

ABSTRACTS

The Effectiveness of Titanium Additions on Mitigating Flow-Accelerated Corrosion under PWR Feedwater Conditions

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Titanium as an additive in CANDU® primary coolant has been shown to reduce the rate of flow-accelerated corrosion (FAC) of the carbon steel feeder pipes that direct the coolant from the core to the steam generators. The mechanism apparently depends upon the incorporation of titanium (Ti) into the magnetite oxide that normally forms on the steel in high-temperature water. Localized corrosion in steam generator crevices has also been mitigated by additions of Ti, apparently by a similar mechanism. It would seem possible, therefore, that Ti as an additive would mitigate FAC of carbon steel piping in pressurized-water reactor (PWR) feedwater systems. To explore this concept, an experimental program sponsored by the Electric Power Research Institute has utilized a high-temperature water loop to evaluate the effectiveness of adding Ti-based compounds to simulated PWR feedwater. On-line tubular probes measured corrosion directly at system conditions by monitoring the FAC-induced thinning of the tube walls with an electrical resistance technique. In the program, three compounds were tested in the loop, each at a concentration producing several $\mu\text{g} \cdot \text{kg}^{-1}$ equivalent of elemental Ti at the probes. Coolant chemistry conditions were: ammoniated water at $\text{pH}_{25\text{ }^\circ\text{C}}$ of 9.2, hydrazine at $40 \mu\text{g} \cdot \text{kg}^{-1}$ (ppb) and temperature of $140\text{ }^\circ\text{C}$. For each additive, plots of the probe internal radius against time directly showed the progression of FAC, and comparison with periods before the addition demonstrated any mitigating effect of the Ti. Indications of the effects of coolant velocity on FAC during Ti addition were obtained by varying loop pumping rates. Destructive examination of probes after exposure revealed any change in surface appearance and constitution brought about by the additive. The paper describes the experiments and results and assesses the possibility of using Ti compounds for mitigating FAC in feedwater systems in operating PWRs.

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International Fossil Cycle Chemistry Guidelines – Part 2: VGB PowerTech e.V., Germany

Ladislav Bursik and Albert Bursik

This paper, the second in a series of overviews of the most recognized international fossil cycle chemistry guidelines, introduces the VGB PowerTech and its current and planned fossil cycle chemistry-related guidelines and instruction sheets. In addition to plant cycle chemistry treatments, these documents cover, among other topics, the selection and the behavior of materials for condenser and heat exchanger tubing, makeup water and cooling water treatment, chemistry in district heating circuits, and internal cleaning and preservation of steam generators and other plant cycle components.

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Instrumentation for Monitoring and Control of Water Chemistry for Light-Water-Cooled Nuclear Power Plants

Shunsuke Uchida, Hideki Takiguchi, and Derek H. Lister

Based on the IAPWS technical guidance on "Instrumentation for Monitoring and Control of Cycle Chemistry for Steam-Water Circuits of Fossil-Fired and Combined Cycle Power Plants," the latest situation regarding instrumentation for nuclear power plants is discussed.

As a result of the discussion, it is concluded that:

- (1) Reliable and safe operation of plants is established by the application of suitable chemical conditions in plant cooling systems, which should be supported by the selection of suitable control targets for monitoring and by the application of reliable instruments.
- (2) The minimum level of key instrumentation consists of on-line as well as off-line instruments for monitoring the key parameters:
 - on-line: pH, conductivity, cation conductivity, O₂ and H₂ concentrations, electrochemical corrosion potential;
 - off-line: radioactive nuclides (⁶⁰Co, ⁵⁸Co, ¹³¹I, etc.), and the concentrations of metallic species (Fe, Cu, Co, etc.) and other species (B, Li, N₂H₄).
- (3) The application of high-temperature water chemistry sensors for in-situ measurement of cooling water properties and diagnosis of anomalous conditions based on monitored data is an important consideration for the future.
- (4) A technical guidance for nuclear plants, similar to the one issued for instrumentation and monitoring of chemistry in fossil-fired and combined-cycle plants, may be useful in the future, when common features could be combined in a unified guidance.

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A Comparison of Amperometric and Optical Dissolved Oxygen Sensors in Power and Industrial Water Applications at Low Oxygen Levels ($< 5 \mu\text{g} \cdot \text{kg}^{-1}$)

Stephen Bell and Frank Dunand

In this paper, the performance of both optical and amperometric oxygen sensors in both fossil and nuclear power plant applications is compared and discussed. The results of independent tests conducted to evaluate the suitability of a new $\text{sub-}\mu\text{g} \cdot \text{kg}^{-1}$ optical sensor for use in power plants and industrial applications of different types are presented. The issues of stability and repeatability, the influence of dissolved hydrogen and performance under flow variation are addressed. In terms of repeatability, accuracy, response time and maintenance efforts the optical sensor is shown to be comparable or superior to amperometric sensors.

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ERRATUM

Nobody is perfect; even we make mistakes sometimes. We apologize to the author and to our readers for a serious mistake in the article

Peter J. Clark:

Effects of Steam Sample Degassing on CCGT Station Start-up Profile
PowerPlant Chemistry® 2010, 12(4), 246–251

Figures 3 and 4 (page 249) are entirely incorrect.

The corrected version of the paper (a PDF file) is available to all readers (free download) at our homepage <http://www.ppchem.net> from May 26, 2010.

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