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Abstracts

Barry Dooley, Digby Macdonald, and Barry C. Syrett
ORP – The Real Story for Fossil Power Plants

Oxidation/reduction potential (ORP) measurements are now used extensively to monitor the feedwater conditions in fossil power plants. These measurements are typically made at ambient temperature, using platinum as the indicator electrode and a saturated silver/silver chloride [Ag/AgCl, KCl(sat)] reference electrode. However, some confusion exists about the physical meaning of ORP in these systems. So the purpose of the present paper is to comment upon the interpretation of measured data in terms of modern electrochemical and corrosion concepts, in particular in terms of the mixed potential model (MPM), and to indicate how the monitoring protocols should evolve so as to maximize the extent of information transferred to the plant operator or chemist. As such, it then becomes clear that ORP reflects a balance between the amounts of dissolved oxygen and the reducing agent in the feedwater. ORP is a function of the system pH, the partial pressures of oxygen and hydrogen, the mass transport properties, the flow rate and the materials in the cycle.

Stefan Ritter and Hans-Peter Seifert
Strain Induced Corrosion Cracking of Low-Alloy Reactor Pressure Vessel Steels under BWR Conditions

In this paper results of slow rising load and low-frequency corrosion fatigue (LFCF) experiments with three different low-alloy reactor pressure vessel (RPV) steels and with a RPV weld material at temperatures of 288, 250, 200 and 150 °C are presented. To characterize and quantify the strain induced corrosion cracking (SICC) and LFCF crack growth behavior under transient boiling water reactor/normal water chemistry conditions, modern high-temperature water loops, on-line crack growth monitoring and fractographical analysis by scanning electron microscopy were used.

Under highly oxidizing conditions, electrochemical corrosion potential (ECP) > 100 mV (SHE), a maximum in SICC susceptibility was observed in all investigated materials at intermediate temperatures (≈ 200–250 °C) and slow strain rates. The SICC growth rates were very similar for all materials, increasing with increasing strain rate and increasing temperature, with a possible maximum/plateau at/above 250 °C.

The cycle-based LFCF crack growth rates $\Delta a/\Delta N$ increased with decreasing frequency and increasing temperature. The LFCF growth behavior of low- and high-sulfur steels and of the weld material was comparable over a wide range of loading conditions. Under low-flow and highly oxidizing (ECP > 100 mV (SHE)) conditions, the ASME XI "wet" reference crack growth curve could be significantly exceeded by cyclic fatigue loading at low frequencies (< 10^{-3} Hz), at high and low load ratios R, and by ripple loading near fatigue thresholds ΔK_{th}. Under low-flow and highly oxidizing (ECP > 100 mV (SHE)) conditions, the ASME XI "wet" reference crack growth curve could be significantly exceeded by cyclic fatigue loading at low frequencies (< 10^{-3} Hz), at high and low load ratios R, and by ripple loading near to fatigue thresholds ΔK_{th}. Sustained environmentally-assisted

crack growth could be maintained down to low frequencies of 10^{-5} Hz. The environmentally-assisted crack growth rates were bounded by the low- and high-sulfur line of the General Electric model.

Supatpong Mattaraj and James E. Kilduff
Using Reverse Osmosis to Remove Natural Organic Matter from Power Plant Makeup Water

A field-scale reverse osmosis (RO) system was used to remove salts and natural organic matter (NOM) from a surface water source. The RO membrane exhibited an NOM solution hydraulic permeability of 8.33×10^{-9} $m \cdot s^{-1} \cdot kPa^{-1}$, about 6 % less than the clean water value, over pressures ranging from 414 to 1 000 kPa (60 to145 psi). The rejection of salt and NOM were greater than 98 % and 99 %, respectively. Under controlled laboratory conditions, greater than 99 % mass recovery of NOM could be obtained. A small fraction of NOM was not recovered using hydrodynamic cleaning but could be recovered with chemical cleaning (NaOH wash solution). The mass recovered in the NaOH solution increased from < 1 % to > 6 % with increasing transmembrane pressures from 414 kPa to 1 000 kPa, respectively. This is consistent with fouling that results from an increase in solution flux, and a concomitant decrease in tangential crossflow velocity.

Wolfgang Hater, Birgit Glüsen, Ulrich Pegelow, and Matthias Schweinsberg
Comparative Assessment of Dispersant Programs for Cooling Water

The prevention of mineral scales and sludge presents a major challenge for cooling tower management throughout a wide variety of industrial processes. The universal application of dispersants has proven itself to be a cost-effective solution to prevent the precipitation of mineral particles contained in feeding waters for industrial cooling systems.

In this paper, an integrated approach to the development and application of new ecologically friendly dispersant systems for cooling water is presented as an example for such processes. A variety of static as well as dynamic monitoring techniques for dispersant performance is presented, ranging from fast on-site testing methods such as turbidity monitoring to sophisticated laboratory techniques such as light scattering and zeta potential measurements. This coherent framework of testing procedures yields comprehensive information ranging from sedimentation mechanisms to optimum concentration balances as a function of key process parameters (temperature, flow rates, water quality) under practical conditions. This enables the development of new chemical formulations and the tailored adaptation of treatment programs to the customer, directly translating into mutual benefits ranging from faster response times to optimized cost-effective solutions for a wide variety of dispersing tasks. This is demonstrated by a case study of the cooling water treatment at a nuclear power plant.

PowerPlant Chemistry
2002' Scientific and Technical Contributions – Papers in English

This contribution contains the abstracts of all the papers published in our journal in 2002.

Albert Bursik

Kesselrohrschäden in Trommelkesseln in der Industrie – Teil 3: Alternative chemische Fahrweisen

Teil 1 dieses Beitrages behandelte die wichtigsten Unterschiede zwischen der Dampferzeugung in Kesseln der EVUs und den Dampferzeugern und anderen dampferzeugenden Apparaten in der Industrie (z.B. Unterschiede im Design, in Werkstoffen und in möglichen Kreislaufverunreinigungen) und diskutierte einige standortspezifische Bedingungen, welche die Kreislaufchemie beeinflussen. Teil 2 wurde der Anwendbarkeit der international anerkannten Verfahren der Kesselwasserkonditionierung und deren Einfluss auf das Auftreten von Kesselrohrschäden gewidmet.

Dieser Teil (Teil 3 einer vierteiligen Veröffentlichung) befasst sich mit der Möglichkeit, die auf Aminen basierende Fahrweisen, die weder von den VGB-Richtlinie für Kesselspeisewasser, Kesselwasser und Dampf von Dampferzeugern über 6,8 MPa noch von den EPRI Cycle Chemistry Guidelines for Fossil Plants abgedeckt werden, anzuwenden.

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Supatpong Mattaraj and James E. Kilduff **Using Reverse Osmosis to Remove Natural Organic Matter from Power Plant Makeup Water**	☐
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