IAPWS International Virtual Conference
on
Film Forming Substances (FFS2021)

Final Agenda / Programme and Abstracts

Day 1 – Tuesday, 23rd March 2021.

All Times are European Time (GMT + 1).
Each 25 minute presentation slot includes presentation plus 5 minutes question/answers

11:00 **Opening *Remarks.*** Conference Chairman: B. Dooley Structural Integrity, UK

Session 1.

11:15 ***Cetamine® Analytical Methods for Industrial Systems.***

A. de Bache, T. Wittig and J. Jasper, Kurita Europa GmbH, Germany.

Abstract. Analytical methods to determine free FFA are well established and used in the field as "Cetamine® Photometric Method" and "Cetamine® Online Monitor". Recently, Kurita developed the "Cetamine® Trace Analysis Method" as a new method to enable the determination of FFA at lower concentrations e.g. below 0.1 ppm. There is also a need to determine the adsorbed FFA molecules on water steam cycle surfaces and for this purpose Kurita's "Cetamine® Wipe Test" has been introduced and is specific to oleyl propylene diamine (OLDA). This is a non-destructive method giving an immediate indication on the surface of protection with Cetamine® treatment. For low pressure boilers and closed systems that operate usually on higher FFA concentrations a simple and practical "Cetamine® Test Kit" has been also developed. The presentation will give an overview of these test methods and examples from the field.

11:40 ***Results of an FFS Trial at Liddell Power Station.***

H. Henderson, AGL Australia.

Abstract. Liddell Power Station was commission in the 1970s and is scheduled for shutdown from 2022-2024. The design of the plant is mixed-metallurgy; due to this the nominal chemical treatment program is AVT(R). However, due to excessive air-in-leakage, it is likely the treatment program is closer to AVT(O). Corrosion product monitoring indicated iron and copper levels significantly above IAPWS limits (>20ppb at the economiser inlet). Excessive corrosion product transport is also demonstrated by the waterwall oxide growth rate of >100 mg/cm^2 every 5 years leading to chemical cleaning intervals of 4-6years. To attempt to reduce corrosion product transport, and the oxide growth rate before the end of life to minimise the risk of hydrogen damage failures an FFS was dosed. This paper presents the results of this trial.

12:05 ***Chemical Correction of the Water-Steam System with the use of Filming Corrosion Inhibitor in the Cyclic Operation of Combined Cycle Gas Turbine Plant.***

M. Rokicki and M. Nietrzeba, POLENERGIA Elektrociepłownia Nowa Sarzyna, Poland, L. Barre, NALCO Europe, France and P. Urbaś, NALCO Polska, Poland.

Abstract. After 20 years operation of combined cycle gas turbine plant, Elektrocieplownia Nowa Sarzyna (ENS) is preparing for new operating conditions within the Power Market. This means a fundamental operational change for ENS generating equipment - instead of stable and continuous operation, the equipment will operate cyclically, with variable power or remain in standby, ready for quick production. One of the challenges is to ensure proper corrosion protection of the water-steam system operating in a

cyclic mode. The presentation discusses the experience gained during the industrial trial of using the Powerfilm 10000 corrosion film forming inhibitor in the ENS water-steam system.

12:30 ***Study and Research on the Effects of using FINEAMIN as a Modern Solution for Conditioning the Feedwater of Power Plants and Industrial Steam Generators.***

A. Lapadat, FINEAMIN Romania, Romania.

Abstract. The FINEAMIN polyamine treatment is currently being used more and more throughout the world in water-steam-condensate circuits of power and industrial plants using conventional fuels. FINEAMIN is a continuous treatment with volatile amines and film forming polyamines. The product has the role of dispersing existing deposits and protecting the metal from the action of oxygen and carbon dioxide through a film of polyamines. This presentation aims to demonstrate the effectiveness of treatment with FINEAMIN (possibly replacing some classical solutions such as hydrazine) as a viable and modern solution for the treatment of steam boiler feedwater by analyzing the results of product use in industrial plants and laboratory conditions.

12:55 ***Open Discussion Period***

Session 2.

14:00 ***Film Forming Corrosion Inhibitor with Improved Handling, Feeding and Corrosion Control Properties for Steam Generators.***

M. Budhathoki, D. Meskers and G. Robinson and C. Pierce, Suez, USA.

Abstract. Film forming amine (FFA) products containing oleyl propylenediamine (OLDA) are known to provide excellent corrosion protection to the alloys used in the steam-water cycle of power plants. However, product formulations based on this filming amine exhibit poor water solubility, which often hinders successful application due to formulation stability, feeding and handling. In this presentation, the water solubility of an OLDA-based FFA product is significantly improved with the addition of a co-surfactant, and its efficacy as a corrosion inhibitor in steam generators is evaluated. Electrochemical and corrosion testing indicate that the water-soluble FFA product can effectively inhibit corrosion, which is attributed to its ability to form a hydrophobic film on metal surfaces. Field trials data of the new product are being collected, and preliminary results will be reported.

14:25 ***Colorimetric Analyzer for Online Analysis of Film Forming Amines.***

H. Stansfield, Waltron Bull & Roberts, USA.

Abstract. Waltron, in cooperation with Suez Water Technologies and Solutions, has developed a Colorimetric analyzer for online analysis of Film Forming Amines. The analyzer is built on Waltron's reliable and stable 3040 series colorimeter platform and is designed to operate in typical industrial environments with minimal maintenance and low operating costs. The presentation will discuss the design basis and present operating case studies from actual plant operations.

14:50 ***Filming Product Application for Use in PWRs/PHWRs: EPRI Nuclear Program Update.***

K. Fruzzetti and J. Jarvis, EPRI, USA, M. Kreider, C. Marks and J. Reinders, Dominion Engineering, Inc., USA.

Abstract. This presentation provides an update of EPRI's technical work supporting safe and effective use of Filming Product (FP) technology at pressurized water reactors (PWRs) and pressurized heavy water reactors (PHWRs). A brief summary of the identified technical gaps is provided for the FP commercial products considered. The focus of the presentation is on the details of the needed laboratory testing of several candidate FPs in support of a potential plant demonstration. This testing includes assessments of general corrosion of key secondary system materials, flow accelerated corrosion, and the impact on elastomers.

15:15 ***Exploring the Effects of OLDA Product G851 on the FAC of Carbon Steel under Two-phase Feedwater Conditions.***

S. Weerakul, N. Leaukosol and D.H. Lister, University of New Brunswick, Canada, and S. Mori, Kurita Water Industries, Japan and W. Hater, Kurita Europe, Germany.

Abstract. On-line probes operating in a high temperature water loop indicate the effects of chemistry and physical condition on the FAC of carbon steel. In particular, the effects on FAC rate of adding the commercial product G851®, containing the FFA OLDA (oleylpropylenediamine), to the loop water at temperatures from 140 to 190°C and under single-phase or two-phase steam-water conditions are monitored. A typical single-phase experiment at 140°C demonstrates how product addition reduces FAC immediately and creates protective FFA films that survive on the steel for many days after the product is removed from the water. By contrast, at high steam voidages, no effect of the FFA on FAC is seen but a typical two-phase experiment at 165°C shows how product addition at 30% voidage reduces FAC only several days after application. The corresponding adsorption of the FFA on loop surfaces is slower than under single-phase conditions, possibly accounting for the delayed action on FAC. Similar behaviour is found over the range of temperatures studied.

15:40 ***The Important Implementation Steps of Applying the IAPWS Technical Guidance Documents on FFS to Fossil and Industrial Plants: Sections 8 and 9.***

B. Dooley, SI, UK. and M. Rziha, PPChem AG, Switzerland.

Abstract. The application of FFS can be very beneficial, but it can also produce more issues than before application. There are sufficient examples for both in the real world. Meanwhile there are two IAPWS Technical Guidance Documents freely available dealing with all the major questions in this respect. Sections 8 and 9 of both guidance documents will help any user to ask the right questions, collect the minimum needed information in advance, and to conduct monitoring during the application in order to avoid any negative effects on the plant. The content of Sections 8 and 9 will be introduced.

16:05 ***Open Discussion Period***

Day 2 – Thursday, 25th March 2021.

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11:00 **Opening *Remarks.*** Conference Chairman: B. Dooley Structural Integrity, UK

Session 3.

11:15 ***History and Updates on ODACON for Fossil and Nuclear Plants.***

R. Wagner, Reicon, Leipzig, Germany and G. Saltanov, VNIIAM, Moscow, Russia.

Abstract. In 1975 the R&D work of a new technology started to increase the reliability and efficiency of energy equipment of nuclear power plants with PWR reactors based on the use of micro-additives of surfactants. This was the starting point of ODACON development in which an international team of specialists and leading institutes of former Soviet Union and East Germany were involved.
45 years later there is still an impact of this groundbreaking innovative project to scientific work and a lot of applications worldwide. The presentation shows the first steps and some actual projects based on the ODACON technology.

11:40 ***FFS Application for Corrosion Control in a Geothermal Reboiler/Steam Transformer Case Study.***

D. Addison, Thermal Chemistry, New Zealand and N. Vandervegte, Ngati Tuwharetoa Geothermal Assets Ltd., New Zealand.

Abstract. The Ngati Tuwharetoa Geothermal Assets Ltd (NTGA) Kawerau reboiler plant has suffered from major corrosion and plant failure issues since commissioning, including the premature complete replacement of the tube bundles. These corrosion related failures have occurred due to water/steam chemistry issues and interactions with plant materials not being fully considered and understood in the design process of the plant. In 2018 a major root cause analysis was undertaken into the failures that included a detailed chemical and metallurgical investigation and successfully identified the failure mechanisms. A number of simple chemical treatment changes, including hydrogen sulfide neutralization, pH correction and the application of corrosion inhibiting film forming substances (FFS), were carried out to successfully mitigate ongoing corrosion of the plant and to significantly extend asset life.

12:05 ***Corrosion in Closed Cooling System – A Risk that can Potentially Impact the Entire Power Plant.***

Y. Nussbaum, EZOM O&M, Israel.

Abstract. This is a case study of changing from traditional nitrite / borate treatment to FFS treatment in a closed cooling system. The change was done with no shutdown of any system in the power plant. Presenting field experience as well as FFS careful dosing and monitoring.

12:30 ***Boiling out with FFS Treatment and Polyacrylates in HP Boiler.***

J. Kallweit, Wasserbehandlung Kallweit GmbH, Germany.

Abstract. The presentation discusses boiling out with FFS treatment. More than 27 years of experience with a lot of boiler manufacturers in Europe. A good way to clean and boiling out new and rebuilt HP boilers.

12:55 **Open Discussion Period**

Session 4.

14:00 ***Conversion to AVT(O) using a Film Former.***

G. Hoffman, PacifiCorp, Utah, USA.

Abstract. Rocky Mountain Power's Hunter Unit 3 (mixed-metallurgy, B&W, natural circulation subcritical power plant) has historically had high levels of iron and copper transport to the boiler and steam cycle. Full flow condensate polishers have been employed since the mid '90s. This paper demonstrates the use of a film forming product, coupled with the elimination of reducing agent, to successfully convert this unit from AVT(R) to AVT(O). Corrosion product analyses and inspection results will be presented.

14:25 ***Electrochemical Impedance Spectroscopy to Study Film-forming Amines for the Corrosion Protection of Carbon Steels.***

J. Baux, N. Pébère, and N. Caussé, Université de Toulouse, France, S. Delaunay and J. Tireau, EDF R&D, France, M. Roy, and D. You, CEA, France.

Abstract. Electrochemical impedance spectroscopy was used to investigate ODA films. Impedance of film-forming amines was modelled. Thickness and dielectric permittivity of the ODA film were obtained. Instantaneous inhibitive efficiency was determined. ODA molecules degradation was shown at 275 °C.

14:50 ***Thermal Stability of OLA in Water-Steam Cycle Conditions.***

S. Vidojkovic, H. Spanjers, and L. Rietveld, Delft University of Technology, The Netherlands, and A. Velriefde, Ghent University, Belgium.

Abstract. The high temperature high pressure stainless steel reactor, operational up to 300 °C /200 bar, was used for studying the thermal stability of Oleylamine (OLA). The results showed the effect of temperature, residence time and initial concentration of OLA on intensity of its thermal decomposition up to 220 °C.

15:15 ***EPRI's Research-based Approach to Understanding Film Forming Product Treatment and Developing Practical Guidance.***

S. Shulder and B. Burns, EPRI, USA, M. Kreider, C. Bunt, B. Hall, C. Hundley and C. Marks, Dominion Engineering, Inc., USA.

Abstract. The Electric Power Research Institute (EPRI) has conducted considerable research to evaluate film-forming products (FFP) for use in power plants and published an interim guideline in 2020. In addition to summarizing a decade of research results and power plant FFP user experiences, the interim FFP guideline provides practical technical direction on FFP selection, application, and optimization in conventional fossil and combined cycle plants. EPRI works with energy companies across the world to properly apply their research based guidance in an effective way. EPRI is also conducting new research on how FFPs may affect cycle chemistry instrumentation and examining how surface coverage correlates to corrosion rates. This presentation will highlight some of the most recent research results and provide an overview of the interim guideline on FFP treatment.

15:40 ***The Intersection between Analytics and FFS Products***

K. Buecher, Mettler-Toledo, Colorado, USA.

Abstract. This presentation will share some commonsense guidelines for starting down the FFS path with links to measurement analytics and residual testing. A brief look at new technology examples will also be shared, that could be used to help plants be successful with the transition to FFS.

16:05 **Open Discussion Period and Closing Remarks**

B. Dooley 19th March 2021