

■ **Course title:**

Corrosion and Materials Technology in Urea Plants

■ **Introduction:**

This course will contribute to a better understanding of the mechanism of corrosion in ammonium carbamate solutions of urea plants. All forms of corrosion with different morphology as well as the parameters promoting these failure modes will be elaborated on the basis of casuistries. A survey is presented of the applied materials of construction in urea plants of different licensors. A correct choice of materials of construction as well as proper design is a prerequisite for safe operation of the HP equipment in Urea plants. Inspections based on an RBI philosophy are required to set up adequate programs to perform a predictive/preventive maintenance.

Duration 12 hours

■ **Course outline:**

Module 1: Corrosion aspects in urea plants

1. Introduction.
 - a. Urea processes; schematics.
2. Mechanism of ammonium carbamate corrosion.
3. Parameters influencing corrosion in ammonium carbamate solutions.
4. Morphology of different forms of corrosion in urea plants.
5. Casuistry of corrosion in urea plants.

Module 2: Materials of construction in urea Plants

1. Introduction.
2. Historical overview of materials of construction in Stamicarbon, Saipem, Toyo and Urea Casale plants.
3. Advantages and disadvantages of:
 - a. Austenitic stainless steels.
 - b. Duplex stainless steels (Safurex, DP28W,

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 cooperation 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.

- Uremium29).
- c. Titanium and zirconium.
- d. Bi-metallic and Omegabond stripper tubes.

Module 3: Corrosion aspects in urea plants related to design and manufacturing

1. Introduction.
2. Design aspects HP equipment urea plants; codes and standards; post weld heat treatments (PWHT).
3. Leak detection systems.
4. Innovations in equipment design to mitigate corrosion.
5. Catastrophic failures due to malfunctioning of leak detection systems.

Module 4: Quality control and inspections

1. Introduction.
2. Quality control of materials of construction (i.e., corrosion testing, PMI).
3. Corrosion Inspections in Urea Plants based on a Risk Based Inspection (RBI) philosophy:
 - a. Inspection techniques.
 - b. On-line corrosion monitoring.
4. Life Time Assessment (LTA) Studies.

Module 5: Summary

1. How to prevent detrimental corrosion in Urea plants in:
 - a. Design phase.
 - b. Manufacturing / Construction / Storage / Shipment phase.
 - c. Operating / maintenance phase.
2. Conclusions.
3. Final case: Catastrophic failure of weld-o-let in HP pipeline.

Learning outcomes:

By the end of this training course you will understand:

- The mechanism of corrosion in ammonium carbamate solutions.
- The parameters which influence the several corrosion phenomena in urea plants.
- How to mitigate corrosion by means of correct choice of materials of construction and design of equipment.

- How to perform quality control of materials of construction
- How to perform inspections and LifeTime Assessment (LTA) studies to ensure safe operation of the plant.

■ **Who will benefit:**

Employees who are responsible or share responsibility with respect to the mechanical integrity and safe operation of urea plants: process, mechanical, maintenance, corrosion and inspection engineers involved in licensing/designing or employed in urea plants.

■ **Course materials:**

- Hand-out presentation slides in PDF format.

■ **Price:**

€1.200

■ **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:** MAT08

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

