

Abstracts**R. Barry Dooley and Kevin J. Shields
Alleviation of Copper Problems in Fossil Plants**

Research sponsored by EPRI has now led to a clear understanding of both the science of copper corrosion, transport and deposition, and the transport processes through the feedwater, boiler water and steam in a fossil plant.

**Brian J. Handy, John C. Greene, and Kenneth Tittle
The Estimation of Degassed Acid Conductivity of Steam/Water Samples in Power Plant**

The present paper proposes a method of estimating the degassed acid conductivity (DK_H) from the measured acid conductivity (K_H) and the total carbon dioxide content of a sample. The acid conductivity of a sample is a summation of contributions from a number of anion-hydrogen ion pairs having a range of equivalent conductance values. In the first part of the paper a single "mean" equivalent conductance is selected and used to estimate the total hydrogen ion concentration, $[H^+]$, in the acid conductivity sample. The $[H^+]$ value is then used to estimate the fraction of the total carbon dioxide concentration in the sample that is present as bicarbonate ion, HCO_3^- . This allows the contribution to the acid conductivity due to the HCO_3^-/H^+ ion pair, (K_{H/HCO_3}), to be calculated. The "degassed" acid conductivity, (DK_H), is then given by

$$DK_H = K_H - K_{H/CO_3}$$

The procedure is applied to the range of possible steam/water samples, illustrating the comparison between the "estimated" and calculated degassed acid conductivities. This procedure takes no account of the changes in the contributions to the total conductivity from other weak electrolytes present in the acid conductivity sample (e.g., water, acetic acid).

The second part of the paper describes a more sophisticated method using measured carbon dioxide and conductivity values and known thermodynamic and electrochemical data to calculate the degassed after cation conductivity. "Mean" equivalent conductances are selected for the anions present both before and after degassing. A series of equations is written for the dissociation constants for the acids that may be present in terms of the concentration of ionic species and hydrogen ion concentration. These equations are coupled with the mass balance and charge balance equations and expressions are derived for concentrations of all species. The conductivity of the solution can then be calculated before and after degassing. Comparisons are made in cases with low, intermediate and high carbon dioxide concentrations and in cases where conductivities are dominated by (a) mineral acids, and (b) organic acids. Optimum values of "mean" equivalent conductance are presented for several types of secondary water.

Jeffrey S. Rohrer, Edward Kaiser, Beverly Newton, Kannan Srinivasan, Rong Lin, Dennis Libby, and Edward Riley
Ion Chromatography for Anion Analysis of Borated Waters

Borated waters are commonly used in power plants to control thermonuclear reactions. Contaminant anions, such as chloride and sulfate, in borated waters are known to cause corrosion in power plant components. A reliable method is needed to measure these anionic contaminants in this borate matrix. Ion chromatography with a tetraborate eluent has been used to monitor contaminant anions. However, this technique requires manually prepared eluents that can yield inconsistent results. A new method using eluent generation with a boric acid eluent allowed us to reliably determine fluoride, chloride, and sulfate to low $\mu\text{g} \cdot \text{L}^{-1}$ (ppb) levels in waters with $2\,000 \text{ mg} \cdot \text{L}^{-1}$ (ppm) boron.

Santhanam Ranganathan, Madapuzi P. Srinivasan, Pandalgudi S. Raghavan, Raghavachary Gopalan, and Sevilmedu V. Narasimhan
Role of Reductants in Dilute Chemical Decontamination Formulations

Iron(III) oxides are the major corrosion products formed in boiling water reactors. The iron(III) oxides are of two types, namely hematite ($\alpha\text{-Fe}_2\text{O}_3$) and maghemite ($\gamma\text{-Fe}_2\text{O}_3$). The dissolution of these oxides is in no way simple because of the labile nature of the Fe(III)-O bond towards the chelants. The leaching of metal ions is partially controlled by reductive dissolution. In order to understand the role of the reductant, it is essential to study the dissolution behaviour of a system like Fe_2O_3 , which does not contain any Fe^{2+} in the crystal lattice. The present study was carried out with $\gamma\text{-Fe}_2\text{O}_3$ and dilute chemical decontamination (DCD) formulations containing ascorbic acid and citric acid with the addition of Fe(II)-L as a reductant. The chelants used for the dissolution process were nitrilotriacetic acid, 2,6-pyridinedicarboxylic acid and ethylenediaminetetraacetic acid. The $\gamma\text{-Fe}_2\text{O}_3$ was chosen since the earlier studies revealed that the dissolution kinetics of $\alpha\text{-Fe}_2\text{O}_3$ is slow and it is difficult to dissolve even by strong complexing agents, whereas $\gamma\text{-Fe}_2\text{O}_3$ dissolution is comparatively easier. This is due to the structural difference between these two oxides. The studies also revealed that the dissolution was partly influenced by the nature of the chelating agents but mainly controlled by the power of the reductants used in the formulation. The dissolution behaviour of $\gamma\text{-Fe}_2\text{O}_3$ under various experimental conditions is discussed and compared with that of magnetite in order to arrive at a suitable mechanism for the dissolution of iron oxides and emphasize the role of reductants in DCD formulations.

Phillip Smurthwaite and Colin Harrison
Investigation of a Superheater Multiple Tube Failure Incident at a CCGT Power Plant

An investigation was carried out into the failure of 30 of 33 HP superheater tubes that occurred during a single incident at a modern combined cycle gas turbine power plant. Metallurgical examination of a failed tube uncovered a multi-layered corrosion product that once cleaned revealed significant wall thinning of the sample tube. Analysis of the corrosion product revealed a grey inner layer containing the elements Na, Fe, P and O, possibly indicating the presence of maricite (NaFePO_4), covered by a dark outer layer probably of magnetite (Fe_3O_4). It is proposed that the tubes failed as a result of an acid phosphate corrosion mechanism caused by excessive liquid and contaminant carry-over from the HP steam drum. A liquid entrainment test was carried out during the course of the investigation that revealed a carry-over of approximately 2–3 %. Contributing factors to the failures included a minimal level of control instrumentation and substandard condition of the drum water/steam separation equipment.

VGB PowerTech e.V. Conference "CHEMISTRY IN POWER PLANTS 2004"

This year's VGB PowerTech e.V. Conference "Chemistry in Power Plants 2004" took place in Essen, Germany, on October 27–28, 2004. Here we present abstracts of all the papers presented at this conference.

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