MINUTES OF MEETING

EFC Working Party no 13 Corrosion in Oil and Gas Production
WP meeting held during Eurocorr 2004.

Date/place: Nice / 15. September 2004

Minutes:

Welcome, News and Confirmation of the Agenda

The prize for the best presentation by a young (< 35 years) author offered by ANTIKOR was given to Tomohiko Omura from SMI for the paper " 125 ksi grade high strength low alloy steel OCTG for mildly sour environments".

The Use of Inhibitors in Oil and Gas Production

Status on the new document
Jim Palmer gave a brief description of the document. A new section on weld corrosion will be included. The document is now published.

Injection of acetic acid for Ca-naphthenate control, J. Palmer
Ca-naphthenates can be formed in topside equipment due to increased pH. This is only relevant for production of oils with a high Total Acid Number (TAN). A standard way of preventing Ca-naphthenates is to inject acetic acid. Preferential weld corrosion occurred in a line with high concentration of acetic acid even though a corrosion inhibitor was injected. Tests were undertaken with ZRA that showed large anodic currents from the weld metal. A new inhibitor was qualified.

Testing of corrosion inhibitors for HT service, A. Dugstad
Testing of corrosion inhibitors at elevated temperatures is challenging as the effect of the inhibitor cannot be separated from the effect of protective carbonate scales. IFE has developed a testing procedure where the iron ion content is kept very low to limit the effect of the protective carbonate scales. The conditions will be very corrosive, but the effectiveness of the corrosion inhibitor can be clearly identified. Testing for a specific field showed that only one out of 4 candidate corrosion inhibitors offered acceptable corrosion protection at 110 degrees C. For this specific product, local attacks at 80 degrees C was a challenge.

Status of case histories document
There is no progress to report from 2003. Liane Smith has made a system to submit new cases on the Internet (http://www.intetech.com/index.htm). Presently there are 5 case histories reported. Cases related to inhibition can also be reported. The lack of response to this may indicate that a new EFC publication on case histories is not possible in the near future. This is to be discussed at the next meeting.

Carbon Steel in H2S Service

Corrosion fatigue of armour in flexible pipes in sour environments, Carol TARAVEL-CONDAT

Corrosion fatigue of armour wires in flexible pipes has become an important subject and the results are directly applied in design of lifetime of dynamic risers made of flexible pipes. The annulus between the inner and outer polymeric layers will trap corrosive gases such as CO2 and H2S and water. 10-20% of the annulus volume can be filled with water. The water will be condensed water that will rapidly be oversaturated of iron ions due to the extreme area of steel / volume of electrolyte ratio. The annulus is normally drained on the top of the risers and significant amounts of hydrogen gas can be detected that is a strong indication that CO2/H2S corrosion is taking place.

The stress can be residual stresses, static stress due to the internal pressure and dynamic tensile stress due to movement of the ship/floater. The corrosion fatigue testing is normally undertaken as uniaxial or FPB testing, and a N2 box outside the test setup is used to control the oxygen content below 1 ppb. SN-curves are generated for a set of combinations of gases and these curves are applied directly in design of new risers made of flexible pipes.

Hydrogenation permeation through pipe and induced loss of thermal efficiency for PiP S. Duval

For Pipe-in-Pipe (PiP) systems the thermal insulation is based on vacuum in the annulus. In case the inner pipe is made of C-steel, hydrogen generated by the corrosion process can lead to hydrogen pressure build up in the annulus. The flux of hydrogen strongly depends on the pH in the produced environment, but also H2S and CO2 content and temperature are important parameters. IFP have undertaken tests that show that the U-value and be doubled already when a hydrogen pressure of 150 mbar is reached in the annulus. The conclusion from this work is that large scale testing should be undertaken and that this effect has to be considered when designing new PiP systems. An important parameter is to control the corrosion rate.

Corrosion Resistant Alloys in H2S Service

Sulphide stress corrosion cracking of weld overlays , M. Billingham

Partial weld overlays with Inconel 625 in seal areas have been tested in service conditions, in design conditions and in NACE TM 0177, solution A with 1 bar H2S. Testing at service and design conditions showed no cracking, whereas testing in NACE TM0177 solution A gave several indications near the weld interface. Sectioning revealed multiple sub-surface cracks along the weld fusion line; occasionally surface-breaking.

Conclusion: Lower cost of a partial weld overlay is attractive. Testing must be undertaken to prove that the solution is acceptable for the service conditions. There is a possibility of failure in more severe conditions, despite materials complying with NACE MR0175 / ISO 15165.

In the following discussion it was confirmed that a local hard zone will be found near the fusion line due to diffusion of C. Partial weld overlaying should thus be used with great care as the weld interface always will be a weak point.

Issues affecting the reliable environmental testing of weldments in 13Cr Martensitic Stainless Steels, B. Nimmo

NPL has undertaken a project to study the FPB testing procedures. If specimens with an intact weld root are to be tested, it is advisable to use thick specimens, up to near full wall thickness. When testing welds under fully machined conditions, the surface under tension should be as close as possible to the root surface as there may be hardness variations through-thickness. Strain gauges should be attached to the parent plate symmetrically on either side of the weld metal as close as possible but sufficient far from the weld toes. This to ensure that the measured strain is not directly affected by any local stress/strain concentration or non-uniformity of the surface.

Typically, the objective is to attain a strain adjacent to the weld corresponding to 100% of the 0.2% proof stress measured for the parent material. The 0.2% proof stress of the parent material must be obtained in a separate test with the same configuration to be used in the exposure test. Because every weld specimen can be somewhat different, it is not possible to assign a specific deflection based on some calibration specimens. Each weld must be individually strain gauged.

For testing at elevated temperatures, the material properties at the test temperature must be obtained and used as basis for the stressing. Duplex stainless steels are known to creep even at ambient temperature when stressed to levels close to the 0.2% proof stress. In a FPB specimen the stress/strain is only obtained in the out fibre of the specimen and the other side is in compression. The underlying material that is not stressed to the same level as the outer fibres will act as a constraint that will reduce the degree of creeping.

NPL has made a test procedure for FPB testing based on the results from the project.

Testing with elemental sulphur , C. Fowler

There was a discussion on test methods in environments with elemental sulphur. There was a general agreement that a standardized procedure was needed. Gunter Schmitt has published a paper on this subject at CORROSION 95. In Germany there is a standard for testing, VDEh Rec. test M SEP1865. In this document type of environment and the test method is described. Chris Fowler suggested that a subgroup is set up to rationalise testing in elemental sulphur. The following people were suggested for the this group:

Chris Fowler, Gunter Schmitt, Liane Smith, Russ Kane, Gerit Sigmund.

The objective is to produce a test methodology / procedure to be included in EFC 17, which then can go into ISO 15156. Status to be reported in Lisboa.

Impact of ISO 15156 on EFC16 and EFC 17 ,C. Fowler

Chris Fowler gave a presentation.

Both documents are Guideline Documents and are still widely quoted by the Industry. Both contain information outside the scope of ISO 15156 and should continue to be updated as necessary.

EFC 16:

HIC Acceptance criteria should possibly be changed to be in line with the ISO.

EFC: CLR <15%, CTR <3%, CSR < 1.5%

ISO: CLR < 15%, CTR <5%, CSR < 2.0%

Changes can be made to the document without a ballot. Therefore important issues can be fast tracked for Industry use.

EFC 17:

As per EFC 16 fast track revisions can be made. The document has a wider scope than the ISO 15156-3.
Testing in the Presence of Elemental Sulphur
Test Procedure needs further definition. It is important to be comparable between test laboratories. (Subgroup already formed – see above).
The test methodology/procedure should be included in a new edition of EFC17 and fed into ISO 15156 as a reference method.

Corrosion in CO2 Service

Should EFC 23 be updated? There are several sections in this document that could be updated. In addition there are new issues that can be included, such as pH stabilization. To be discussed in 2005.

pH stabilization – interaction between corrosion and process, A. Dugstad
A. Dugstad gave a presentation on pH-stabilization. There are currently several pipelines now in operation where pH-stabilization is the only method for corrosion control. In general the field experience is good, but there is a complex interaction between corrosion and process issues. In particular the MEG regeneration system and pH-stabilization has to be considered in parallel when designing new systems. Salt accumulation, salt reclaiming, particle accumulation, filtering are all issues that are closely inter-linked.

Corrosion Aspects of CRAs in Oil and Gas Production in the Absence of Hydrogen

HESC of duplex, P. Woolin
The results from a JIP at TWI were presented. UT testing of 22% and 25% Cr duplex stainless steels under cathodic charging showed that these materials could initiate cracking already close to the actual 0.2% proof stress. An important parameter is the low temperature creep of these duplex steels that can be significant at stress close to the 0.2% proof stress. The material parameter that influenced the results most was the “austenite spacing” which is a parameter quantifying the grain size in the material. For more details, see paper presented at OMAE, Vancouver 2004 – 51203.

Updated information about "Multimedia corrosion guide", JL Crolet
Status on the system was given. The program contains a case history library from cases experienced by TOTAL. The program is commercially available.
(http://www.cdcorrosion.com/)

Next meeting will be in Lisboa during Eurocorr 2005.