Process Analyzer and Sampling Systems

Course Price

£3050

Course Description

Analytical instruments used for online chemical analysis of process streams or plant environments are generally called Process Analyzer Systems or Quality Measuring Instruments. Reliable online analytical data is crucial for a safe and efficient operation is not limited to the Oil & Gas and Chemical Industry but also for Pharmaceutical, Power Generation and other industries. Legislative requirements, economic as well as health and safety, emissions control and energy conservation are setting increasing stringent limits for reliable analyzer data which may result in huge losses or fines to the operating company.

For latter reasons it is obvious that sustainable optimum performance of online instrumentation, sample-handling systems and correct data handling is indispensable which requires continual professional attention from the analyzer engineers and maintenance staff.

To achieve optimal performance a thorough understanding of operating principles, possible interferences and practical skills are key requirements.

In this course complete analyzer systems are discussed while special attention is given to applied sampling systems next to the main types and principles of currently applied Process Analyzers ranging from Physical Properties, online Chromatography, Water type analysis to the promising future of Spectroscopic type of on-line analysis while advantages and disadvantages are clarified with the aim to enhance the understanding the operational ranges and limitations of each type of analysis system.

Course Objectives

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

- Describe the purpose, operation of sample handling and application of a Process Analyzer system, Quality Monitoring systems and Spectroscopic Analyzer systems,
- Describe the principles of the applied types of Physical Property analyzers and Gas Chromatography,
- Identify and explain the different types of QMI applications like Process Quality control and Emission Monitoring (CEMS),
- Understanding of the basic tools for Analytical Performance & Quality Assurance.

Who Should Attend

This course is intended for all who are regularly involved with Process Analyzer systems like Instrument Technicians and Engineers, Production, Operation and Laboratory staff.

Course Content

DAY 1

Introduction to the world of QMI

- Why Instruments,
- Where do we need it,
- What types are there,
- What is measurement,
- Measurement Standards,
- Traceability,
- Quality Assurance,
- Response,

Measurement Accuracy & Quality Assurance

- Measurement Standards,
- Units & Systems,
- Introduction Quality Assurance,
- Traceability & Organization,
- Definitions Accuracy, Systematic Errors and Precision,
- Factors influencing Accuracy,
- Measurement Calibration procedure,
- Hysteresis Accuracy, Precision, Standard Deviation & Variance
- “Playing Darts”
- Repeatability and Reproducibility,
- Variability & Probability,
- Statistical Control & Normal Distribution,
- STD & Systematic Error,
- Control Chart Tool,
- Setting up a Control Chart for Performance Monitoring,
- Warning & Control Limits,
- Statistical Decision Rules
- Historical STD
- Reproducibility Rate

Analyser Sampling & Conditioning + Analyser House

- Process Analyser Sampling & Conditioning,
- Analyser systems,
- Conditioning,
- Analysis and Sampling organization
- Process Conditions,

- Dead Volumes
- Phase Diagram
- Specific Engineering issues
- Sample lag time
- Sampling systems examples
- Sample Recovery

Vapor Pressure

- Significance and Definitions
- Vapor Pressure Properties
- Volume and Saturated Pressure
- Vapor Pressure and Boiling Point relation
- Evaporation of a liquid
- Evaporation and Boiling
- Norms and Standards
- Reid Vapor Pressure and Grabner development
- On line Vapor pressure analyzers

DAY 2

Principles of Gas Chromatography

- History
- Combinations of GC and MS
- What is Chromatography
- Retention phenomena
- Separation factors
- Retention factor
- Types of Chromatographic columns
- Band broadening and column efficiency
- Theoretical Plate Model
- Temperature influence on separation
- Van ‘Deemter’ efficiency curve
- Selection of the type of carrier gas
- Peak Selectivity and Resolution
- Base line properties, Noise and LOD

Types of GC Detectors and Peak Quantitation Methods

- Thermal Conductivity Detector and measurement
- Flame Ionization Detector
- Dynamic Range of Detectors
- Application of Make-up gas
- Electron Capture Detector
- Flame Photometric Detector
- Detector and Relative Response Factors
- Integration Methods
- Analysis Data Processing

- Standard Calibration Methods

Viscosity Theory & Measurement

- Dynamic Viscosity
- Shear stress
- Types of Liquid Viscosity
- SAE system
- Kinematic Viscosity measurement
- Types of Lab analysis
- Capillary type of measurement
- Vibrational types
- New Developments

DAY 3
Heating Value Measurements

- Introduction Calorimetry
- Types of Calorimeters
- Determination of Heating Values
- Higher and Lower Heating Value
- Wobbe Index and CARI
- Online Wobbe Index analyzer
- NMR application

Oxygen Analysis

- Main applied methods for Oxygen measurement
- Principle of Electrochemical cell
- Introduction to Combustion Control
- Stoichiometric ratio
- ZrO2 type Oxygen analyzers
- Operating principle ZrO2 analysis
- Nernst Equation
- Combustion possible interferences
- Paramagnetic type Oxygen analyzer
- Background gas interference
- Sampling and installation
- Magnetic wind type analysis
- Trouble shooting
- New Development – ‘LaserGas’ Single Path Oxygen analyzer

Spectroscopic Analysis IR, UV and FTIR

- Types of Spectral Absorptions
- Spectral Ranges
- Relation frequency and wavelength
- Diffraction methods
- Principles & Techniques applied

- Types of Spectroscopy
- Lambert Beer's Law
- NIR spectrum
- Industrial Non Dispersive IR analysis
- UV analysis
- FT-IR and FTNIR
- How are FTIR results obtained
- Practical Differences FTIR and IR
- Raman Spectroscopy
- Spectrometers for CEMS
- NMR application

DAY 4
Moisture Theory & Analysis Methods

- Dew Point / Frost Point,
- Water Vapor properties,
- Dalton's Law,
- Dew Point / Pressure relationship,
- Relative Humidity,
- Psychrometric RH measuring method,
- Moisture Analysis methods,
- SiO2 and AlOx sensors,
- Electrolytic type moisture sensor,
- Quartz crystal (Ametek) Moisture analysis,
- Chilled Mirror DP analysis,
- New Developments,
- Spectroscopic Moisture analysis,
- IR / NDIR Moisture analysis,
- Tunable Diode Laser Moisture sensor,
- Moisture Sample Conditioning.

Density measurements

- Significance of Density
- Applied Density terms
- Lab Density determination
- Oscillating type Densitometer
- U-type Density transducer
- Nucleonic type Density meter
- Specific Gravity measurement
- Hydrostatic type
- Gas Density transducer installation
- Density verification methods

Introduction to "Continuous Emission Monitoring System" – CEMS

- Directives & Approvals
- Mission and purpose of the "EPA"

- The EPA “Plain English Guide”
- Quality Assurance Levels – QAL
- What is the “EMC” ?
- Monitoring requirements
- Essential parts of a CEMS system
- Certification requirements
- Emission reporting
- CEMS Sampling systems
- Types of online Analyzer systems

Turbity, Hardness & TOC analysis

- Turbidity Measurements
- FTU and NTU type turbidity
- Water Hardness types and analysis
- Photometric Measuring Principles
- Nernst Law application
- Why measuring TOC?
- Main steps TOC analysis
- Oxidation methods
- Industrial types of TOC

DAY 5

pH measurement

- Reasons for pH analysis,
- Introduction to pH measurements,
- Construction of the glass measuring electrode,
- Types of pH electrodes and their application,
- pH measuring circuit,
- pH measuring principle and Nernst equation,
- Potentials present in a pH loop,
- Asymmetry potential,
- pH practical notes and Measuring Range,
- pH buffers and calibration conditions,
- pH -Temperature compensation clarification in relation to Process temperature,
- Conditioning, storage and Cleaning of pH sensors,
- Checking and Calibration of pH system,

Conductivity & TDS measurement

- Basic construction of a Conductivity cell,
- Specific Conductivity,
- Cell Constant,
- Liquid Conductivity and TDS ranges,
- Application of Conductivity measurements,
- Conductivity versus concentration,
- Relation Conductivity and TDS measurement,
- Principle Toroidal Conductivity measurement,
- Applied type of Voltage and Polarization effects,
- Four Electrode type sensors,

- Principle difference between the type of temperature compensation pH and Conductivity,
- ? factors of common type of liquids,
- High Conductivity measurements

CPD Unit

Continuing Professional Development

35 HOURS CPD