

Abstracts**The Effects of Steam Chemistry on the Condensation Process**

Miroslav Šťastný and Miroslav Šejna

A two-population numerical model of hetero-homogeneous condensation is used for the calculation of the wet steam flow with condensation in convergent-divergent nozzles. This computational model applies governing equations of the wet steam flow and equations of spontaneous nucleation. Parallel heterogeneous nucleation is evaluated on the assumption that heterogeneous water droplets originate by nucleation on chemical impurities (for instance sodium chloride) in the salt solution zone close above the steam saturation line. The calculation results of the flow in the nozzles with mean expansion rates of $4\,500\text{ s}^{-1}$ and $1\,000\text{ s}^{-1}$ in divergent nozzle parts are described and the effects of heterogeneous and/or spontaneous nucleation and condensation are discussed and compared with experiments. The concentrations of heterogeneous droplets were found by fitting of calculation results to experimental ones. A possible dynamic gradual origin of heterogeneous droplets during expansion was observed.

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Carbon Dioxide and Feedwater Chemistry

Robert Svoboda and Albert Bursik

In this paper, the influence of carbon dioxide contamination on the pH of condensate/feedwater at temperature in fossil plant cycles is investigated. It is shown that in particular at temperatures below 200 °C , automatic feedwater pH control (ammonia dosing) has to be adapted to the overall cycle conditions (e.g. to a carbon dioxide ingress into the cycle. While at higher temperatures the presence of carbon dioxide has nearly negligible influence on pH (at cation conductivity $\leq 2\text{ }\mu\text{S}\cdot\text{cm}^{-1}$), at temperatures lower than 200 °C , the pH at temperature may significantly decrease. Disregarding adequate pH (25 °C) control during periods with increased carbon dioxide content (increased cation conductivity) may create dangerous environmental conditions that favor flow-accelerated corrosion.

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Optimization of Chemistry in PWR and VVER Nuclear Power Plants

Francis Nordmann

This paper, based on international feedback and studies, proposes potential improvements for PWR and VVER operation:

- pH optimization in the primary coolant in order to minimize corrosion product transport/deposition and associated radiation exposure, crud induced power shifts (previously called axial offset anomaly), and fuel failure;
- use of enriched boron acid (enriched with ^{10}B) to easily optimize the above described pH, particularly with the increased use of higher fuel enrichments;
- zinc addition in the reactor cooling system;
- establishment of secondary water chemistry specifications which take into consideration the steam generator tubing materials and design to minimize corrosion risk while keeping sufficient plant availability and decreasing environmental impact;
- amine selection for the secondary system aimed at mitigating steam generator tube fouling, power loss and maintenance costs as well as corrosion risks;
- overall operating chemistry options designed to minimize environmental impact, such as elimination of condensate polishers and optimum ion exchange resin use.

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Automated Control of Chemistry Whilst under Cycling Regime at Teesside Power Station

J. Barry Hughes

Today a large number of power plants are run under cycling regimes. This calls for detailed control of the chemistry using automatic analysis and process control. The best determinant for analytical control has to be one that is directly measurable and controllable. A number of processes on the overall plant cycle at Teesside Power Station will be discussed and the reason for each determinant will be shown.

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A Comparative Account of the Wet Oxidation of Cation Exchange Resin with Hydrogen Peroxide Using Titanium, Vanadium, and Molybdenum Doped MCM-41 as Catalysts

Muthiah Puspha, Keezhanatham Srinivasan Seshadri, Pradeep Kumar Sinha, and Kamal Bihari Lal

Ion exchange resins are widely used in the nuclear industry for treatment of radioactive waste as well as for the upgrading of heavy water used in the primary heat transport system and moderator system. Repeated usage of the resins calls for replacement and treatment before disposal. The present work involves the application of metal-doped MCM-41 material as a catalyst for the wet oxidation of cation exchange resins using hydrogen peroxide as an oxidizing agent. The sulfate produced from the exchangeable group of the resin reflects the extent of decomposition and the carbonate produced reflects the extent of oxidation of the ion exchange resin. Results indicate that the percentage decomposition and oxidation increase with the weight of the catalyst and the volume of the oxidant, i.e., hydrogen peroxide. As much as 0.5 g of the resin could be decomposed by 12 mL of 30 % hydrogen peroxide to 98.7 % and oxidized to 99.25 % using molybdenum doped MCM-41. Vanadium doped and titanium doped MCM-41 required 14 to 16 mL for complete decomposition and 18 to 20 mL for complete oxidation of the ion exchange resin.

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The Measurement of Dissolved Oxygen in Condensate and Feedwater Circuits

Eric V. Maughan

Questions often arise about the calibration, verification, and maintenance of oxygen sensors. This paper offers an overview of the available systems and gives advice with respect to troubleshooting related to the on-line measurement of oxygen and to the storage of oxygen sensors.

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