



THE CHEMICAL ENGINEERING MAJOR

Gas Treating & Sulfur Recovery

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Introduction:

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

Training Description:

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. Sulfur 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.

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 who require a comprehensive overview of natural gas processing will find this course ideally suited for them.

Objectives and Benefits:

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. Specifically, by attending this course you will:

- Gain a deep knowledge of the properties, specifications and end uses of natural gas.
- Gain a deeper understanding of typical natural gas processing operations, including:
 - Dehydration
 - Acid gas removal
 - Recovery of ethane, propane and NGL (natural gas liquids)
 - Sulfur recovery

- Gain a deeper understanding of the production of liquefied natural gas (LNG).
- Gain a deeper knowledge of the different equipment and facilities found in natural gas processing plants.
- Learn about fundamentals of gas transportation and distribution

Course Outline:

Day 1:

- What is natural gas?
- Origins
- Properties
- Specifications
- End uses and markets for natural gas
- Environmental advantages
- Physical behavior of natural gas systems
- Physical and thermal properties
- Phase behavior analysis
 - Pure substances
 - The phase rule
 - Behavior 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
- 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 vapor
 - 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 H₂S to sulfur
 - Sulfide 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:

Sulfur recovery unit

Molten sulfur solidification methods

Operational Problems and how to overcome

Important aspects in dealing with sulfur

Safety considerations in SRU

Sour Water Stripping:

- Fundamental Sulfur Plant Chemistry.
- Process Monitoring and operation guideline.
- Sulfur Plant Incinerators:
 - Thermal Incinerators.
 - Catalytic Incinerators.
- Tail Gas Cleanup.
- Sulfur Plant Problems:
 - Pressure Drop.
 - Plugged Seal Legs.
 - Disintegrated Catalyst.
 - Carbon Deposits.
 - Boiler Leaks.
- Inadequate Conversion of H_2S to Liquid Sulfur.
- Maximizing Sulfur Plant Capacity.