO

CHEMICAL PROCESS HAZARDS ANALYSIS

HAZOP, FAILURE MODE & EFFECTS ANALYSIS (FMEA)
FAULT TREE ANALYSIS (FTA), CHECKLIST, WHAT-IF