

■ **Course title:**

# Corrosion (-erosion) and Fouling Control in Boiler (Feed-) Water and Steam Systems

■ **Introduction:**

This course will contribute to a better understanding of the cause and mechanism of corrosion (-erosion) failure modes in steam systems. It is explained how to control these failure modes by implementing steam treatment programs and monitoring the system. In several case histories with different failure modes it is elaborated that also equipment in steam systems should be incorporated in a Risk Based Inspection program to ensure safe operation of the plant by a proper predictive maintenance.

*Duration 4 hours*

■ **Course outline:**

## Module 1: Different forms of failure modes in steam systems; mechanisms, parameters and preventive measures

1. Introduction.
2. Magnetite formation – Schikorr reaction.
3. Survey of different types of failure modes in boiler (feed-) water and steam systems:
  - Mechanisms and parameters influencing these failure Modes.
  - Measures to mitigate the failure modes on the basis of practical experiences.
    - a. Oxygen corrosion.
    - b. Acid and caustic corrosion.
    - c. Caustic stress corrosion cracking.
    - d. Phosphate wastage; Hot water corrosion.
    - e. Erosion-corrosion phenomena.
    - f. Hydrogen Induced Stress Corrosion Cracking (HISCC).

Author(s) / Trainer(s):



### Giel Notten

Materials & Corrosion Engineer,  
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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<sup>®</sup>, 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.

- g. Corrosion -fatigue (Deaerator cracking).
  - h. Chloride stress corrosion cracking.
  - i. Creep.
4. Monitoring and inspection of steam systems.
5. Conclusions and recommendations.

## **Module 2: Case histories of failure modes in boiler (feed-) water and steam systems**

1. Hydrogen Induced Stress Corrosion Cracking in a Steam Drum.
2. Deaerator Cracking: Observations, Failure Analysis and Mechanism.
3. Chloride Stress Corrosion Cracking in Austenitic Stainless Steel Tubes of Steam Generators.
4. Erosion-Corrosion in Carbon Steel Tube sheet of Condensers in Fertilizer Plant.

### **Learning outcomes:**

By the end of this training course you will understand:

- The mechanism of the several corrosion (-erosion) phenomena in boiler (-feed) water and steam systems.
- The parameters which influence the corrosion (-erosion) phenomena as well as fouling aspects.
- How to mitigate the problems by implementing a steam treatment program and control the relevant parameters.
- Which materials of construction to be used in specific circumstances.

### **Who will benefit:**

Employees who are responsible for, or share responsibility, with respect to a proper functioning of utility systems like boiler (feed-)water and steam systems: process, mechanical, maintenance, corrosion and inspection engineers employed in (petro-) chemical plants handling boiler (feed-) water and steam.

### **Course materials:**

- Hand-out presentation slides in PDF format

### **Price:**

**€450.00**

■ **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: MAT06**

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

