Course title:

High-Temperature (HT) Failure Modes in Ammonia Plants

Introduction:

This course will present in separate modules the most important high-temperature failure modes like metal dusting, HTHA, nitriding, creep and DMW occurring in ammonia plants. The parameters influencing these high-temperature failure modes are elaborated. It is explained how to mitigate the failure modes by correct choice of the materials of construction and equipment design.

In an additional module a survey is given of other, may be less well known, failure modes like graphitization, SRC, hydrogen embrittlement, temper embrittlement, brittle fracture, fatigue and oxidation.

Duration 8 hours

Course outline:

Module 1: Metal Dusting

1. Introduction.
3. Parameters influencing metal dusting:
   a. Parameters regarding metallurgy of materials of Construction.
   b. Process parameters.
4. Measures to mitigate metal dusting.
5. Experiences with metal dusting.
6. Inspection on metal dusting.
7. Case histories of metal dusting.
8. Conclusions and recommendations.
Module 2: High Temperature Hydrogen Attack (HTHA); Nelson

1. Introduction.
2. Mechanism and parameters influencing HTHA.
3. Measures to mitigate HTHA.
4. Inspection (techniques) on HTHA.
5. Conclusions and recommendations.
6. Case history: Catastrophic failure of a carbon steel heat exchanger in Naphta Hydrotreater (NHT) due to HTHA.

Module 3: Nitriding

1. Introduction.
2. Mechanism and parameters influencing nitriding.
3. Measures to mitigate nitriding.
4. Inspection on nitriding.
5. Case histories of nitriding.
6. Conclusions and recommendations.

Module 4: Creep

1. Introduction.
3. Parameters influencing creep rate.
4. Calculation of used life-fraction.
5. Inspection (techniques) for creep damage in reformer tubes.
6. Typical locations of creep in ammonia plants.
7. Measures to mitigate creep.
8. Case histories of creep.

Module 5: Dissimilar Metal Weld (DMW) failures and the influence of hydrogen

1. Introduction.
3. Parameters influencing DMW-failures.
5. Typical locations of DMW’s in ammonia plants.
6. Inspection (techniques) of DMW’s.
7. Case history of DMW-failures.
8. Conclusions and recommendations.

Module 6: Survey of other types of HT failure modes occurring in NH3 plants

1. Introduction.
2. Survey of failure modes; mechanisms and parameters influencing these failure modes:
   a. Graphitization.
   b. Stress relaxation cracking (SRC).
   c. Hydrogen embrittlement.
   d. Temper embrittlement.
   e. Fatigue.
   f. Oxidation.
   g. Brittle fracture (is basically a LT failure mode).
3. Indication of the locations of the failure modes in PFD’s.
4. Measures to mitigate these failure modes.
5. Inspection (techniques) on these failure modes.
6. Case histories.
7. Conclusions and recommendations.

Learning outcomes:

By the end of this training course, you will understand:

- The mechanisms of the several High-Temperature failure modes occurring in ammonia plants.
- The parameters which influence these High-Temperature failure modes
- How to mitigate these failure modes by correct choice of material of construction and equipment design.
- How to inspect these failure modes in Turnarounds and during operation.

Who will benefit:

Employees who are responsible or share responsibility with respect to the mechanical integrity and safe operation of ammonia plants: process, mechanical, maintenance, corrosion and inspection engineers employed in ammonia plants.
Course materials:

- Hand out presentation slides in PDF format

Price:

€ 800

Discounts:

- 2 places – 10% discount
- 3 places – 15% discount
- 4 or more places – 20% discount.

In-company training:

This course is also available as an in-company course (face-to-face or online) where content can be customised to meet your organisation's specific needs and delivered on a date/location that suits your requirements.

Contact us for more information.

Training code: MAT07

On request the electronic (recently revised) version of the Corrosion Engineering Guide (> 800 pages) is available for additional costs of €95.00