

Abstracts

Hans Blöchl, Norbert Staub and Joachim Fahlke

20 Years of Reverse Osmosis at Grosskraftwerk Mannheim – Operating Experience

For makeup water production in Mannheim Power Station two makeup water treatment plants with integrated reverse osmosis are operated. The older system was commissioned in 1982 and the newer system was commissioned in 1996. These plants produce makeup water with electric conductivities below $0.2 \mu\text{S} \cdot \text{cm}^{-1}$ (at 25 °C). The production varies between $75 \text{ m}^3 \cdot \text{h}^{-1}$ and occasionally even $350 \text{ m}^3 \cdot \text{h}^{-1}$. For both systems, the raw water is the Rhine River bank filtrate. The overall raw water quality is very good. The level of organics is low with an average TOC below $1 \text{ mg} \cdot \text{L}^{-1}$.

Besides a description of the treatment technique, the paper gives a short overview of the different types of reverse osmosis membranes which have been used in both plants since the beginning of operation until today, and the operating experience that has been made with these membranes so far. In addition, there is a short description of a problem with a catalytic ion exchanger in one of the plants.

Andrew G. Howell and Sandra J. Lucero

Copper Deposition in Superheater Tubing

Copper deposits have frequently been observed in power station superheater tubing. Deposit density measurements were made on superheater specimens from a number of boilers of varying drum pressure, with results ranging from less than 0.1 to $215 \text{ g} \cdot \text{m}^{-2}$ (< 0.01 to $< 20 \text{ g/ft}^2$). The heaviest deposition was found in the primary section of the superheater. Microstructural observation indicates that the deposition is crystalline in form, consistent with a deposition mechanism from steam on an atomic growth basis, rather than with physical transport of solid particulates. Microanalysis demonstrated that the surface of some copper deposits were in oxide form, whereas others were metallic; the oxidation state of copper likely has significance regarding the extent of transport of superheater copper deposits to the high pressure turbine.

Ladislav Bursik and Albert Bursik

Inhibited Hydrofluoric Acid – an Effective Chemical Cleaning Solvent

Inhibited hydrofluoric acid has been used in Europe for 35 years for the preoperational and operational chemical cleaning of water- and steam-touched surfaces of steam generators and cycle components. The scientific studies on the dissolution of iron oxides in different acids were begun already in the 1950s; the most significant results, especially for hydrofluoric acid, were achieved in the 1960s.

Chemical cleaning with hydrofluoric acid has proven very successful in combination with the open circuit technique for supercritical once-through boilers. The advantages of the OC technique together with inhibited hydrofluoric acid are the fast dissolution of iron oxides, short application time, low temperatures (50 °C – 80 °C), and the relatively easy handling of wastewater.

The OC technique combined with the use of inhibited hydrofluoric acid is also used for parts of drum-type boilers and heat recovery steam generators.

Luda Nasri, Paul Leinonen, Frank V. Puzzuoli, and Dev Swami

OPG Operational Experience with Stator Conductor Bar Fouling

Over the last three years, Ontario Power Generation (OPG) Pickering Nuclear has experienced fouling of the stator conductor bar cooling water channels on two units. To address the associated stator bar temperature rises, chemical cleaning was undertaken three times on one unit and once on the other.

These events were the subject of two formal investigations and a single rigorous chemistry assessment. The investigations were conducted using a formalized root-cause protocol.

The assessment involved a system chemistry review over a 10-year period and a critical evaluation of dissolved oxygen control.

This paper describes:

- the internal investigations undertaken by OPG to better understand and resolve the problem,
- OPG's cleaning strategy and different cleaning options performed on affected units,
- the remedial actions undertaken by OPG, and
- The interim actions following the final post-cleaning inspections.

EPRI Publishes Revision 1 of the Cycle Chemistry Guidelines for Fossil Plants: All-Volatile Treatment

This contribution is a short review of the Revision 1 of the *Cycle Chemistry Guidelines for Fossil Plants: All-Volatile Treatment*, which was published in November 2002. This Revision is evaluated as a very important guide for all fossil utilities operating units on all-volatile treatment. Some of the attachments to the revision are also valuable for operators using other cycle chemistry treatments.

In publishing this Revision, EPRI has clearly demonstrated its leadership in the field of fossil plant cycle chemistry and chemistry of water and steam in general.

Steam Turbines – Steam Purity – A New Technical Specification Issued by the IEC

This paper is a short review of the IEC technical specification IEC/TS 61370, *Steam Turbines – Steam Purity* issued in June 2002. The review focuses on a comparison between the new technical specification and the classic EPRI and VGB plant cycle chemistry guidelines.

Ladislav Bursik and Albert Bursik Inhibierte Flusssäure - eine effektive Beizlösung

Inhibierte Flusssäure wird in Europa seit 35 Jahren für die Beizung (chemische Reinigung vor Inbetriebnahme) und chemische Reinigung des Wasser-Dampf-Kreislaufs und der Anlagenteile verwendet. Die wissenschaftlichen Untersuchungen zur Löslichkeit von Eisenoxiden in verschiedenen Säuren wurden bereits in den 50er Jahren durchgeführt, die wichtigsten Ergebnisse, insbesondere für die Flusssäure, wurden in den 60er Jahren erzielt.

Die Beizung und chemische Reinigung von überkritischen Zwangsdurchlaufkesseln mit Flusssäure haben sich – in Kombination mit dem Open-Circuit-Verfahren (OC-Verfahren) – als sehr erfolgreich erwiesen. Die Vorteile liegen in der schnellen Auflösung von Eisenoxiden, kurzer Anwendungszeit, niedrigen Temperaturen (50 °C – 80 °C) und der relativ einfachen Behandlung des Abwassers.

Das OC-Verfahren mit inhibierter Flusssäure wird auch für die Beizung bzw. chemische Reinigung von Kombianlagen (Abhitzekeesseln) eingesetzt.

Hans Blöchl, Norbert Staub and Joachim Fahlke 20 Jahre Umkehrosmose im Grosskraftwerk Mannheim – Betriebserfahrungen

In der Grosskraftwerk Mannheim AG wird das benötigte Zusatzwasser in zwei Aufbereitungsanlagen mit integrierter Umkehrosmose erzeugt. Die ältere Anlage wurde im Jahre 1982 und die neuere Anlage im Jahre 1996 in Betrieb genommen. Beide Anlagen produzieren Zusatzwasser mit einer elektrischen Leitfähigkeit von kleiner $0,2 \mu\text{S} \cdot \text{cm}^{-1}$. Die stündlichen Erzeugungsmengen schwanken zwischen $75 \text{ m}^3 \cdot \text{h}^{-1}$ und manchmal bis zu $350 \text{ m}^3 \cdot \text{h}^{-1}$.

Für beide Anlagen wird Uferfiltrat als Rohwasser verwendet. Die Wasserqualität ist insgesamt sehr gut, der mittlere TOC Gehalt liegt unterhalb von $1 \text{ mg} \cdot \text{L}^{-1}$.

Neben der Beschreibung der Verfahrenstechnik wird, von der Inbetriebnahme bis heute, im folgenden über Betriebserfahrungen mit den verschiedenen Membrantypen berichtet. Darüber hinaus wird ein Problem beschrieben, das wir mit dem katalytischen Ionenaustauscher in einer der beiden Anlagen hatten.

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