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Abstracts

Single-Phase Flow-Accelerated Corrosion in Bifurcations

Daniel Zinemanas and Amiel Herszage

Flow-accelerated corrosion (FAC) is a corrosion mechanism that is induced by a combination of various chemical, physical and hydrodynamic factors. Among these factors, the flow has, through its coupled relation to the mass transport, a dominant role. Prediction and mitigation of this phenomenon thus requires a deep understanding of these two phenomena, and in particular, of the local nature of their interactions. As shown in this paper through a comparison between the numerical analysis of the flow in two types of bifurcations and the actual outcome of two FAC failures, these interactions are not simple and do not behave as in straight pipes. In the bifurcations studied here it is found that the highest local wall wear rate cannot always be directly correlated to the mean flow or to the highest flow near the wall. Interestingly, in one case the region of the highest wear rate is in a zone where the local velocities are low. In this region, however, the mass transport near the wall is predicted to be the highest.

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Prediction for Pitting Corrosion of AISI Type 403 Stainless Steel in Chloride-Containing Borate Buffer Solution

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The prediction of pitting corrosion damage on low-pressure steam turbine (LPST) blade surfaces has been investigated experimentally and the results have been interpreted in terms of the Point Defect Model (PDM) for passivity breakdown and the nucleation of pits. Experimental relationships between the critical breakdown potential (V_C) and the chloride activity a_{Cl^-} and pH have demonstrated the applicability of the PDM for describing passivity breakdown on AISI Type 403 stainless steel (SS), a commonly employed blade alloy in LPSTs, in chloride-containing borate buffer solutions. The model parameter values, as determined by optimization of the PDM on passivity breakdown data, may be used to predict the nucleation and accumulation of pitting damage on LPST blades under simulated turbine shutdown conditions. In order to evaluate the predictions, integral damage functions (IDFs) and extreme value distributions in pit depth have been measured on samples taken from failed blades recovered from the field (Texas Genco). These data are being used to test the predictions of Damage Function Analysis (DFA), which is based on the PDM and on deterministic models for pit growth and delayed repassivation. However, the success of this analysis critically depends on our ability to define the corrosion evolutionary path.

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Effect of Heat Flux on Deposition Rate of Iron Corrosion Products in Boiler Tubes

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The reliability of operation of heating surfaces of modern boilers is mostly determined by the deposition rate on heat exchange surfaces. Due to the increased purity of feedwater for both drum-type and once-through boilers, deposits on the inner surfaces of steam generating tubes mainly consist of corrosion products of construction materials, i.e., iron and copper oxides. The aim of this EPRI-sponsored research was to study the effect of (a) water chemistry, (b) heat flux, (c) iron concentration in water, and (d) copper concentration in water on the deposition rate of iron corrosion products in drum-type boiler tubes. The results have indicated that (a) the amount of deposits with AVT was higher than that with OT chemistry; (b) an increase in high flux resulted in a higher amount of deposits with both AVT and OT chemistries; and (c) the presence of copper corrosion products had a slight effect on the deposition rate of iron corrosion products.

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Chemistry-Related Instrumentation in Fossil Plant Cycles

Albert Bursik

The paper discusses the required extent of chemistry-related instrumentation for control of chemistry in plant cycles. The focus is on comparison of EPRI and European guidelines specifying the parameters to be monitored. Particularly in non-standard utility and industrial cycles, tailoring of the extent of instrumentation is required for identification and control of contaminant ingress and possibly emerging problems or chemistry upsets.

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Understanding Microbially Induced Corrosion in Process Water Systems: Recent Findings on Its Control

E. D. Beaton

Corrosion of cooling water systems has been evaluated in terms of parameters that may control microbially induced corrosion (MIC) in these systems. Results from tests on parameters such as flow and dead leg geometry suggest that mass transfer throughout a system determines whether MIC bacteria are more or less active. The preconditioning of the steel surface also appears to affect MIC by the sulfate reducing bacteria. These results aid in identifying locations where MIC would be prevalent in process water systems and may also provide a justification for selecting locations for corrosion monitoring.

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Characterization of Ferrites and Chromites Prepared by Solid-State Methods: XRD, XPS and Mössbauer Study

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Corrosion of structural materials of the coolant system in nuclear reactors leads to the formation of oxides like ferrites and chromites, which are contaminated with radioactivity. This causes radiation field build-up in the out-of-core surfaces and must be removed by the dilute chemical decontamination (DCD) process. Understanding of the contamination process and development of a suitable decontamination formulation require knowledge about the nature of these corrosion products formed on the surface. In this study an attempt has been made to synthesize ferrites and chromites by solid-state reaction in the temperature range 900 °C – 1 400 °C. The synthesized spinels are characterized by powder X-ray diffraction. The chemical state of the metal ions present in the ferrites and chromites is investigated by the X-ray photoelectron spectroscopy technique. In addition, the elemental composition at the oxide surface is determined using the $2p_{3/2}$ photoelectron peaks. The metal ion distribution in the tetrahedral and octahedral sites is studied by Mössbauer spectroscopy and the results are discussed.

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