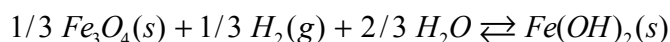


## Abstracts

**Stephen E. Ziemniak and Harmon M. Tunison**

### **Hydrothermal Synthesis of Maricite via Iron Oxide Decomposition in Sodium Phosphate Solutions**

Aqueous sodium phosphate solutions having Na:P atom ratios between 1.6 and 2.0 are shown to transform iron oxide ( $\text{Fe}_3\text{O}_4/\text{Fe}(\text{OH})_2$ ) into either of two sodium-iron-phosphate minerals: maricite ( $\text{NaFePO}_4$ ) or a member of the alluaudite group. Microchemical, infrared and Mössbauer spectroscopic analyses indicate that the latter compound has the approximate (single-phase) composition  $\text{NaFePO}_4 \cdot 4 \text{NaFe}(\text{OH})\text{PO}_4$ . Maricite formation was promoted by the imposition of dissolved hydrogen gas, which likely stabilizes a layer of hydrous iron(II) oxide on the magnetite surface:



On the basis of observed reaction threshold sodium phosphate concentration and temperature values for maricite synthesis via:



the standard entropy ( $S^\circ$ ) and free energy of formation ( $\Delta G_f^\circ$ ) for maricite were calculated to be  $157.3 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$  and  $-1419.4 \text{ kJ} \cdot \text{mol}^{-1}$ , respectively.

**Jan Stodola**

### **Fifteen Years of Equilibrium Phosphate Treatment (Correct Use of Phosphates in Drum Boilers)**

This paper explores differences between the Ontario Power Generation Inc. (formerly Ontario Hydro) and the EPRI concepts of equilibrium phosphate treatment (EPT). After a brief developmental history of the EPT method, the paper addresses the actual differences in the areas of boiler water alkalinity control and control of contaminants. In addition, the paper also discusses the fundamental behavior of sodium phosphates in pure solutions and in operating boilers to offer alternatives to the EPRI interpretation of the root causes of phosphate induced corrosion and hydrogen damage. The purpose is to rationalize safe chemistry control practices in boilers using sodium phosphates.

**Peter Angell**

### **Use of Microbial Kinetics to Control MIC in the Nuclear Industry**

In common with many other industries that use large quantities of water in nuclear power utilities have experienced piping degradation attributable to microbially influenced corrosion (MIC). The effects of MIC are generally associated with fire protection and cooling water systems, which may use large quantities of untreated water. Failure of these systems could lead to a forced shutdown of a nuclear

power plant. Existing countermeasures, which are often expensive and have a negative environmental impact, are not always adequate; however, lessons can be learned when MIC does occur.

This paper reviews a number of MIC failures discovered in nuclear power plants, as well as the associated failure mechanisms. Based on an understanding of the microbial kinetics involved in the failure, design and operational remedial measures are then explored. It is shown that a fundamental understanding of microbial growth kinetics can be applied to mitigate many MIC problems without the use of expensive and potentially environmentally damaging biocides.

**Michael A Sadler**

### **Condensate Polishing for Fossil Power Stations: A Review of Recent Work Aimed at Reducing Costs**

EPRI has for many years encouraged fossil power stations to use condensate polishing, as its use not only allows them to use more effective forms of water treatment but, also protects steam/water cycles. Many stations, however, still do not use condensate polishing and the reasons for this are believed to be the capital and operating costs involved. EPRI, therefore, initiated an "Innovative Condensate Polishing Program" aimed at identifying methods of reducing the capital and/or operating costs of polishing. The small team of specialists involved have now studied and prepared a guideline document on "Ammonium Form Operation". Appropriately used, this procedure can reduce operating costs of deep bed plants by 80–90 %. They have also prepared a guideline document on the use of "Off-Site Regeneration of Condensate Polisher Resins" as in some new plant situations this can result in a 20–30 % reduction in capital costs. Attention has been paid to reducing the cost of service vessels and in particular to the use of radial flow vessels, as computer studies have shown that their use can offer both cost and space savings. Other interesting innovative ideas are also being pursued and, as part of the program, a training course for station staff on condensate polishing has been developed and instruction is being given.

**Robert D. Bartholomew, David A. Cline, Jr., and Gary H. Roberts**

### **Renovation or Replacement of Existing Makeup Water Treatment Systems**

The renovation or replacement of existing makeup water treatment systems at power plants should consider both old and new treatment technologies, water usage, wastewater production, and the choice of permanent or leased equipment. These considerations are extensively discussed in EPRI's Revised Guidelines for Makeup Water Treatment. In this progress report, case studies are presented as examples of system selection for facilities with a zero liquid discharge requirement and makeup water supply limitations.

### **EPRI's Seventh International Conference on Cycle Chemistry in Fossil Plants**

Boiler water, feedwater, and steam purity are recognized as some of the most important considerations for ensuring availability and reliability of components in utility power generating systems. Localized corrosion damage in boilers and steam turbines has led to expensive and sometimes lengthy forced outages. This international conference will provide the industry with broad and expert experience in all aspects of cycle chemistry. The major conference theme is to review, document, and transfer technology on the most recent developments in understanding the root causes of the major corrosion-related failure mechanisms. Included will be the basics and experiences in fossil plant cycle chemistry and control including combined cycle/heat recovery steam generator (HRSG) units; it will combine the aspects of cycle and component design, metallurgy, operation, chemical

thermodynamics, sampling, and analysis. Presentations will be made by U.S. and international utilities, equipment manufacturers, and consulting and research organizations.

Detailed information about the conference (including the conference agenda) follows.

This year's conference will also be offering three additional workshops: Condensate Polishing Training Course Workshop, Managing Flow-Accelerated Corrosion (FAC) in Fossil Plants and HRSGs, and Water Chemistry Tutorial for Generators.

**Jan Stodola**

**Fünfzehn Jahre der Gleichgewichts-Phosphatfahrweise (richtige Anwendung von Phosphaten in Trommelkesseln)**

Dieser Beitrag untersucht die Unterschiede zwischen den Konzepten von Ontario Power Generation Inc. (früher Ontario Hydro) und EPRI bei der Anwendung der Gleichgewichts-Phosphatfahrweise (equilibrium phosphate treatment, EPT). Nach der kurzen Entwicklungsgeschichte der EPT werden die tatsächlichen Unterschiede bei der pH-Wert-Einstellung und der Beherrschung von Verunreinigungen angesprochen. Zusätzlich wird das Verhalten von Natriumphosphaten in reinen Lösungen und in Kesseln während des Betriebes beschrieben, um eine Alternative zu der EPRI-Interpretation von Ursachen der phosphat- und wasserstoffinduzierten Korrosion anzubieten. Es wird beabsichtigt, eine zuverlässige chemische Fahrweise bei der Phosphatanwendung sicherzustellen.

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