CORROSION CONTROL IN THE REFINING INDUSTRY

Improve Your Working Knowledge of Corrosion Control with Expert Specialist

25th - 29th August 2014, Kuala Lumpur, Malaysia

Petrosync Lecturer

Yousuf Memon B.E.
Plant Inspection & Corrosion Control Consultant

- Over 35 years of experience in upstream & downstream oil & gas industry
- CEO of Reliance Swift Veritas (Pvt) Ltd.
- Director of Petrosult & Unimart
- Specializing in corrosion & integrity management systems execution and training

Case Studies, Discussion, Simulation Learning and many Practical exercises!

Major Corrosion Projects
- Prepared Policies for Corrosion Monitoring Systems & Corrosion Inhibitor Injection System for Total ABK.
- Prepared Corrosion Management System for Jeddah Oil Refinery
- Presented technical paper on Failures in Refinery Overhead of Atmospheric Distillation Column.

Masterclass Overview

Petroleum Refineries are perusing sustained approach from identification of corrosion and material failure issues to long-term corrosion control approaches. However, the risks to corrosion failures are still evident in the refineries. The course covers key topics pertaining to refinery processes, corrosion issues, corrosion monitoring and corrosion control methods.

Supported by

WorldOils  PETROFINDER  Asia Oil & Gas  TAMBANG

EnergyChinaForum.com  China Oil & Gas  IndiaCore.com  EnergyUpdate  ConferenceFocus
This course is geared toward those with a minimum of 1-2 years experience in refineries including:

- design engineers
- process engineers
- procurement agents
- maintenance planners
- service company representatives who support refineries
- corrosion and equipment engineers
- metallurgists
- inspectors
- inspection supervisors.

**Masterclass Objectives**

- To provide understanding various petroleum refinery processes including CDU, FCC, Platformer, Hydrocracker, Amine Units, etc.
- To provide understanding of common material construction and metallurgy used in petroleum refinery equipment.
- To provide understanding of common corrosive environment encountered in petroleum refinery processes.
- To provide understanding of refinery-specific corrosion problems, material degradation and various damage mechanisms involved in the refinery.
- To provide understanding of corrosion monitoring techniques used in different units of the petroleum refinery.
- To provide understanding of corrosion prevention methods mainly corrosion control chemicals injection at different stages of refinery processes.

**WHY YOU SHOULD ATTEND PETROSYNC’S EVENTS**

- To ensure that all objectives of the course matches yours, all PetroSync programs are developed after intensive and extensive research within the industry.
- PetroSync programs focus on your immediate working issues to ensure that you are able to apply and deliver immediate results in real work situations.
- Application and implementation of industry knowledge and experience are the drivers for our course design, not theoretical academic lectures.
- PetroSync training focuses on practical interactive learning tools and techniques including case studies, group discussions, scenarios, simulations, practical exercises and knowledge assessments during the course. Invest a small amount of your time to prepare before attending the course to ensure maximum learning.
- PetroSync follows a rigorous selection process to ensure that all expert trainers have first-hand, up-to-date and practical knowledge and are leaders of their respective industrial discipline.
SECTION 1
Refinery Operations & Overview
• Refinery Operating Objectives
• Refinery Process Overview

Fundamentals Metallurgy & Corrosion

Other Damage Mechanism

SECTION 2
Common Metals & Alloys Used in Refinery
• Killed Steel
• Steels
• Carbon Steel
• C-Mo Steels
• Low-Alloy Steels
• Cr-Mo Steels
• Nickel Steels
• Stainless Steels
• Other Metals and Alloys

SECTION 3
Crude Distillation Unit
• Sources of Crude Oil
• Composition of Crude Oil
• Remaining Constraints
• Crude Oil Pre-treatment
• Desalting
• Corrosion in Crude Distillation Units
• Columns
• Exchangers and Piping
• Fired Heaters
• Corrosion Monitoring in Crude Units
• Water Analysis (Overhead Corrosion Control)
• Hydrocarbon Analysis
• Corrosion Rate Measurement
• On-Stream, Non-destructive Examination
• Materials of Construction of CDU

SECTION 4
• Corrosion Control in Crude Distillation Units
• Desalting
• Caustic Addition
• Overhead pH Control
• Corrosion Inhibitor
• Control Washing

Vacuum Distillation Unit (VDU)

SECTION 5
Fluid Catalytic Unit (FCCU)
• Process Description
• Riser/Reactor
• Regenerator
• Flue Gas System
• Fractionator

Thermal & Mechanical Aspects
• Type selection
• Fouling behavior/mitigation
• Tube Insert Technologies
• Header types
• High Fin tube types
• Materials of Construction of FCCU
• Corrosion in FCCU
• Regenerator Reaction Mix Line
• Main Fractionator
• Bottoms Piping
• Flue Gas Systems
• High-Temperature Oxidation
• High-Temperature Sulfidation (H2S Attack)
• High-Temperature Carburization
• Polythionic Acid Stress Corrosion Cracking
• Catalyst Erosion
• Feed Nozzle Erosion
• Refractory Damage
• High-Temperature Graphitization
• Sigma-Phase Embrittlement
• 885° F (475° C) Embrittlement
• Creep Embrittlement
• High-Temperature Creep
• Thermal Fatigue
• Corrosion Control in FCC Units
• Damage Mechanisms and Suitable Materials
• Reactors
- Materials of Construction of HPU
- Reactor Loop-General
- Reactor Feed System
- Reactor Feed Furnaces
- Reactors
- Reactor Effluent System
- Fouling/Corrosion of Reboiler Circuits
- Fouling/Corrosion of Reboiler Circuits
- Corrosion in SAAU
- Sulfuric Acid Corrosion
- Acid Concentration
- Acid Temperature and Velocity
- Acid Dilution
- Hydrogen Grooving
- Feed Contaminants
- Acid and Neutral Esters
- Acid Carryover
- Corrosion Under Insulation

SECTION 6
Catalytic Light Ends Recovery Unit (CLERU) Units
- CLER Process Description
- Materials of Construction
- Columns
- Exchangers
- Corrosion in CLERU
- Hydrogen Induced Damage
- Inspection Techniques for Hydrogen Induced Damage
- Prevention and Repair Techniques
- Ammonia Stress Corrosion Cracking
- Carbonate Stress Corrosion Cracking
- Fouling/Corrosion of Reboiler Circuits
- Corrosion Control Measures
- Water Washing
- Polysulfide Injection
- Corrosion Inhibitors
- Corrosion Monitoring
- Hydrogen-Activity Probes
- Chemical Tests
- Corrosion Probes

SECTION 7
Sulfuric Acid Alkylation Unit (SAAU)
- Process Description
- Reaction Section
- Treating Section
- Fractionation Section
- Refrigerator Section
- Materials of Construction
- Corrosion in SAAU
- Sulfuric Acid Corrosion
- Acid Concentration
- Acid Temperature and Velocity
- Acid Dilution
- Hydrogen Grooving
- Feed Contaminants
- Acid and Neutral Esters
- Acid Carryover
- Corrosion Under Insulation

SECTION 8
Hydroprocessing Units (HPU)
- Hydroprocessing
- Hydrotreating
- Hydrocracking
- Variations on Hydroprocessing
- Corrosion in HPU
- High-Temperature Hydrogen Attack
- High-Temperature H2S Corrosion- With Hydrogen Present
- High-Temperature H2S Corrosion- With Little or No Hydrogen Present
- Naphthenic Acid Corrosion
- Ammonium Bisulfide Corrosion
- Chloride Stress Corrosion Cracking
- Failures Often Happen After Startup
- Failures Happen at Predictable Points
- Reactions with Stainless Steel
- Polythionic Acid (PTA) Stress Corrosion Cracking
- Other Methods Used to Prevent PTA SCC
- Wet H2S Cracking
- Sulphide Stress Cracking
- Temper Embrittlement
- Hydrogen Embrittlement
- Materials of Construction of HPU
- Reactor Loop-General
- Reactor Feed System
- Reactor Feed Furnaces
- Reactors
- Reactor Effluent System
- Fouling/Corrosion of Reboiler Circuits
• Reactor Effluent-Distillation Feed Exchangers
• Effluent Air Coolers
• Effluent Air Cooler Inlet and Outlet Piping
• Separator Vessels
• Recycle Hydrogen System
• Distillation Section

SECTION 9
Catalytic Reforming Unit (CRU)
• Octane Number (RON)
• Catalyst
• Catalytic Reforming Process
• Platformer (UOP)
• Catalytic Reformer, Semi-Regenerative
• Reactor Design
• Corrosion I CRU
• HTHA
• Stress Corrosion Cracking
• Materials of Construction
• Reactors
• Exchangers and Piping
• Fired Heaters and Other Equipment
• Corrosion Control
• Corrosion Monitoring

SECTION 11
Amine Treating Unit (ATU)
• Process Description
• Tail Gas Units
• Corrosion Phenomena
• Corrosive Species
• Amine Degradation
• Cracking Phenomena
• Corrosion Inhibitors
• Materials of Construction
• Corrosion Monitoring
• Corrosion Control Measures

SECTION 12
Sulfur Recovery Units (SRU)
• Sulfur Recovery Units
• Sulfur Chemical Processes
• Sulfur Recovery Process
• Tail Gas Treating Unit
• Incinerator
• Cold Bed Adsorption (CBA) Unit
• Corrosion Mechanisms
• Sulfidation of Carbon Steels
• Sour Environment Corrosion
• Weak Acid Corrosion
• Corrosion of CBA Units
• Burner and Mixing Chamber
• Tail Gas Reactor and Waste Heat Exchanger
• Water Quench and Re-Circulation Blower System
• H2S Adsorption System

SECTION 10
Delayed Coking Units (DCU)
• Equipment and Operation of the Delayed Coking Unit
• High-Temperature Sulfur Corrosion
• Naphthenic Acid Corrosion
• High-Temperature Oxidation/Carburization/Sulfidation
• Erosion-Corrosion
• Aqueous Corrosion
• Corrosion Under Insulation
• Thermal Fatigue
• Temper Embrittlement of Cr-Mo Steels

SECTION 13
Refrery Corrosion Prevention Methods
Process Additives and Corrosion Control
• Factors Affecting Corrosion
• Acids
• Temperature
• Pressure

IN-HOUSE SOLUTIONS
SAVE COST • IMPROVE PERFORMANCE • REDUCE RISK
PetroSync understands that in current economic climate, getting an excellent return on your training investment is critical for all our clients. This excellent training can be conducted exclusively for your organization. The training can be tailored to meet your specific needs at your preferred location and time. We will meet you anywhere around the globe.

If you like to know more about this excellent program, please contact on +65 6415 4500 or email general@petrosync.com
• Flow
• Turbulence
• Material Selection

• Methods to Mitigate Corrosion
• Desalting and Caustic Injection
• Water Washing
• Acid Neutralization
• Barrier Between Metal and Environment
• Chemicals Used to Combat Corrosion
• Filming Amines
• Filming Formulation
• Filmer Application
• Treat Rates
• Monitoring Filmer Performance
• Neutralizing Amines
• Polysulfides
• Napthenic Acid Corrosion Inhibitors

• Application of Corrosion Inhibitors

SECTION 14

Corrosion Monitoring Methods in Refineries
• Uses of Corrosion Monitoring
• Corrosion Monitoring Techniques
• Corrosion Coupons
• Electrical Resistance Monitoring
• Electrochemical Corrosion Monitoring
• Linear Polarization Resistance
• Potential Monitoring
• Zero Resistance Ammetry (ZRA)
• Electrical Impedence Spectroscopy (EIS)
• Electrochemical Noise (EN)
• Hydrogen Flux Monitoring
• Atmospheric Distillation Unit
• Vacuum Distillation Unit
• Fluid Catalytic Cracking Unit
• Amine Treating Unit
• Sour Water Stripper Units
• Sulfuric Acid Alkylation Unit
• Automated On-Line Monitoring

SECTION 15

Refinery Injection Systems
• Materials Selection Considerations
• Location of Injection Point
• Injection System Hardware
• Chemical Storage Tanks
• Chemical Injection Pumps
• Additive Control Systems
• Piping Systems
• Injector

Petrosync Quality

Limited Attendees
The course has limited seats to ensure maximum learning and experience for all delegates.

Certificate of Attendance
You will receive a Certificate of Attendance bearing the signatures of the Trainer upon successful completion of the course. This certificate is proof of your continuing professional development.

Interactive Training
You will be attending a training designed to share both the latest knowledge and practical experience through interactive sessions. This will provide you with a deeper and more long-term understanding of your current issues.

High Quality Course Materials
Printed course manual will provide you with working materials throughout the course and will be an invaluable source of reference for you and your colleagues afterward. You can follow course progress on your laptop with soft copies provided.

Program Schedule

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>08:00 – 09:00</td>
<td>Registration (Day 1)</td>
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<tr>
<td>09:00 – 11:00</td>
<td>Session I</td>
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<tr>
<td>11:00 – 11:15</td>
<td>Refreshment &amp; Networking Session I</td>
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<tr>
<td>11:15 – 13:00</td>
<td>Session II</td>
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<td>13:00 – 14:00</td>
<td>Lunch</td>
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<tr>
<td>14:00 – 15:30</td>
<td>Session III</td>
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<tr>
<td>15:30 – 15:45</td>
<td>Refreshment &amp; Networking Session II</td>
</tr>
<tr>
<td>15:45 – 17:00</td>
<td>Session IV</td>
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<tr>
<td>17:00</td>
<td>End of Day</td>
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</table>
Yousuf Memon is the CEO of Reliance Swift Veritas (Pvt) Ltd. with over 35 years of experience in upstream & downstream oil & gas industry, specialized in corrosion & integrity management systems execution and training. Yousuf Memon has been working for national & international oil & gas exploration, petroleum refineries, petrochemical plants, chemical plants, fertilizer plants, power plants and desalination plants for several years. Different areas of Mechanical Integrity remained his areas of expertise such as; API Plant, Risk-Based Inspection, Failure Analysis, Fitness-For-Services, Non Destructive Testing (Conventional & Advanced), Corrosion Monitoring, Corrosion Inhibitor Injection, Material Selection, Protective Coatings, Material Performance Evaluation, Cathodic Protection System. He also delivers in-house, public training courses, and distant learning courses on Corrosion Control, Plant Inspection & Mechanical Integrity to local and international upstream, midstream, and downstream oil and gas industries.

### Professional Affiliations
- National Association of Corrosion Engineers (NACE)
- The American Society of Mechanical Engineers (ASME)
- American Society of Quality (ASQ)
- American Educational Society of Surface Finishing (AESF)
- American Institute of Chemical Engineers (A.I.Ch. E.)
- Pakistan Engineering Council (PEC)

### Skill & Expertise
- Piping
- Inspection
- Oil & Gas
- Refinery
- NDT
- Metal Fabrication
- Power Plants
- Plant Inspection
- Risk Based Inspection
- API 510
- API 570
- Desalination Plants
- Boilers
- Petroleum Refinery
- Natural Gas
- Petrochemicals
- Material Selection
- Metallurgy
- Corrosion Control
- Protective Coatings
- Damage Mechanisms
- Fertilizers
- Petrochemical
- Petroleum

### Client List
- BP
- UEP
- ADCO
- GASCO
- ZADCO
- QP
- PSO
- PAPCO
- PARCO
- Asia Petroleum
- TUV NORD
- DEWA
- DPL
- HUBCO
- FODCO
- Fauji Power
- Engro Powergen
- FFC
- OMIFCO
- Engro Fertilizer
- Engro Polymers
- DUBAL
25th – 29th August 2014, Kuala Lumpur, Malaysia

INVESTMENT PACKAGES

Please checklist the package that you are attending!

<table>
<thead>
<tr>
<th>Investment Package</th>
<th>Deadline</th>
<th>Course Fee</th>
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<tbody>
<tr>
<td>Standard Price</td>
<td>22nd Aug 2014</td>
<td>SGD $2,995</td>
</tr>
<tr>
<td>Early Bird Offer</td>
<td>25th Jul 2014</td>
<td>SGD $2,795</td>
</tr>
<tr>
<td>Group Discount (3 or more delegates)</td>
<td>22nd Aug 2014</td>
<td>10% discounts for group of 3 registering from the same organization at the same time</td>
</tr>
</tbody>
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* To enjoy the promotion & discount offer, payment must be made before deadline
* For 5 or more delegates, please inquire for more attractive package.
* Prices include lunches, refreshments and materials. Promotion & discount cannot be combined with other promotional offers.
* Important: Please note that registration without payment will incur a SGD 200 administration fee.

DELEGATES DETAILS

1st Delegate Name: ___________________________  Mr [ ]  Mrs [ ]  Ms [ ]  Dr [ ]  Others [ ]
Direct Line Number: ___________________________  Email: ___________________________
Job Title: ___________________________  Department: ___________________________
Head of Department: ___________________________

2nd Delegate Name: ___________________________  Mr [ ]  Mrs [ ]  Ms [ ]  Dr [ ]  Others [ ]
Direct Line Number: ___________________________  Email: ___________________________
Job Title: ___________________________  Department: ___________________________
Head of Department: ___________________________

3rd Delegate Name: ___________________________  Mr [ ]  Mrs [ ]  Ms [ ]  Dr [ ]  Others [ ]
Direct Line Number: ___________________________  Email: ___________________________
Job Title: ___________________________  Department: ___________________________
Head of Department: ___________________________

INVOICE DETAILS

Attention Invoice to: ___________________________
Direct Line Number: ___________________________  Fax: ___________________________
Company: ___________________________  Industry: ___________________________
Address: ___________________________  Postcode: ___________________________
Country: ___________________________  Email: ___________________________

Please note:
- Indicate if you have already registered by Phone [ ]  Fax [ ]  Email [ ]  Web [ ]
- If you have not received an acknowledgement before the training, please call us to confirm your booking.

PAYMENT METHODS

- By Credit Card: Please quote invoice number(s) on remittance advice
  PetroSync LLP Bank details:
  Account Name: PetroSync LLP
  Bank Number: 7144 • Branch Code: 001 • Account No: 010-2255-105
  Name of Correspondent Bank: Standard Chartered Bank, 6 Battery Road, Singapore 049999
  SWIFT Code of Correspondent Bank: SCBLSGSGXXX
  All bank charges to be borne by payer. Please ensure that PetroSync LLP receives the full invoiced amount.

Payment is due in full at the time of registration. Full payment is mandatory for event attendance.

I agree to PetroSync’s terms & conditions, payment terms and cancellation policy.