

Abstracts

Keith Fruzzetti, Paul Frattini, Phil Robbins, Alan D. Miller, Robert D. Varrin, and Marc Kreider

Dispersant Trial at ANO-2: Results from a Short-Term Trial Prior to SG Replacement

Corrosion products that make their way to the secondary side of pressurized water reactor (PWR) steam generators (SGs) via the feedwater can deposit on the SG tubes. These deposits can form an occluded region which inhibits heat transfer, leads to thermal hydraulic instabilities through blockage of tube supports and creates regions where corrosive species can concentrate along tubes and tube to tube support plate crevices. The performance of the SG is compromised not only by formation of an insulating scale, but by the removal of tubes from service due to corrosion.

A promising new method for significantly reducing corrosion product deposition on the secondary side of recirculating steam generators is the use of online dispersant addition to help prevent the corrosion products from adhering to the steam generator surfaces. By inhibiting the deposition of the corrosion products, they are more effectively removed from the steam generator via blowdown. After completion of a significant and comprehensive qualification program, a short-term dispersant trial was performed at Arkansas Nuclear One Unit 2 (ANO-2) in Winter/Spring 2000, lasting approximately 3 months. A high purity, high molecular weight polyacrylic acid (PAA) dispersant produced by BetzDearborn was injected at low concentrations ($0.5 \mu\text{g} \cdot \text{kg}^{-1}$ to $12 \mu\text{g} \cdot \text{kg}^{-1}$) into the final feedwater. The blowdown iron removal efficiency was observed to increase by an order of magnitude and more with use of PAA. Normal chemistry parameters, such as blowdown cation conductivity and TOC/TIC, were unaffected by PAA application. The results and conclusions from the trial are presented and discussed.

David G. Daniels

HRSO Waterside Failure Mechanisms

Heat recovery steam generators (HRSGs) are responsible for more and more of the steam generating capacity of many utilities. Unfortunately, they are also increasingly responsible for the number of tube failures in the system. Corrosion that leads to failures often begins before commissioning and is exacerbated by cycling operation. This article reviews common waterside failure mechanisms in HRSGs, where they occur, and what can be done to prevent failures in the future.

Joseph W. Harpster

Reducing Dissolved Oxygen under Conditions of High Air Ingress

Recent considerations of steam and air mixture dynamics in operating condensers have led to a more thorough understanding of how condenser performance is affected by air in-leakage. Results of this model-based theoretical description, which are in agreement with measurement data from operating condensers, are reviewed and used to propose beneficial design features for new and re-tubed condenser assemblies.

It is anticipated from this work that condensers can be designed which significantly reduce the amount of dissolved oxygen in condensate from locations of free air ingress above the hotwell level. This reduction also applies to other undesirable noncondensables that enter condensate driven by the same mechanism contributing to dissolved oxygen. When air in-leakage becomes sufficiently high, it contributes to excess back pressure on the turbine. In this region of high air in-leakage, the amount of dissolved oxygen can become very high. The design, therefore, minimizes or eliminates the corrosive effects of air in-leakage, both high and low, which is particularly important during periods of high demand when load must be maintained.

K. Anthony Selby

Closed Cooling and Heating Systems in Power Plants

Closed recirculating systems are used for cooling and heating tasks in power plants. In the power plant environment, these "balance of plant" systems often do not receive the same attention as the steam generating/turbine cycle. Nonetheless, closed recirculating systems play an important role in the consistent and safe operation of the plant.

Closed recirculating systems experience problems of corrosion, microbiological growth and fouling. These problems can be minimized through appropriate chemical and physical treatment. Closed systems must be adequately monitored to determine treatment needs, control treatment programs and detect problems.

Ken Natesan, Ankur Purohit, and David L. Rink

Fireside Corrosion of Alloys for Combustion Power Plants

A program on fireside corrosion is being conducted at Argonne National Laboratory to evaluate the performance of several structural alloys in the presence of mixtures of synthetic coal ash, alkali sulfates, and alkali chlorides. Candidate alloys are also exposed in a small-scale coal-fired combustor at the National Energy Technology Laboratory in Pittsburgh. Experiments in the present program, which addresses the effects of deposit chemistry, temperature, and alloy chemistry on the corrosion response of alloys, were conducted at temperatures in the range of 575 °C – 800 °C for time periods up to \approx 1850 h. Alloys selected for the study included HR3C, 310TaN, HR120, SAVE25, NF709, modified 800, 347HFG, and HCM12A. In addition, 800H clad with Alloy 671 was included in several of the exposures. Data were obtained on weight change, scale thickness, internal penetration, microstructural characteristics of corrosion products, mechanical integrity, and cracking of scales. Results showed that the relationship of corrosion rates to temperature followed a bell-shaped curve, with peak rates at \approx 725 °C, but the rate itself was dependent on the alloy chemistry. Several alloys showed acceptable rates in the sulfate-containing coal-ash environment; but NaCl in the deposit led to catastrophic corrosion at 650 and 800 °C.

H. Vasken Aposhian

Elemental, Mercuric and Organic Mercury: Biological Interactions and Dilemmas

The greatest exposure of the general population to mercury appears to be from the elemental mercury emitted by dental amalgams. The next greatest exposure is from methylmercury in seafood. One of the major sources of this methylmercury is from mercury emitted by power plants burning fossil fuel. After the mercury enters the atmosphere, some of it will be deposited in lakes, rivers, bays, seas and oceans. In an aquatic environment, inorganic mercury is converted to methylmercury by bacteria. Once in the methylmercury form, it is bioaccumulated up the food chain. The bacteria are consumed by other unicellular organisms that are eaten by small fish; small fish are eaten by bigger fish; then bigger fish are eaten by other animals and humans. Methylmercury and elemental mercury are efficiently absorbed by humans and are transported rapidly to and deposited in the brain. In the brain, methylmercury is converted very slowly to mercuric mercury while the elemental mercury is converted very quickly. Methylmercury and elemental mercury are extremely toxic to the developing central nervous system. Those at greatest risk are fetuses, very young children, women of childbearing age and pregnant women. There are no safe or reliable methods to remove these two forms of mercury and their biotransformant mercuric mercury from the human brain. The chelating agents DMPS (sodium dimercaptopropanesulfonate) and DMSA (dimercaptosuccinic acid) decrease the body's burden of mercury but not the brain's. Because of the toxicity of methylmercury, the major source of mercury emissions, namely, emissions from power plants, needs to be curtailed.

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