EXPIRED

IAPWS Certified Research Need - ICRN 7

Carryover Coefficients of Salts and Metal Contaminants in Boiler Water

The IAPWS Working Group - Physical Chemistry of Aqueous Solutions has examined the published work in the area of the volatility of salts and metals from aqueous solutions which is of interest to the electric power industry.

IAPWS recognizes that there is a requirement for work to be pursued in this field and has prepared this document to assist potential investigators obtain sponsorship. The knowledge of the volatility of the dissolved solids which constitute the chemical additives and corrosion products in the boilers of nuclear and fossil power stations is necessary to predict formation of damaging turbine deposits.

Although encouraging this work, IAPWS is not able under its statutes to provide financial support. The IAPWS contact can provide any further development information and will liaise between research groups.

Issued by the

International Association for the Properties of Water and Steam

President: **J.R. Cooper**
Queen Mary and Westfield College
London E1 4NS England

Executive Secretary: **Dr. R.B. Dooley**
Electric Power Research Institute
Palo Alto, California 94304 USA

IAPWS

IAPWS Certified Research Need - ICRN

Carryover Coefficients of Salts and Metal Contaminants in Boiler Water

Low concentrations of salts, dissolved silica, and various metal oxides are present in the boiler water of all nuclear and thermal steam generators. Although the volatility of the metal species is not high at temperatures below about 325 °C, the very high throughput of steam can lead to significant turbine deposits that can cause extensive damage (1,2). Copper and silicate deposits have been particularly troublesome. The problem is more severe in high-performance units operating at temperatures approaching the critical point of water because the volatility is higher.

"Carryover" coefficients define the distribution of dissolved solids between steam and liquid water (1,3). The concentration in the liquid phase is limited by the oxide solubility. The most troublesome oxides are those with a combination of high solubility and high carryover coefficient. The presence of complexing agents such as ammonia, acetate or chloride aggravates the problem by enhancing metal solubility through the formation of neutral species.

The measurement of carryover coefficients is technically challenging because of the very low concentrations, the difficulty in sampling the steam phase, and the corrosive nature of the fluids at operating temperatures of steam generators. Most of the original data in the ray diagram were measured in Russia, at a time when modern instruments for multi-element trace analysis such as ICP-MS were not available. The methods used are not well documented in the Western literature and the effects of complexes such as those involving carboxylate have not been examined. In addition, the measured concentration in both phases used to calculate the partitioning ratio are not given. Only the value of this ratio is shown in the ray diagram.

At this time EPRI is funding an experimental study of the volatility of soluble electrolytes such as NaOH, NaCl, H_2SO_4 and NH_4Cl (4). Future work on sodium and ammonium sulphates is planned. There is a major need for a parallel study of the volatility of copper and other metals as a function of pH and the concentration of NH_3, acetate, chloride and phosphate.

IAPWS

IAPWS Contact: Dr. Peter Tremaine
Head, Department of Chemistry
Faculty of Sciences
Memorial University of Newfoundland
St. John's, Newfoundland
A1B 3K7 Canada
Telephone: 709-737-8772
Fax: 709-737-3702

ICRN Issue Date: June 1994

ICRN Expiration Date: June 1997

Bibliography

1. O. Jonas, "Transport of Chemicals in Steam Cycles. Corrosion 85, NACE, Boston, Mass., paper 245, 1989.

2. W.T. Lindsay and P.K. Lee in *Proc. EPRI Conf. Corrosion Fatigue of Steam Turbine Blades*, 1981..

3. O.I. Martynova and B.S. Rogatskin, *Teploenergetica*, 17, 50-54, 1970.

4. J.M. Simonson and R.E. Mesmer, private communication.

IAPWS