Training Title

FURNACE OPERATION & TROUBLESHOOTING

Training Duration

5 days

Training Venue and Dates

REF RM046	Furnace Operation & Troubleshooting	5	19-23 April 2020	$6,150	Munich, Germany

In any of the 5 star hotels. The exact venuew will be intimated soon.

Training Fees

- **6,150US$ per participant for Public Training includes Materials/Handouts, tea/coffee breaks, refreshments & Buffet Lunch.**

Training Certificate

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

TRAINING DESCRIPTION

Furnace operations are important unit operation in all oil and gas facilities, refinery operation and gas processing. Understanding Furnace operation in very important for safe and efficient operation of furnaces in oil and Gas industries.

The course is designed to give a detailed understanding of furnace construction, operation with design considerations as well as more detailed operations, control and safe guard system.

Combustion process described in detail is part of this course. Understanding air – fuel ratio. Safe operation practices.

Course sessions will emphasis on implementing the procedures/documentations & control measures required for ensuring safe operation, integrity and best operational practices.

Design constrains, operational issues, troubleshooting etc. will be included with case studies and experience transfer from similar examples from other countries.

TRAINING OBJECTIVE

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

- **Identify and list the applicable codes and standards for fired process heaters. Determine the mechanical limitations of heaters.**
- **Describe the theoretical and practical aspects of burners and combustion air supply, common and complex instrumentation applications, heater operation, tube and refractory design**

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- Explain key operating parameters
- Employ techniques to minimize emissions, corrosion and fouling.
- Implement safe practices.
- Identify safety issues.
- Identify typical problems and identify possible causes.
- Identify the key inspection and turnaround items.

WHO SHOULD ATTEND?

The program is ideal for junior, supervisory and middle management level personnel whooperating and /or supervising oil, gas, and refinery operation.

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. Very useful Course Materials will be given.

- 30% Lectures
- 30% Workshops and work presentation
- 20% Group Work& Practical Exercises
- 20% Videos& General Discussions

DAILY OUTLINE

DAY 1:

Introduction to Fired Heater
Furnace Construction and Operating
Different types of furnaces and their functions.
Operating conditions. Distribution of heat supplied, influence of operating conditions.
Efficiency of energy recovery. Estimation rule, parameters governing furnace efficiency, scope and limitations for improving furnace efficiency.

Construction of heat exchange areas and refractory materials: tube bundle arrangement, insulation, type of materials used.

- General Types
- Fire Box
- Convection
- Stack

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- Burners
- Fired Heater Engineering
- Fluid Flow
- Heat Transfer
- Fuels, gases and oil
- Design Guidelines

Heat Transfer and Tube Bundle

Heat transfer to the tube bundle: heat flux, conduction, convection and radiation, parameters governing heat transfer, tube skin temperature, type of fuel burned, tube temperatures, fouling effects.

Division of the heated fluid into several passes: control of partition, low flow rate safety systems.

DAY 2:

Basic Principles of Combustion Science:

What is Combustion?

What is Perfect Combustion?

Fuels Combustion

- Proper combining proportions for perfect combustion
- Proportioning Mixing Ignition
- Heat available from fuels
- Flame temperatures
- Gross and net heating (calorific) values of simple fuels
- Comparison of some flame temperatures
- Flammability limits
- Flame speeds, flammability limits
- Combustion characteristics of fuels
- Combustion reaction times and intensities
- Combustion intensity

Properties of gaseous fuels

- Gas Gravity
- Heating value
- Condensable hydrocarbon content, sulphur content, gaseous fuels data
- Analyses of typical gaseous fuels
- Properties of gaseous fuels

DAY 3:

Products of combustion

Formulas for determining products of complete combustion of gaseous fuels

Flue Gas Analyses:

- Significance of %CO_2, O_2 and combustibles

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- **Effect of air/fuel ratio on flue gas analysis**
- **Effect of excess air on % O_2 and % CO_2 in combustion products**

Combustion Efficiency:

- **Dry flue gas loss**
- **Sankey diagram for a heater heat balance**
- **Heat contents of combustion gases, in Btu/ib**
- **Moisture loss**
- **Available heat**
- **Available heats for some typical fuels**
- **Available heat chart for natural gas**
- **Excess air required for various temperature differentials**
- **Effect of excess air on hot mix temperature**
- **Losses due to incomplete combustion**
- **Optimum air supply**
- **Variation of heater losses and available heat with air/fuel ratio**

Burners

Burners characteristics

- **Flame shape**
- **Combustion value**
- **Stability**
- **Drive**
- **Turndown rate**

Combustion system & burner compact

- **Source of air**
- **Source of fuel**
- **Burner**
- **Values & proportioning devices**

Burners used for gaseous fuels firing

- **Atmospheric**
- **Air aspiration gas burners**
- **Independent supply of gas & air to mixture**

Flow of Flue gases

Draft and heater pressure

Heater pressure-natural variations vs. controlled

Stack Draft

Heater ports and flues

Maximum flow through heater flues

<u>Draft Systems</u>

Natural chimney design and construction

Forced System pressure drop and fan characteristics

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DAY 4:

Control of fired heaters and improved thermal efficiency

Firing rate

Stack temperature

Excess air

Waste heat recovery and den point of sulphur trioxide

Instrument for Heater Measurements

Temperature

Thermocouples

- **Resistance Temperature Detectors (RTDs).**
- **Thermistors.**
- **Radiation Pyrometers.**
- **Infrared Cameras.**
- **Selection of Temperature Measurement Instrument.**

Pressure

- **Manometers**
- **Bourdon Tube Pressure Gauges.**
- **Bellows Element Pressure Gauges.**
- **Diaphragm and Capsular Element Pressure Gauges.**
- **Strain Gauges Pressure Transducers**
- **Selection of Pressure Measuring Instruments.**

Flow

- **Orifice Plates**
- **Venture Tubes**
- **Picot Tubes**
- **Rotameters**
- **Vortex Flow Meters**
- **Positive Displacement Meters**
- **Selection and Application of Flow Meters**

Heater Energy Balances and Efficiency

- **Elements of the Heater Energy Balance**
- **Wall Loss During Steady-State Operation**
- **Wall Losses During Intermittent Operation**
- **Heat Loss by Radiation Through Openings**
- **Heat Loss by Heater Gases Escaping Around Doors**
- **Heat Loss Due to a Part of the Stock Projecting Out of the Heater**
- **Loss by Conduction of Heat through Terminals or Electrodes**
- **Losses to Charging and Conveying Devices**
- **Combustion Heat Losses**
- **Heaters calculation example**

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- **Specific energy consumption parameters**

Environmental Aspects of Furnaces

Gas Emissions

- **Nitrogen Oxide**
- **Sulphur Oxide**
- **Carbon Dioxide**

Removal Absorption of Polluting Gas Emissions

Environmental Measures & Standards for Combustion Products

DAY 5:

Furnace Operation

On-stream furnace operations: monitoring of combustion and heating. Modifying operating conditions.Analysis of disturbances. Key points for safe operation, operating conditions control and follow-up.

Start-up and shutdown: preparation, safe ignition procedures, ignition after a short shutdown, normal shutdown, emergency shutdown.

Incidents: explosive atmosphere in the radiation zone, tube rupture, unbalancing of the heat,

- **Defined burner management system (BMS)**
- **Determine requirements for BMS Design considerations**
- **Determine Burner start-up sequence**
- **Determine BMS Hazards and protection**
- **Determine the BMS required instruments and interlocks**

Demonstrate many case study to manifest to the attendees how to optimize the operation of the fired heater using video tape .

Note:

Pre & Post Tests will be conducted

Case Studies, Group Exercises, Group Discussions, Last Day Review & Assessments will be carried out.

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