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Avoid pollution: Protection of embedded oil tanks

FORCE Technology's inspectors regularly examine oil tanks to avoid pollution of soil and contents. In the Danish Statutory Guidance, the authorities have defined requirements for both structure, surface treatment and inspection.

Editorial

Stainless steel is stainless and a correctly dimensioned steel beam will endure what it must! But what happens with the materials after a fire? Are the material properties still undamaged? Often this is not the case.

In this edition of Material News you may read about the risk of damaged materials in connection with a fire. Which observations do you need to make and which investigations should be launched?

You may also read about how to protect embedded oil-tanks and about a new piece of equipment at our office in Esbjerg for performing rapid and accurate metal analyses.

We also present new employees and you get our up-dated survey of various courses.

Enjoy your reading.

Nils Linde Olsen
Vice President



FORCE Technology assist at determining the correct surface treatment of embedded tanks to avoid corrosion.

In order to perform the correct corrosion preventive surface treatment, FORCE Technology have made a guideline that focuses specifically on embedded oil tanks. The paper describes the correct treatment of both outside and inside surfaces. It also says how the product in the tank determines the choice of paint type. If you wish to receive the instruction (no. 3101-1-en) you may contact Alice Rasmussen at telephone no. +45 43 26 74 00 (direct line) or via e-mail at ar@force.dk.

Not just a Danish problem

Pollution from embedded tanks is also a huge problem in the USA and the paper has enjoyed interest from the largest American organisation of industrial painters, the Steel Structures Painting Council. SSPC chose to print the instruction in a revised version in their members journal – the largest American journal in this field, the Journal of Protective Coatings and Linings.

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After the fire – what is the risk of damaged materials?



Fireplace with different workshop machinery

Fire on industrial equipment occurs now and then. The extension and strength of the fire varies from case to case, which means that the extent of smoke and heat generation varies too.

Humidity generated from the fire and use of water to extinguish also varies, but in any case: In order to answer following questions after the fire some analytical work has to be done early after the fire for planning the salvage work:

- Are metallic materials damaged by the heat?
- What is the risk of immediate corrosion?
- What is the risk of future corrosion?

Heat may damage steel structures in different ways

Steel as reinforcement in concrete structures has got the necessary strength from considerable cold work. Consequently, rebars exposed to sufficiently high temperatures for sufficiently long time may have lost the strength required for the structure, due to lost concrete cover during the fire exposing the steel to the heat.

Stainless steel may lose its corrosion resistance at elevated temperatures in two ways - by severe oxidation and

sensitization. The latter occurs by structural changes when heating stainless steel to temperatures between 500 and 800°C for sufficiently long time.

Thus potential risks of heat damage to steel structures exist after a fire, but the risk can be evaluated by on site checking of the hardness as a measure of the strength of the steel. The stainless structure can be assured by means of on site metallographic investigation.

Loss of strength at high temperatures was the cause for the collapse of the towers in the World Trade Centre.

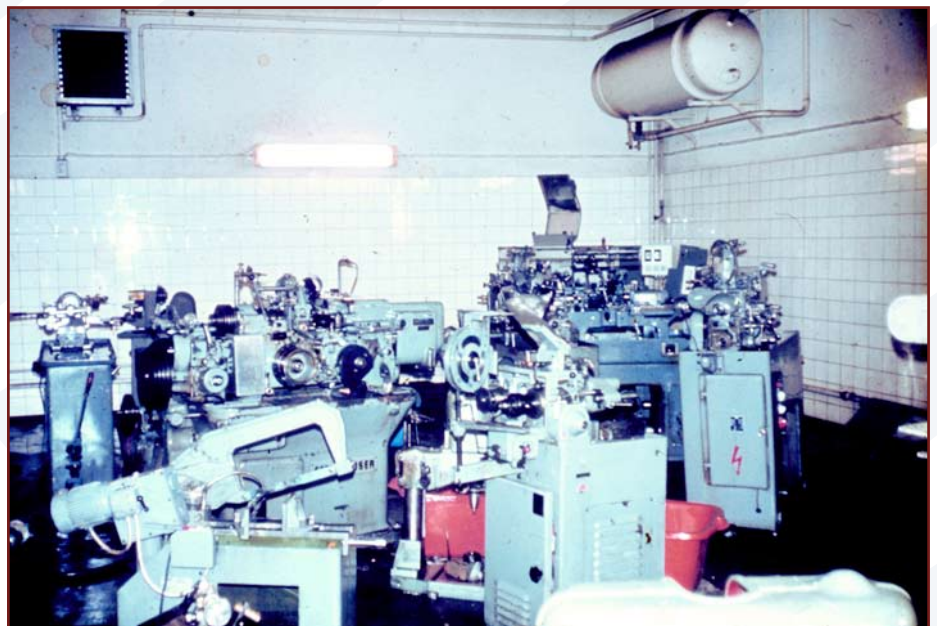
The immediate corrosion risk is managed.

The often very humid post fire condition leads to corrosion of unprotected metals. Therefore it is routine to install dehumidifying equipment rather rapidly to eliminate this risk and to freeze the situation while analyzing the situation and planning the salvage work. This temporary measure is removed again when the salvage work has been carried out and things revert to normal.

Surfaces corrode due to corrosive compounds in the smoke.

By combustion of polymers organic acids are formed, but the most frequent source forming corrosive smoke is PVC. This chlorine containing material is widely used as insulation for electrical installations and burn to a more or less extent in every fire. Consequently the smoke contains more or less hydrochloric acid.

The action of hydrochloric acid is an immediate reaction with the metals forming metal chloride corresponding to the metal. This is in fact a corrosion reaction, but in many cases the surface is not damaged due to the limited amount of hydrochloric acid present. Only a thin layer of extremely evenly distributed rust will form on the steel surface by the initial reaction with the acid.



The same machinery after completed salvage work.

Metal chloride contamination of the surface alters the interaction with the surrounding air humidity. For instance, ferric chloride contamination on a steel surface results in that the surface will corrode at humidity higher than 45%RH whereas a generally contaminated surface will start to corrode above 60%RH. Thus metals with a general contamination exposed to 55%RH will not corrode. If it is contaminated with chloride during a fire it will afterwards corrode at the same humidity. This means that the conditions have changed due to the fire and a real corrosion risk exists if the chlorides are not removed.

It is thus important to know about the degree of chloride contamination level after the fire. This can be done by determination of the surface chloride concentration. Many years of research and experience has shown that a level above 8-10 $\mu\text{g}/\text{cm}^2$ indicates elevated chloride level which needs cleaning to eliminate the corrosion risk. This baseline comes from a possible background chloride level up to 8 $\mu\text{g}/\text{cm}^2$. In special places, for instance clean rooms, where the acceptable chloride level is below 5 $\mu\text{g}/\text{cm}^2$ this level has to be referred to when the action of a fire is judged.

The determination of the chlorides is made by electrochemical analysis directly on surfaces selected from the information about the spreading of the fire.

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FORCE Technology present at the NACE conference once again

Once again FORCE Technology presented papers at the NACE conference, NACE is "The National Association of Corrosion Engineers". The papers were presented by Troels Mathiesen, Jan Elkjær Frantsen and Svenn Magne Wigen.

Troels Mathiesen presented a paper on unusual corrosion failures on stainless steel, focusing on possible theories as to why damages occur and which precautions may be taken to avoid future problems.

Jan Elkjær Frantsen presented a paper on common corrosion problems in the brew-

ery sector. Corrosion problems are not unknown in the brewery sector and the paper is based on several cases of corrosion attacks and they propose theories as to why corrosion is so widespread in the sector and how this may be avoided in future.

Svenn Magne Wigen spoke on the experiences with corrosion mitigation by use of cathodic protection in sea water cooling systems at the Sleipner oil rig in the North Sea.

Fact box

All papers are available in our web site www.forcetechnology.com under the menu option "Downloads" and "Scientific papers". Previously published papers can also be found here.

Investment in new equipment for metal analysis

FORCE Technology in Esbjerg has recently invested in new OES-analysis equipment (Optical Emission Spectrometry). This provides the customers with the opportunity to get their stainless steel analysed in addition to the unalloyed and low alloyed steel, which have been analysed in Esbjerg so far.



The new equipment differs from the previous as it is able to determine and detect nitrogen, a quality that is more and more in demand.

Interesting to the off-shore business

The new equipment will appeal to a great deal of our existing customers. Not least the off-shore business which we will be able to supply with very rapid analysis results on almost all steel types.

The off-shore business' use of stainless steel is highly increasing as are the documentation requirements on e.g. the supplied products chemical composition.

Possibility of mask analyses

With the new equipment FORCE Tech-

nology will also be able to perform fast and complete analyses of very little items, - the so called mask analysis - e.g. on a chip taken from a pipe, a flange or the like. The size requirement on such a chip is that one should be able to flatten it or spread it out - to a diameter of minimum 6 mm.

Further information:

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Courses in "Corrosion and materials' technology" and "Maintenance" in 2008

Area	Ref.	Titel	Duration	Date	Price DKK
Aluminium	A.2	Aluminium – decomposition forms, corrosion, cracks, wear	2 days	24-25 September 2008	7.900
	A.5	Aluminium – Joints	2 days	16-17 September 2008	7.900
Construction	B.3	Domestic water installations, materials and Corrosion prevention	2 days	30 September - 1 October 2008	7.900
	B.5	Legionella and water quality in the domestic water systems	1 day	25 November 2008	4.700
Energy systems	E.1	Maintenance of boiler plants	3 days	11-13 November 2008	10.800
	E.80a	Cooling with sea water	1 day	9 September 2008	4.700
	E.80b	Cooling with fresh water	2 days	21-22 October 2008	7.900
Stainless steel	R.8	Food safety – stainless production equipment	2 days	28-29 October 2008 (Århus)	7.900
Steel	St.3a	Steel – Surface treatment, corrosion protection	2 days	4-5 November 2008	7.900
	V.06	Inspection and Maintenance, module 1 (Materials and decomposition)	3 days	27-29 October 2008	10.800
	V.07	Inspection and maintenance, module 2 (NDE and NDT methods)	4 days	17-20 November 2008	13.600
	V.08	Inspection and maintenance, module 3 (Planning the inspection and maintenance)	3 days	1-3 December 2008	10.800

Registration

Please register with Jette Jacobsen by phone: +45 43 26 74 26, on email jtj@force.dk or on our website forcetechnology.com

New employees

Christian Højerslev



34 years and Master of Science, Ph.D., has been employed as of 1 May 2008 as a Materials specialist in the Department of Corrosion and Metallurgy in Århus. Christian is educated as a chemical engineer,

and he has specialised in materials technology and failure and damage analyses.

Christian will be a member of Denmark's largest impartial group of materials' specialists and his competences will be highly applicable in our many faceted working areas. Furthermore, Christian will partake in the work on service life analyses at power plants.

Christian has previously been employed as a senior consultant with Teknologisk Institut, with whom he has worked on materials' consultancy and failure and damage analyses for the past 2½ years.

Christian may be contacted at the telephone no. +45 87 34 02 13 and via e-mail at cho@force.dk

Marianne Strange



40 years and Master of Science in Engineering has been employed as of 1 March 2008 in the Department of Chemical Analysis. Marianne is a Master of Science in chemical engineer-

ing and has a Ph. d. in polymer chemistry.

Marianne will primarily work within the fields of polymers and the customs laboratory.

Marianne has previously worked as a senior consultant in the Department of Polymers at Risø DTU, the National Laboratory for Sustainable Energy, at which she has primarily worked on commercial polymer-related research and development tasks for the past 5 years.

Marianne may be contacted at telephone no. +45 43 26 76 42 and via e-mail at mqs@force.dk

Jakob Mølholm



Jakob Mølholm, 36 years and Master of Science, has been employed as of 1 March 2008 in the department of Corrosion and Metallurgy in Esbjerg. Jakob has a degree as M. Sc. in chemistry, and he

has specialised in the fields of corrosion and materials' technology.

Jakob will work with failure and damage analyses and materials' selection among other things.

Jakob has previously been employed as a secondary school teacher at the HTX in Kolding, where he has taught chemistry and mathematics for the past two years.

Jakob may be contacted at telephone nos. +45 76 10 06 77 / +45 22 69 75 05 and at jkm@force.dk

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For more information please use our website: www.forcetechnology.com

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