

**TRAINING TITLE**

**SULPHUR RECOVERY & TROUBLESHOOTING**

**TRAINING DURATION**

5 Days

**TRAINING VENUE AND DATES**

PE076	Sulphur Recovery & Troubleshooting	5	24-28 March, 2019	\$6,250	London
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**In any of the 5 star hotel. The exact venue will be informed soon.**

**TRAINING FEES**

6,250 US\$ per participant includes Training Materials/Handouts, Tea/Coffee breaks, Refreshments and International Buffet Lunch.

**TRAINING CERTIFICATE**

**DEFINE** Management Consultancy & Training Certificate of course completion will be issued to all attendees.

**WHO SHOULD ATTEND?**

Technical and non-technical personnel involved in the activities of natural gas industry. Specifically, technical, operations and maintenance personnel who had limited exposure to this area, or professionals involved in other areas of the gas industry that require a comprehensive overview of natural gas processing will find this course ideally suited for them.

**COURSE OVERVIEW – INTRODUCTION/DESCRIPTION**

The rapidly increasing worldwide demand for natural gas as an energy source requires expertise in gas engineering technology, which involves several production operations such as dehydration, acid gas removal, recovery of natural gas liquids and the production of liquefied natural gas. In addition, one involved in such industry needs to be familiar with different gas sources, specifications, storage requirements, transportation and distribution

The H<sub>2</sub>S, together with some or all of any carbon dioxide (CO<sub>2</sub>) present, is removed from the natural gas or refinery gas by means of one of the gas treating processes described in the previous section. The resulting H<sub>2</sub>S -containing acid gas stream is flared, incinerated, or fed to a sulphur recovery unit. This course for as an effective practical shortcut to understand the gas sweetening and sulphur recovery process and all features and troubleshooting problems encountered in the plant operations. With increasing demands to natural gas over the world, sour gases are being tapped for utilization after purification. But, the natural gas that is transported to the market must meet legal and safety requirements; it must be non-toxic, non-corrosive and safe to environment. For that reasons, gas conditioning or specifically gas treating is a very important step in gas processing scheme. H<sub>2</sub>S, and CO<sub>2</sub>, are removed to certain level through a gas sweetening process

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This course will start by defining what natural gas is, its properties, specifications and end uses. Then, typical gas processing operations will be discussed, including dehydration, acid gas removal, recovery of ethane, propane and NGL (natural gas liquids), and liquefied natural gas (LNG) operations. Sulphur recovery, tail gas conditioning and process control will also be discussed. Typical equipment and facilities that are found in typical natural gas processing operations will also be discussed including compressors, vessels, relief systems and safety systems. Finally, the fundamentals of gas transportation and distribution will be discussed.

**COURSE OBJECTIVES:**

This short course is designed to give the attendants the fundamentals of natural gas conditioning and processing including some of the details of the process.

**Upon the successful completion of this course, participants will be able to:-**

- To present the fundamentals of all aspects of Sulphur recovery from process selection through operation and plant optimization.
- Identify properties, specifications and end uses of natural gas.
- Discuss about typical natural gas processing operations, including:
  - Dehydration
  - Acid gas removal
  - Recovery of ethane, propane and NGL (natural gas liquids)
  - Sulphur recovery
- Discuss about the production of liquefied natural gas (LNG).
- Recognize the different equipment and facilities found in natural gas processing plants.
- Discuss about the fundamentals of gas transportation and distribution.
- Describe how each component in the unit operates, the effects of process variables
- Describe how to monitor the unit and make necessary adjustments
- Explain how to perform routine maintenance, and troubleshooting common problems affecting proper operation of the unit, in order to achieve the goals of gas sweetening and Sulphur Recovery units.

**TRAINING METHODOLOGY:**

A highly interactive combination of lectures and discussion sessions will be managed to maximize the amount and quality of information and knowledge transfer. The sessions will start by raising the most relevant questions, and motivate everybody find the right answers. You will also be encouraged to raise your own questions and to share in the development of the right answers using your own analysis and experiences. Tests of multiple-choice type will be made available on daily basis to examine the effectiveness of delivering the course.

All presentations are made in excellent colourful power point. Very useful Course Materials will be given.

- 30% Lectures
- 30% Workshops and work presentation

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- 20% Group Work & Practical Exercises
- 20% Videos & General Discussions

### **TOPICS COVERED**

- Gas-well gas and associated gas
- Typical near well surface production operations and facility
- Gas processing, conditioning and treating
- Objectives of the gas process
- Reaction type sweetening and the mechanisms of H<sub>2</sub>S and CO<sub>2</sub> removal
- Typical sweetening unit and the process variables
- Recommendation for start-up and shutdown
- Basis of the Claus Process
- Design Considerations
- Tail Gas Clean-Up Processes

### **COURSE OUTLINES:**

#### **DAY 1**

- **What is natural gas?**
- **Origins**
- **Properties**
- **Specifications**
- **End uses and markets for natural gas**
- **Environmental advantages**
- **Physical behaviour of natural gas systems**
- **Physical and thermal properties**
- **Phase behaviour analysis**
  - Pure substances
  - The phase rule
  - Behaviour of mixtures
  - Vaporization by gas pressure
  - Molecular theory of gases and liquids
  - Natural gases
  - Density of natural gas
  - Density of liquids
  - Dense phase
  - Surface tension
  - Viscosity
  - Thermal conductivity of gases
  - Thermodynamic properties
  - Sampling and analysis

#### **DAY 2**

- **Natural gas processing plant**
  - Flowsheet

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- Equipment and components
- **Heat exchange in gas processing**
  - Heat transfer theory
    - Mechanisms of heat transfer
    - Process heat duty
  - Heat exchangers types
    - Shell and tube
    - Double-pipe
    - Plate and frame
    - Aerial coolers
  - Fired heaters
  - Heat recovery units

### **DAY 3**

- **Hydrates**
  - Determination of hydrate formation temperature or pressure
  - Condensation of water vapour
  - Temperature drop due to gas expansion
  - Thermodynamic inhibitors
  - Kinetic inhibitors and anti-agglomerators
- **Low temperature exchange (LTX) units and line heaters**
  - LTX units
  - Line heaters
  - Heat duty
  - Fire-tube size
  - Coil size
  - Standard size line heaters
- **Condensate stabilization**
  - Partial pressure
  - Multistage separation
  - Multi flashes
  - Cold feed distillation tower
  - Distillation tower with reflux
  - Condensate stabilizer design
  - Trays and packing
  - Condensate stabilizer as a gas processing plant
  - LTX unit as a condensate stabilizer

### **DAY 4**

- **Acid gas treating**
  - Gas sweetening processes
    - Solid bed absorption
    - Chemical solvents
    - Physical solvent processes
    - Direct conversion of H<sub>2</sub>S to sulphur

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- Sulphide scavengers
    - Process selection
    - Design procedure for iron-sponge units
    - Design procedure for amine systems
- **Amine absorber**
- **Amine circulation rates**
- **Flash drum**
- **Amine reboilers**
- **Amine stripper**
- **Rich/lean amine exchanger**
- **Amine cooler**
- **Amine solution purification**
- **Materials of construction**
- **Gas dehydration**
  - Water content determination
  - Glycol dehydration
    - Process description
    - Choice of glycol
    - Design considerations
    - System sizing
  - Solid bed dehydration

## DAY 5

- **Sulphur recovery unit**
- **Molten sulphur solidification methods**
- **Operational Problems and how to overcome**
- **Important aspects in dealing with sulphur**
- **Safety considerations in SRU**
- **Sour Water Stripping:**
  - Fundamental Sulphur Plant Chemistry.
  - Process Monitoring and operation guideline.
  - Sulphur Plant Incinerators:
  - Thermal Incinerators.
  - Catalytic Incinerators.
  - Tail Gas Clean-up.
  - Sulphur Plant Problems:
  - Pressure Drop.
  - Plugged Seal Legs.
  - Disintegrated Catalyst.
  - Carbon Deposits.
  - Boiler Leaks.
  - Inadequate Conversion of H<sub>2</sub>S to Liquid Sulphur.
  - Maximizing Sulphur Plant Capacity.

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**NOTE:**

- Pre & Post Tests will be conducted
- Case Studies, Group Exercises, Group Discussions, Last Day Review & Assessments will be carried out.

*Note: The Course Manual will contain the Handouts as reference book as well as the Presentation Slides which will be used during the Course and supported by the Handouts.*



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