DEFINE
MANAGEMENT CONSULTANTS
P.O.Box 45304, Abu Dhabi,UAE. Tel:+971 2 6711680 / 6264455, Fax:+971 2 6711614 / 6275344

Training Title

NATURAL GAS HYDRATES & DEHYDRATION

Training Duration

5 days

Training Venue and Dates

Natural Gas Hydrates & Dehydration		**5**		**06-10 June**		**$3,300**		**Abu Dhabi**
Natural Gas Hydrates & Dehydration		**5**		**01-05 August**		**$3,300**		**Dubai**
Natural Gas Hydrates & Dehydration		**5**		**19-23 December**		**$3,300**		**Dubai**

In any of the 5 star hotel. Exact venue will be informed later.

Training Fees

- **3300 US$ per participant for Public Training includes Materials/Handouts, tea/coffee breaks, refreshments & Buffet Lunch**

Training Certificate

Define Management Consultants Certificate of course completion will be issued to all attendees.

Language: English

TRAINING OVERVIEW

TRAINING DESCRIPTION:

This course will start by defining what natural gas is, its properties, specifications and end users. 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 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.

OBJECTIVES:

This short course is designed to give the attendants the fundamentals of natural gas handling systems and facilities 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.

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 in 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.

TRAINING METHODOLOGY:

A highly interactive combination of lecture and discussion sessions will be managed to maximize the amount and quality of information, knowledge and experience transfer. The sessions will start by raising the most relevant questions, and motivate everybody finding the right answers. The attendants will also be encouraged to raise more of their own questions and to share developing the right answers using their own analysis and experience

OUTLINE

The course content will include the following will be covered in 5 days of time.

1 The water molecule and the hydrogen bond – Explains why water is different in term of its boiling point, enthalpy of vaporization and expansion upon freezing, and the structure of ice.
2 Hydrate and non-hydrate formers – Type I, Type II and Type H and structures of hydrates.
3 Hydrate compositions – Theoretical composition and actual compositions.
4 Calculation of hydrate forming conditions – Manual calculation methods; gas gravity method, and K-factor method.
5 Advanced calculation methods.
6 Methods for preventing hydrate formation – Chemicals (inhibitors (methanol), Hammerschmidt equation: advanced methods and methanol injection rates), Heat (line heaters and heat tracing), and dehydration (glycol dehydration, refrigeration, and molecular sieves).
7 Physical properties of hydrates – Density, heat capacity, heat of formation, and mechanical properties.
8 Water content of gas – Calculating the water content of sweet, sour, and acid gas.
9 Use of phase diagrams to understand the subtleties of hydrate formation conditions -Phase loci, triple points, quadruple points, pressure-temperature diagrams, pressure composition diagrams, and temperature-composition diagrams.
10 Dehydration – Why is gas dehydrated and where does the water come from?
11 Dehydration with liquid desiccants – Glycols, safety, physical properties, storage and handling and tri-ethylene glycol (TEG).
12 TEG Dehydration process description – Glycol contactor, inlet separator, the regenerator and process flow.
13 TEG Dehydration: Design – Inlet gas temperature, contactor pressure, number of equilibrium stages, circulation rate, contactor diameter, lean glycol temperature, glycol concentration, reboiler temperature, reboiler pressure, stripping gas, still Temperature and reboiler duty.
14 TEG Dehydration: Operation – Operations problems and dehydration unit start-up.
15 Solid desiccant dehydration – Absorbents, process description and dryer regeneration.
16 Mole sieve simplified design – Adsorption design and regeneration calculations.

DAILY CONTENT

DAY 1

What is natural gas?
Origins
Properties
Specifications
End users 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
Equipment and components
Heat exchange in gas processing
Hydrates

The water molecule and the hydrogen bond ,Hydrate and non-hydrate formers – Type 1, Type 2 and Type H and Structures of hydrates.
Hydrate compositions – Theoretical composition and actual compositions.
Calculation of hydrate forming conditions – Manual calculation methods; gas gravity method, and K-factor method. Advanced calculation methods.

Methods for preventing hydrate formation – Chemicals (inhibitors (methanol), Hammerschmidt equation: advanced methods and methanol injection rates), Heat (line heaters and heat tracing), and dehydration (glycol dehydration, refrigeration, and molecular sieves).

DAY 3

Physical properties of hydrates - Density, heat capacity, heat of formation, and mechanical properties.
Water content of gas – Calculating the water content of sweet, sour and acid gas.
Use of phase diagrams to understand the subtleties of hydrate formation conditions – Phase Ioci, triple points, quadruple points, pressure- temperature diagrams, and temperature-composition diagrams, and temperature-composition diagrams.

- **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**
- **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

⚜ **Dehydration with liquid desiccants – Glycols, Safety, physical properties, Storage and Handling and tri-ethylene glycol (TEG)**

TEG Dehydration process description – Glycol contactor, inlet sepeator, the regenerator and process flow.

TEG Dehydration : Design – Inlet gas temperature, contactor pressure, number of equillirium stages, circulation rate, contactor diameter, lean glycol temperature, glycol concentration, reboiler temperature, reboiler pressure, stripping gas, still temperature andreboiler duty.

TEG Dehydration: Operation – Operations problemsand dehydration unit start-up.

Solid desiccant dehydration –Absorbents, process describtion and dryer regeneration.

Mole sieve simplified design – Absorbtion design and regeneration

- **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

DAY 5

Gas dehydration

- **Water content determination**
- **Glycol dehydration**
- **Process description**
- **Choice of glycol**
- **Design considerations**

- System sizing
- Glycol powered pumps
- Solid bed dehydration
- Process description
- Design consideration
- Absorption/lean oil
- Refrigeration
- Choice of process
- Valve sizing
- Installation

Valves, fittings and piping details

- Valve types
- Chokes
- Piping design considerations

Case Studies, Pre & Post Tests, Group Discussions, Last day review will be carried out.

TRAINING OUTCOME

At the end of the course, the delegates will be able to:

1. Describe the problems of water in natural gas systems.
2. Identify hydration types and structures of hydrates.
3. Describe the hydrates and dehydration processes in natural gas systems.
4. Perform the calculation of water contents in gas composition that can cause hydrates formation.
5. Troubleshoot the facilities once the hydration occurred.
6. Design and select proper equipments or processes for the dehydration unit.

.....