

The Third International Conference on Film Forming Substances (FFS 2019) Highlights and Press Release



The third FFS International Conference was held on the 19th – 21st March 2019 in Heidelberg, Germany chaired by Barry Dooley of Structural Integrity. FFS2019 was a unique conference on a narrow topic in cycle chemistry control of power plants but attracted over 70 participants from 22 countries.

The FFS conferences are supported by the International Association for the Properties of Water and Steam (IAPWS). The 2019 conference was organized by BHT GmbH and PPCHEM AG, publisher of the PowerPlant Chemistry Journal. Both Fineamine SA (Gold Sponsorship) and Anodamine Inc. (Regular Sponsorship) provided financial support.

The meeting provided a highly interactive forum for the presentation of new information and technology related to FFS, new research results, case studies of fossil, combined cycle, nuclear and industrial plant applications, and for open discussion among plant users, equipment and chemical suppliers, researchers and industry consultants. The conference provided an opportunity for plant users to discuss questions relating to all aspects of FFS with the industry's international experts and researchers. A panel session was held which focused on a number of the key questions and uncertainties about the applications of FFS and the results in plants some of which are highlighted below.

Key highlights from FFS2019 included:

- The participation of attendees from over 20 countries in FFS2019 illustrates the strong and increasing interest around the world in understanding and applying FFS.
- Feedback from the previous conferences had indicated confusion about the various terminologies so IAPWS introduced the new international terminology for Film Forming Substances (FFS). Two subsets describe these substances in terms of them either being amine based (FFA, Film Forming Amine, and FFAP, Film Forming Amine Product) or non-amine based (FFP, Film Forming Products). This terminology is now used worldwide and was used throughout FFS2019.
- There was worldwide appreciation and recognition of the unique IAPWS Technical Guidance Document, TGD8-16, on FFS published in 2016. IAPWS will be introducing in 2019 a new TGD on FFS for Industrial Plants, and a White Paper on the application of FFS for Nuclear plants.
- International updates were presented on recent experiences from fossil, combined cycle, nuclear and industrial plants. Examples of problems that have emerged in fossil and combined cycle plants after application of FFS were presented. These relate to increased levels of deposits on the heat transfer surfaces resulting in under-deposit corrosion. Common aspects discussed were: there had been no consideration given to pre-ap-

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plication review of the plant or chemistry as per Section 8 in the IAPWS TGD, and that there was no understanding why a polyacrylate addition was included in the proprietary FFAP.

- The experience in nuclear plants continues to be good with ODA being the FFA of choice. There was low impact on the chemistry control with complete observation of hydrophobic films in the feedwater and condensate as well as cycle clearance. However, film formation in dry steam areas is still a question.



- Whereas there is a full wide range of FFS being applied to the other plants, and the experience in fossil and combined cycle plants continues to be variable in terms of corrosion product transport and film formation in steam circuits. Suggestions were made to improve the verification process using tube samples and corrosion product monitoring during startups.
- Updates were provided on ongoing research activities from different international organizations dealing with decomposition / breakdown products of FFA, thermolysis and distribution of FFA, measuring/quantifying the concentration of the FFS in the water, adsorption kinetics of film formation, and the effects of FFS on flow-accelerated corrosion.
- A Panel Session addressed a number of open issues related to inspection aspects following application of FFS to a plant, and the methods of determining hydrophobic films on surfaces, especially on steam surfaces, and whether their presence can be related directly to corrosion protection.
- As a direct follow-on from the 2018 FFS conference basically no new work was presented to understand the mechanism of the interaction of FFS with surface oxides and how a FFS film might change the growth mechanism and morphology, and result in reduced levels of corrosion product transfer. This relates to the

interaction of the FFS film with existing oxide/deposit surfaces of Fe_3O_4 , Fe_2O_3 , FeOOH , CuO and CuO_2 in condensate/feedwater and in boiler/evaporator water. Much discussion took place on the oxides which form in steam circuits, and on the chromia oxides which form in the phase transition zone of the steam turbine.

- One of the continuing conclusions from FFS2019 was the need to first optimize the current chemistry on a plant with verification or otherwise through baseline monitoring before application of any FFS.



- There were intensive discussions regarding gaps of knowledge and needs for further research work. IAPWS will be defining through an ICRN (IAPWS Certified Research Need) document the further work that is needed on the interactions that occur under all plant conditions and temperature ranges.
- From the good balanced discussions, it was clear that there is still much to learn and a lot of fundamental work that needs to be done to understand the mechanisms at play with FFS. This includes film formation kinetics, equilibrium and stability, film structure (e.g., thickness or number of layers), how the adsorption is affected by other amines, and the correspondence to the reduction in corrosion rate through understanding of the interactions with oxides and deposits.

The fourth FFS international conference is planned to be held in France in the first quarter of 2020.

Please contact Barry Dooley (bdooley@structint.com or bdooley@IAPWS.org) for further information on FFS and with presentation suggestions for FFS2020.