Course Content

Title: SynGas Plants - Preventing Fixed Equipment Failures

Potential PDH: 40 **Code:** BTT069

Description:

One of the biggest concerns for owners and operators of syngas plants, is a loss of primary containment event, which brings with it the potential for personnel injury, significant equipment damage, and plant downtime.

Ultimately, all equipment failures are preventable, so why do fixed equipment failures still occur? Basically, equipment failures occur because there are gaps in a plant's equipment 'failure prevention controls'. Controls are what manufacturing facilities put into place to ensure continued safe and reliable operation of plant.

For example: Plant A suffered an on-stream failure of a catalyst tube. What was the root cause and what remedial actions should be implemented to ensure this doesn't happen again?

(a) Design and Construction: Were there gaps in the original manufacturing specification / QAQC during manufacture?
(b) Process Operating Controls: How well balanced is your steam methane reformer, do you have some tubes running much hotter than others?
(c) Maintenance Controls: Is the tube support system effectively maintained?
(d) Inspection Controls: Why did your tube inspection program not pick up the damaged tube prior to failure? How effective is your remnant life assessment program?

Outline:

Training program participants will have an opportunity to take a deep dive into the metallurgy, damage mechanisms and failure prevention controls applicable to equipment on your syngas plants. Participants are invited to submit questions for discussion during the 5-day program. An outline of the program is detailed below.

Metallurgy fundamentals, Damage Mechanisms specific to Syngas Plant, Repair of Fixed Plant
M1 Basic Metallurgy Principles – Steels and Alloy Steels
M2 Basic Metallurgy Principles – Austenitic Materials
M3 Elevated Temperature Damage Mechanisms – 20 syngas plant elevated temperature DM's
M4 Corrosion Damage Mechanisms – 23 syngas plant corrosion / SCC DM's
M5 Mechanical Damage Mechanisms – fatigue and brittle fracture DM's
M6 Welding Technology & Equipment Repair of Syngas plant
M7 Heat Treatment Principles pertaining to Syngas plant

Steam Methane Reformers
A1 SMR's – Basic understanding of SMR Process Function & Design
A2 SMR's – Basic understanding of key aspects of start-up, shut-down & balancing SMR's
A3 SMR's – Catalyst Management
A4a SMR's – Radiant Inlet System
A4b SMR's – Catalyst Tubes
A4c SMR's – Radiant Outlet System

A4d SMR's – Transfer Lines / Cold Collectors
A4e SMR's – Convection Section

Hydrogen, Ammonia, Methanol Manufacturing Plants
A5 Secondary Reformer & refractory management (ammonia & methanol)
A6 Process Waste Heat Boilers (hydrogen, ammonia, methanol)
A7 Shifted Gas Loop (hydrogen, ammonia, methanol)
A8 CO2 Removal Loop (hydrogen, ammonia, methanol)
A9 Methanation Loop (ammonia)
A10 Ammonia Conversion Loop (ammonia)
A11 Condensation Loop (ammonia)
A12 Refrigeration & Ammonia Storage Loop (ammonia)

Who Should Attend:

This highly interactive and hands-on training caters for inexperienced as well as experienced engineers and inspectors. This program is very beneficial to Fixed Equipment Reliability Engineers, Process Engineers, Materials Engineers, Mechanical Engineers, Inspectors and Design / Construction Project Engineers (QA/QC) who work on or support Syn Gas Manufacturing Plants.

Benefit to participants and their facilities:

This experiential training program will provide participants with a much broader and deeper working knowledge of:

- Materials and damage mechanisms applicable to your syngas plant, including potential for and consequence of equipment failure.
- What damage mechanisms should be included in your sites RBI program to ensure effectiveness of inspections and condition assessments.
- What critical process controls need to form part of your plant's integrity operating windows program.
- What gaps may be present in your current fixed equipment failure prevention controls.
- What equipment may be approaching end of life and what actions would be needed to quantify remnant life.
- The importance of linking damage mechanisms with manufacturing specifications to ensure equipment does not fail from design and construction gaps.
- Equipment integrity focused operation of critical plant equipment such as steam methane reformers, process waste heat boilers, thick walled pressure vessels, cyclic equipment such as pressure swing absorbers and so on.

Instructors:

David Keen is a qualified Metallurgist with over 46yrs domestic and international experience in Syngas manufacturing facilities. David is a Subject Matter Expert (SME) on fixed equipment integrity management and has in recent years downloaded this knowledge into a series of training modules focused on preventing equipment failures through experiential learning and team problem solving sessions.

He has held various positions including Global Company Chief Engineer, VP Global Reliability & Risk, Company Engineer Fixed Equipment, Reliability Manager, Operations Manager, Maintenance Manager,

T/A Manager and Plant Metallurgist. David has worked as a consultant to Hydrogen, Ammonia and Methanol plants in 12 countries globally. He has been involved in implementing RBI programs, IOW programs, auditing fixed equipment management, completion of failure investigations, root cause analyses, fixed equipment repairs and design and construction of new fixed equipment.

David has worked on 33 steam methane reformers and is a recognized subject matter expert in the integrity management of SMRs.

Dan Drabble is a mechanical and metallurgical engineer with particular expertise in the high-temperature damage mechanisms such as creep, creep-fatigue, stress relaxation cracking, HTHA and high-temperature corrosion. He holds a B.E.(Mechanical) and a Ph.D in the field of materials science, both from the University of Canterbury in New Zealand. He has worked as an engineering consultant since 2011, joining Becht in 2022.

He has worked in primarily the petrochemical and refining industries, with significant experience in steam-methane reformers (SMRs). Dan led the remaining life assessment program for SMR catalyst tubes at his previous company for many years and has presented papers at several international conferences. He has also been involved in a number of large-scale syngas plant Risk-Based Inspection (RBI) implementation projects, development of Integrity Operating Windows (IOWs), and both field and laboratory metallurgical work.

Andrew Cleverdon is a Mechanical Engineer with 19 years' experience in design, maintenance, and reliability management of static and rotating equipment in Hydrogen, Ammonia and Methanol Plants, globally. He has held site-based positions including Company Engineer, Reliability Manager, Maintenance Manager, and Global Rotating Equipment Engineer.

Andrew has provided equipment integrity technical support globally on numerous syngas plants, hydrogen, ammonia and methanol, implementing RBI and IOW programs, conducting equipment failure investigations & facilitating equipment repairs during outages and turnarounds.

Monika Ko has 15 years-experience as a materials and corrosion engineer involved in asset integrity management in operating plants as well as consulting in the oil and gas, petrochemical and power industries. Monika has a Bachelor of Engineering and a PhD in CO2 Corrosion of Pipeline Steel, both from the University of Auckland, NZ.

She is experienced in failure and root cause investigation, material selection, fitness for service, identification of damage mechanisms and development of corrosion management programs for fixed equipment and pipelines, implementation of RBI and IOW programs. Monika has held site-based positions on hydro-carbon plants, such as Senior Expert Integrity and Pipeline Engineer, and Senior Materials and Corrosion Engineer. She has also worked as a materials and corrosion consultant to hydrogen, ammonia and methanol plants globally.