Minutes of EFC WP 15

Corrosion in the Refinery Industry

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Acknowledgement

The EFC WP 15 Refinery Corrosion Group would like to express thanks to Nalco for hosting this meeting in Leiden with special thanks to Chris Claesen for organising of meeting.

1 Welcome

The meeting was opened by Arthur de Jong from Nalco Europe. Nalco is a supplier of specialty chemicals and applications for the oil exploration, production, refining and chemical process industries. For over 75 years, Nalco has offered solutions for both upstream and downstream markets within the hydrocarbon industry. Some major dates in the development of the Nalco company are:

- 1928 creation in Chicago of the National Aluminate Corporation Through the merger of Chicago Chemical Company and the Aluminate Sales Corporation.
- 1928 Via Visco Products Nalco becomes active in the oil industry.
- National Aluminate's expertise in water treatment led to early international expansion. At the end of World War II, steam locomotives from the United States were shipped to Europe. The railroads in Italy and Germany relied on Nalco's chemicals to keep these locomotives operating efficiently.
- In 1952, a subsidiary was formed in Italy to satisfy the growing demand for Nalco products and services. The replacement of steam locomotives by diesel units eliminated virtually half of Nalco's domestic business. This proved a real turning point for the Company as it realized the need for diversification. Diesel fuel oil treatments and combustion catalysts, along with weed control chemicals for railroads created opportunities for Nalco in larger industrial markets.
- In 1959 the Company name was officially changed to Nalco Chemical Company to reflect the broadening scope of activity. Within Nalco's research and development efforts, there was significant movement from inorganic to organic chemistry and Nalco pioneered the development of important synthetic polymers for use in water treatment. A revolutionary new process for making lead antiknock compounds for gasoline was also introduced.
- 1964 introduction of Nalco at the New York Stock Exchange – building of the first pilot plant for demonstration
- 1979 A new Technical Center in Naperville, Illinois was opened with sophisticated process simulation equipment that, for the first time in this industry, allowed researchers to test product performance under customer plant operating conditions. In 1986, a 300,000 square foot complex was constructed adjacent to the Technical Center and Nalco moved its corporate headquarters to Naperville, Illinois.
- The 80's and 90's were marked by increasing emphasis on the environment. Leading the market, an innovative alternative to drums was introduced by Nalco in 1984 – the PORTA-FEED® Advanced Chemical Handling System – which features stainless steel units of various sizes that are fully drainable, stackable, and easily reused. Innovations in technology led Nalco to develop sophisticated diagnostic feed, control and monitoring systems that provide more value-added service to the customers. In 1999, the U.S. President Green Chemistry Challenge Award was presented to Nalco as a technical innovator in the area of green chemistry in recognition for its ULTIMER® technology.
- 1990's Nalco acquired more than 37 companies during this period and expanded its reach in all regions of the world. In 1994, Nalco/Exxon Energy Chemicals was created as a joint venture partnership to serve the petroleum

industry with chemical treatments for production, transmission, process and additive applications.

- 1999 Nalco becomes a part of Suez – Lyonnaise des Eaux, a world leader in infrastructure services, and its operations were integrated with those of Calgon Corporate and Aquazur – both world leading water treatment and process chemicals organizations.
- 2003 Nalco is bought by capitals partners (Blackstone, Appolo, Goldman Sachs)
- 2004 Via a public offering Nalco returns to the New York Stock Exchange as a publicly traded company.

Nowadays Nalco employs 11000 persons all over the world and has more than 60000 customers in 130 countries with yearly sales of 3.9 billion $.

22 persons attended the meeting and briefly introduced themselves. Apologies were received from 31 persons. The lists of the participants and the excused persons are enclosed in Appendix 1.

2 EFC WP 15 Activities

2.1 EFC WP 15 Activities and Minutes of Meetings

Information on the activities of EFC WP 15, Corrosion in the Refinery Industry was presented by Francois Ropital. This information can also be found on the EFC WP15 web-site, where the minutes of previous WP15 meetings minutes can be consulted and downloaded. More information is enclosed in Appendix 2.

2.2 Publications

The following publications from WP15 are available:

- EFC Guideline no. 40: Prevention of Corrosion by Cooling Waters.
- EFC Guideline n° 42: A Collection of Selected Papers.
- EFC Guideline °46: Amine Unit Survey.
- EFC Guideline n° 55: Corrosion under insulation (CUI) guidelines.

Guideline no. 55 that has recently been written by an EFC WP15 task force led by Stefan Winnik is now available.

2.3 Project for future publications

During last year's spring meeting in Paris, some presentations and discussions were related to relaxation cracking of stainless steels that are mainly used for furnace applications. Within the activities of the high temperature group of the French Cefracor petroleum industry commission, some work is going on the elaboration of a

procedure to evaluate the sensitivity of coupons to relaxation cracking and to propose guidelines to avoid this phenomenon. This work could be potentially be published as an EFC guideline. A presentation on the advancement of this work is proposed for the next WP15 meeting in Edinburgh (September 2008).

2.4 Collaboration with NACE

Corrosion in cooling water treatment: A task force group between NACE TG 361, EFC WP1 (Inhibition and Scaling) and WP15 has been launched to cooperate on the publication of updated documents in the field of corrosion in cooling water systems. A first draft of the common version has been issued. Valerie Beucler is preparing comments on behalf of WP 15 that will be available by the end of May. Volunteers that would like to help with the revision of this document should contact Valerie Beucler or Francois Ropital.

Opportunities for collaboration between EFC and NACE are fully supported by the board of administrators of the two associations. Exchange of information between WP15 and the NACE groups dedicated to the same topics are encouraged. Rob Scanlan continues to be the EFC WP15 representative during the NACE meetings coinciding with the annual NACE Conference, and will inform the relevant NACE committees on the WP15 activities. Also during the annual WP15 meeting (this year in Edinburgh), some information will be given on NACE activities by Rob and other NACE delegates.

2.5 Collaboration with other EFC Working Parties

During Eurocorr 2008 (in Edinburgh), a joint workshop on "Naphtenic Acid Corrosion" will be held together with WP1 "Inhibition and Scaling".

2.6 EUROCORR 2008

Eurocorr 2008 "Managing corrosion for sustainability" will take place in Edinburgh, United Kingdom from 8-11 September 2008.

The web site for this conference is: http://www.eurocorr.org/

On Monday 8 September after the annual WP15 meeting, there will be an open Workshop on "Corrosion under Insulation"

On Wednesday 10 September, there will be sessions on "Refinery Process Corrosion", "Ethanol Biofuel Corrosion" and "Refinery Inspection-Monitoring".

On Thurday 11 September a joint workshop will be organised with WP1 "Corrosion Inhibition" on "Naphthenic Acid Corrosion".

The draft program for these sessions is attached in Appendix 2.

2.7 EUROCORR 2009

Eurocorr 2009 will take place in Nice (France). Some proposals of topics on joint sessions with other Working Parties have been discussed. One subject could be

corrosion education for refinery plant inspectors. Other proposals are always still welcome.

3 Corrosion under insulation

3.1 Information on the EFC CUI guideline

The guideline can be bought as EFC Guideline n°55 (see paragraph 2.2)

3.2 Case histories and 5 year track history of a liquid applied CUI coating

As an introduction, Michael MeLampy (Hi Temp Coatings) showed some CUI failure cases and provided information on coating evaluation tests in boiling water. A review of the requirements on specialized coating systems for surfaces at high temperature was presented with some examples of applications for refineries, chemical plants and offshore equipment (insulation of nozzles after blast cleaning). A discussion on the influence of thermal shock on coating performance concluded the presentation. A copy of the presentation is provided in Appendix 3.

3.3 Unusual CUI failure

Hennie de Bruyn (Borealis - Norway) reported an unusual CUI failure on a carbon steel line in a Benfield CO_2 removal unit. The cracks initiated on the external surface and have propagated intergranularly into the steel, away from any weld. A high nitrate level has been detected on the external surface. No direct source of nitrate has been found, but an atmospheric contamination from a nearby nitric acid plant is suspected. For remediation, painting or TSA is considered. Thoughts on the potential use of aluminium foil for this SCC mechanism were also expressed. However, electrochemical data on such protection is required. More information is provided in Appendix 4.

4 High Temperature Hydrogen Attack

4.1 Assessment of the resistance to HTHA of a 5% Mo steel equipment

As an introduction, Martin Richez from Total showed the main HTHA mechanisms. Examples of HTHA on 0.5 Mo steel illustrated this part of the presentation. A strategy for the management of "old" 0.5 Mo steel equipment has been presented that includes the definition of 5 areas of severities on the T, P diagram. For old 0.5 Mo equipment, Capstone accelerated hydrogen exposure testing on scoop samples is used to evaluate remaining life. Field metallography, replica, Angle Beam Spectrum Analysis (ABSA) and Advanced Ultrasonic Backscatter Technique (AUBT) are also used to detect HTHA and cracks. More information is provided in Appendix 5.

5 Failure Cases

5.1 Typical Refinery Failure Cases web page

During the previous meetings, it has been decided to start with the creation of a web site in which WP15 members can incorporate typical failure case data sheets. To identify the category of corrosion damage, the API 571 classification will be followed.

Francois Ropital presented the web area to collect and consult typical corrosion failure cases of the refinery industry in order to share experiences. Its address is:

http://project.ifp.fr/cui-efc-wp15

Members who would like to have access to this web area should send an email to Francois (francois.ropital@ifp.fr).

An Excel file contains the list of all failures cases in the web page and a search by the API 571 category of failure is possible. At present, the web page includes only 5 failure cases and every member of the group is encouraged to extend it.

More information is provided in Appendix 6.

5.2 PASCC case in a FCCU

Wim Verstijnen from Shell presented a failure case on a 304H stainless steel FCC reactor lift pot. The failure occurred after a 20 years run without problems during which regular Infra Red (IR) inspection have been performed to check for hot spots.

A leak occurred due to intergranular cracking of a sensitized weld. Failure occurred in the HAZ of the weld. It is postulated that the locally cold areas on the shell (under the internal refractory insulation) has resulted in steam condensation and the formation of polythionic acids.

As a long term remedy, selection of a SCC resistant stainless steel or a different design (cold wall with carbon steel) has been proposed. More information is provided in Appendix 7.

6 Fitness for service

6.1 Use of fitness for service assessments

Hennie de Bruyn (Borealis – Norway) briefly presented some thoughts on where fitness-for-service (FFS) assessments are fitting into inspection management. This was followed by a short overview of different assessment methods and routines. A quick survey amongst the meeting participants highlighted the following:

- The most common assessment document used in Europe is probably API 579-1/ASME FFS-1.
- Most companies have some in-house specialists that perform assessments when damage is detected.
- Inspectors are generally not involved in FFS assessments as this is seen as a conflict of responsibilities and/or lack of detailed knowledge.

A copy of the slides that were presented is enclosed in Appendix 8.

7 Monitoring

7.1 How, when and where to monitor – D. Wilms – Applus+ RTD

The last presentation of the meeting was dedicated to the monitoring. Dimphy Wilms from Applus+ RTD presented the methods and the techniques used by her company, also showing some applications for CUI. More information is provided in Appendix 10.

8 Visit of Nalco Europe Laboratories

A visit of the Nalco Europe Laboratories concluded this working party meeting. The Leiden laboratories are more dedicated to water treatment additives: laboratory test plants, water and deposit analysis, microbiological investigations.

9 Next Meeting

*The autumn meeting will take place in **Edinburgh (United Kingdom)** during the Eurocorr 2008 conference. The meeting is scheduled for **Monday 8 September from 11h00 – 17h00** and will include an open workshop on Corrosion Under Insulation.*

The final agenda is in preparation and will be sent to WP15 members by 15 July 2008.