

ABSTRACTS

Assessing and Controlling Corrosion in Air-Cooled Condensers

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An increasing number of air-cooled condensers (ACC) are being installed and operated on conventional and combined cycle plants worldwide. Unless understood and corrected, the corrosion associated with the ACC ducts and tube entries can become a major problem for operators of plant. Up to just a few years ago very little was known about the corrosion/ flow-accelerated corrosion (FAC) process. This paper starts to rectify the situation with a description of the corrosion/FAC process, a corrosion index and a relationship between the operating pH and the level of iron at the condensate pump discharge.

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Challenges in Cycle Chemistry

James A. Mathews

The changing face of power generation in response to the worldwide economic and environmental concerns presents an increasing challenge. The focus in the operation of the power plant is to maintain the integrity and operability of the asset and reduce or eliminate performance and availability losses. Past EPRI International Conferences on Cycle Chemistry and Boiler/HRSG (Heat Recovery Steam Generator) Tube Failures provided a prioritization of cycle chemistry concerns and issues to be addressed. EPRI is providing guidance and technology addressing these issues. A brief discussion of the major concerns and some of the leading issues is provided. These issues and others will be topics of presentations at the Ninth International Conference on Cycle Chemistry in Fossil and Combined Cycle Plants with Heat Recovery Steam Generators, June 30 – July 2, 2009, Boston, Massachusetts.

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Chemistry Control Challenges in a Supercritical Water-Cooled Reactor

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The long-term viability of a supercritical water-cooled reactor (SCWR) will depend on the ability of designers to predict and control water chemistry to minimize corrosion and the transport of corrosion products and radionuclides. Meeting this goal requires an enhanced understanding of water chemistry as the temperature and pressure are raised beyond the critical point.

A key aspect of SCWR water chemistry control will be mitigation of the effects of water radiolysis; preliminary studies suggest markedly different behavior than that predicted from simple extrapolations from conventional water-cooled reactor behavior. The commonly used strategy of adding excess hydrogen at concentrations sufficient to suppress the net radiolytic production of primary oxidizing species may not be effective in an SCWR. The behavior of low concentrations of impurities such as transition metal corrosion products, chemistry control agents, anions introduced via make-up water or from ion-exchange resins, and radionuclides (e.g., ^{60}Co) needs to be understood. The formation of neutral complexes increases with temperature, and can become important under near-critical and supercritical conditions; the most important region is from 300–450 °C, where the properties of water change dramatically, and solvent compressibility effects exert a huge influence on solvation. The potential for increased transport and deposition of corrosion products (active and inactive), leading to a) increased deposition on fuel cladding surfaces, and b) increased out-of-core radiation fields and worker dose, must be assessed.

There are also significant challenges associated with chemistry sampling and monitoring in an SCWR. The typical methods used in current reactor designs (grab samples, on-line monitors at the end of a cooled, depressurized sample line) will be inadequate, and in-situ measurements of key parameters will be required.

This paper describes current Canadian activities in SCWR chemistry and chemistry control. Because the direct measurement of chemistry parameters under such extreme conditions of temperature, pressure, and radiation fields is difficult, the approach involves a combination of theoretical calculations, chemical models, and experimental work.

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Novel Electrodeionization Devices: Applications in Inorganic Analysis

John M. Riviello and Archava Siriraks

Electrodeionization (EDI) is a well established technique for the production of ultrapure water (UPW). In this paper the authors discuss novel electrodeionization devices which have been developed primarily for use in chemical analysis. These EDI devices can be incorporated directly into the analytical instruments for on-line production of UPW, or can be used off-line for automated sample dilution or sample preparation. Applications of these EDI devices in trace analysis of inorganic anions will be shown.

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The Modification of Oxides on Nuclear Reactor Materials by Titanium Addition under Primary Coolant Conditions

Lihui Liu and Derek H. Lister

Previous titanium injection studies showed that the transport and incorporation of soluble titanium species can modify the normal magnetite (Fe_3O_4) film on carbon steel and make it more protective. Subsequent experiments in a titanium autoclave system with well-conditioned surfaces have exposed samples of A106B carbon steel, 304L stainless steel, Alloy-600 and Alloy-690 for 1100 hours to simulated CANDU coolant at 310 °C when freshly-machined titanium turnings were present and when they were absent. Detailed surface analyses indicated duplex oxide layers on all surfaces and substantial transport of soluble Ti in both cases, since FeTiO_3 was formed generally in the outer layers. Ulvöspinel was also found on the carbon steel and stainless steel surfaces. Differences between the exposures with fresh titanium metal and those without were minor; the former promoted larger but fewer outer-layer crystals of Ti-bearing oxides but suppressed the formation of NiFe_2O_4 crystals on Alloy-600. The turnings themselves developed TiO_2 (anatase) and FeTiO_3 crystals.

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Behavior of Antimony Isotopes in the Primary Coolant of WWER-1000-Type Nuclear Reactors in NPP Kozloduy during Operation and Shutdown

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This paper focuses on the behavior of the antimony isotopes ^{122}Sb and ^{124}Sb in the coolant of the WWER reactors in the nuclear power plant Kozloduy (Bulgaria) during operation and shutdown. It is concluded that the chemical properties of their actual precursor, the isotope ^{121}Sb , determine the behavior of ^{122}Sb and ^{124}Sb during operation, load fluctuations, and shutdown as well as during the reactor coolant purification process. It is supposed that differences between the reactor bulk and the core fuel cladding surface chemistry as well as the presence of sub-cooled nucleate boiling at the fuel cladding may create conditions under which a local oxidizing environment may come into existence.

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