# NATURAL GAS PROCESSING, SWEETENING & SULPHUR RECOVERY

PCE176
Process and Chemical Engineering

TRAINIT ACADEMY

**COURSE TITLE**

# NATURAL GAS PROCESSING, SWEETENING & SULPHUR RECOVERY

**COURSE DATE/VENUE**

09 – 13 March 2020

London, UK

**COURSE REFERENCE**

PCE176

**COURSE DURATION**

05 Days

**DISCIPLINE**

Process and Chemical Engineering



**COURSE INTRODUCTION**

The Gas and Liquid Contracts that exist (or are being negotiated) will determine the objectives of the processes that you will have to incorporate into any new facility and how you have to operate any existing facility. There exists a variety of processes that will condition your Natural Gas and Hydrocarbon Liquids to satisfy the Contract requirements. The objective of this course is to make you aware of the options available to you so that you can evaluate all the processes that will satisfy your objective to determine which particular process is the best from a capitol cost and operating cost perspective.

**COURSE OBJECTIVE**

Upon completion of this course, you will gain knowledge of the processes available to process your Natural Gas and Hydrocarbon Liquid Products

**COURSE AUDIENCE**

This course is designed for project managers, plant managers, plant supervisors, technical staff, and contractor personnel involved in project planning, process selection and operation of Natural Gas Production. The greatest benefit arises from considering all the processes that will accomplish your process requirements to determine which one is the best for your particular application from a capital cost and operating cost perspective. You will also be able to see which processes are available to you to de-bottleneck or modify existing processes. The practical techniques and examples provide useful insights that are valuable at any stage of project execution and operation.

**COURSE CONTENT**

Gas & Liquid Process Selection

Contract Terms

Basic Consideration

**Gas Contracts**

- Quantity
- Quality
  - Heating Value
  - Sulphur Content
  - Maximum Temperature
  - Water Content ($H_2O$ Dewpoint)
  - Hydrocarbon Dewpoint (HCDP)
  - Other ($N_2$, He, Ar, $CO_2$, Hg, $O_2$)

**Liquid Contracts**

- Commercial Ethane
- Commercial Propane
- Commercial Butane
- Butane-Propane Mixes (LPG)
- Propane HD-5
- Natural Gasoline

**Overall Production System**

**Solution Gas**

**Associated Gas**

**Non-Associated Gas**

**Gas Processing Module**

**Gas Conditioning Module**

- $H_2O$ Removal (Dehydration)
- $H_2S$ & $CO_2$ Removal (Gas Sweetening)
- Nitrogen Removal
- Mercury Removal
- Oxygen Removal

**NGL Extraction Module**

- Products
- Absorption (Lean Oil)
- Adsorption (HRU)
- Condensation
  - Mechanical Refrigeration
  - Mixed Refrigerants
  - Turbo Expander
  - Twister
  - JT Refrigeration
- Stabilization Module
- Product Treating Module

**Characterization of Natural Gas & it's Products**

**Physical Properties of Pure Components**

**Ideal Gas Laws**

- Boyle's Law

- Charles' Law
- Avogadro's Principle
- Dalton's Law
- Combined Ideal Gas Law

**Physical Properties of Mixtures**

**Equations of State**

- Van der Waals
- Redlich-Kwong (RK)
- Soave Redlich-Kwong (SRK)
- Peng Robinson (PR)
- Benedict-Webb-Rubin-Starling (BWRS)

**Thermodynamic Properties**

- Entropy
- Enthalpy



**Equilibrium Ratio (K Value)**

**Separation**

**Types of Separators**

- Horizontal
- Vertical
- Spherical
- Centrifugal
- Cyclone
  - Reverse Flow
  - Axial Flow
  - Recycling
- Filter
- Liquid Coalescer

**Water Vapour Removal ($H_2O$ Dewpoint Control)**

**Water Content**

- HC Liquids
- Natural Gas
- Effect of $H_2S$ & $CO_2$

**Hydrate Formation Temperature**

- Effect of Propane
- Effect of $H_2S$ & $CO_2$

**$CaCl_2$ Dehydrators**

**MeOH Injection**

**EG Injection**

**IFPEX-1**

**TEG Dehydration**

**Solid Desiccant Dehydration**

**HCDP Control**

**Adsorption (HRU's)**

- 2 TOC
- 2 TCC
- 3 TOC
- 3 TCC
- 3 TOC w/TGC
- 3 TCC w/TGC
- Purge Cycle

**JT Refrigeration**

- LTX
- LTS

**Mechanical Refrigeration**

- Variations

**Twister**

**Refrigeration Compressors**

- Compression Cycle
- Single Stage
- Single Stage w/Economizer
- Two Stage
- Types
- Drivers

**Gas Sweetening**

**Terminology**

**Safety Precautions**

**Types of Contaminants**

**Process Selection**

**Chemical Reaction Processes**

- Amines
  - Chemistry
  - Typical PFD
  - General Considerations
  - Amines Used (MEA, DEA, DGA, MDEA, TEA, DIPA, Formulated Solvents)
  - Control Variable
- Caustic Wash
  - Chemistry

NGL Extraction

Low Temperature Mechanical Refrigeration

JT Refrigeration

Refrigerated JT Expansion

Adsorption (Lean Oil)

Turbo Expander

- Typical PFD

- Solid $CO_2$ Formation
- Solid Desiccant Dehydrator
- Inlet Compression
- Gas/Gas Exchangers
- Expander
- Re-Compressor
- De-Methanizer

**Gas to Liquids**

**Sulphur Recovery**

**Claus Plan**

**Modified Claus Plants**

- Typical PFD – 3 Stage
- Process Considerations
- Mechanical Considerations
- Instrumentation

**Tail Gas Clean-up**

- Incineration
- Super Claus 99
- Super Claus 99.5
- SCOT

**Liquid Redox**

**COURSE CERTIFICATE**

**TRAINIT ACADEMY** will award an internationally recognized certificate(s) for each delegate on completion of training.

**COURSE FEES**

$6,150 per Delegate. This rate includes participant's manual, Hand-Outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

## COURSE METHODOLOGY

The training course will be highly participatory and the course leader will present, guide and facilitate learning, using a range of methods including formal presentation, discussions, sector-specific case studies and exercises. Above all, the course leader will make extensive use of real-life case examples in which he has been personally involved. 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.

- 30% Lectures
- 30% Workshops and work presentation
- 20% Case studies & Practical Exercises
- 10% Role Play
- 10% Videos, Software or Simulators (as applicable) & General Discussions