FERTILIZER ACADEMY

Knowledge hub for nitrogen fertilizer industry

Course title:

Corrosion failure modes and materials of construction in nitric acid plants

Abstract:

This course will contribute to a better understanding of the mechanism of corrosion in nitric acid. All relevant parameters which may influence the corrosion in nitric acid will be elaborated. By means of alterations in equipment design and plant lay-out the corrosion can be mitigated and service life extended.

Course outline:

Module 1

1. Introduction; Nitric acid process
2. Corrosive circumstances and mechanism of corrosion in nitric acid solutions
3. Parameters influencing corrosion in nitric acid:
   a) Process parameters:
      a) Temperature,
      b) Pressure,
      c) Nitric Acid concentration,
      d) Dichromic acid,
      e) Noble metals and
      f) Chloride contamination;
4. Parameters regarding metallurgy of materials of construction:
      a) Chemical composition
      b) Microstructure: presence of precipitations / inclusions and grain size.
5. Case History

Module 2

1. Materials of construction in nitric acid service
      a. Austenitic stainless steels
      b. Duplex stainless steels
2. Materials of construction in nitric acid service

Author(s) / Trainer(s):

Giel Notten

Materials & Corrosion Engineer,

Giel Notten is a materials and corrosion expert who, spent thirty eight years working with DSM in The Netherlands. After gaining his Chemical Engineering degree he joined DSM's Materials and Corrosion Department and was heading this Department as Managing Senior Corrosion Engineer. In this job he was involved in a broad range of consultancy activities for numerous (petro-)chemical plants. For Stamicarbon, a previous subsidiary company of DSM, and licensing DSM's know-how, he set up programs for lifetime assessment studies, based on RBI philosophy, in numerous urea and ammonia plants and supervised these studies. Giel was also involved in the development of Safurex®, the super-duplex stainless steel grade (developed by Sandvik in coöperation with Stamicarbon) for application in Stamicarbon urea plants.
He was a board member of NACE Benelux and a member of the Contact Group Corrosion of the Dutch Chemical Process Industry.

Since his retirement from DSM, Giel started his own company NTT Consultancy in 2006 and has remained active as a materials and corrosion engineering consultant for many companies all over the world. He has devoted much of his time to passing on his knowledge and experience on the topic of corrosion engineering to a new generation of engineers in corrosion courses and trainings; numerous trainings have been presented. In cooperation with UreaKnowHow (in-house) training sessions have been organized and presented to more than 1000 urea engineers, managers, (shift-) supervisors and operators from all over the world. Several workshops have been presented in cooperation with UreaKnowHow for CRU in Nitrogen & Syngas Conferences.

Giel published many technical papers in reputable industry magazines and collected his knowledge and experience, illustrated with numerous cases of corrosion, in a book entitled Corrosion Engineering Guide.

   a. Titanium- and
   b. Zirconium-alloys
3. Design and lay-out aspects to mitigate corrosion in nitric acid plants:
   a. Casuistry of corrosion failure modes
4. Quality control of stainless steels for critical equipment in Nitric Acid service

Module 3

1. Experience review of cooler condensers in several Nitric Acid plants - part 1
2. Experience review of cooler condensers in several Nitric Acid plants - part 2
3. Design aspects and materials of construction for cooler condensers (recommendations)
4. Conclusions and Preventive measures

Module 4

1. High temperature failure modes in nitric acid plants
   a. Ammonia combustion reactor:
      i. Introduction; process
      ii. Materials of Construction for HT service
2. High temperature failure modes in nitric acid plants:
   a. Ammonia Combustion Reactor:
      i. Embrittlement by phase formation
      ii. Thermal fatigue
      iii. Relaxation cracking
      iv. Strain Assisted Grain boundary Cracking (SAGC)
      v. Creep
      vi. Nitriding
3. High temperature failure modes in nitric acid plants
   a. Ammonia combustion reactor:
      i. Experience review
      ii. Conclusions and recommendations
4. NOx Removal Reactor (Uhde EnviNOx® reactor)
   a. Nitriding
   b. Introduction; NOx removal process
   c. Mechanism and parameters influencing nitriding, measures to mitigate;
   d. Experience review
   e. Conclusions / recommendations

Learning outcomes:

By the end of this training course you will understand:

- The mechanism of the several corrosion phenomena in nitric acid
- The parameters which influence the corrosion aspects in equipment of nitric acid plants
- How to mitigate corrosion by means of changes in equipment design and plant lay-out.
- Which materials of construction to be used for the various equipment.

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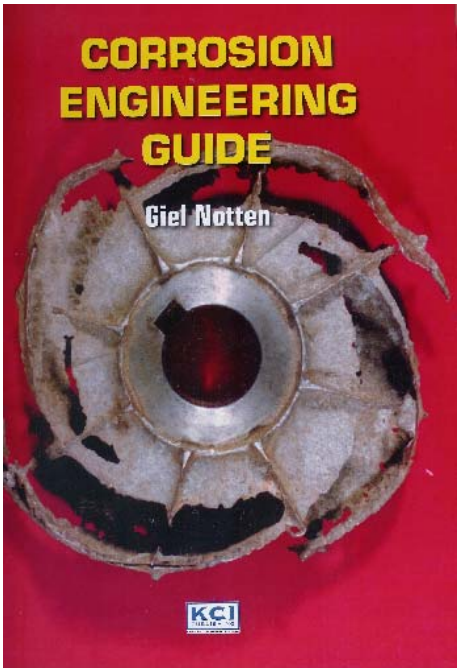
Who will benefit:

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

Course materials:

- Hand out presentations.pdf



Price:

€700.00

Discounts:

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

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