

**Abstracts****Efficient, Sustainable, and Economical Plant Operation**

Francis Nordmann

Nuclear power plant operation has to be improved in regard to its environmental impact and economical performances. Chemistry may bring its own contribution to such improvements through several approaches:

- corrosion minimization, which always brings improved safety and availability of the nuclear power plant (NPP),
- a chemistry specifications update which takes into account the development of new designs and materials,
- shorter shutdown duration thanks to optimized processes,
- costs and maintenance reduction through better operating modes.

This paper describes the most important approaches to achieve the above objectives. The first one deals with the integrity of the fuel and the mitigation of crud-induced power shifts. Primary water chemistry purification and shutdown process improvement, particularly hydrogen elimination, is a way of decreasing dose rates and increasing availability.

The secondary water chemistry specifications should be modified to achieve the progressive elimination of sensitive materials, particularly Alloy 600 MA, from steam generators in order to increase flexibility in operation and particularly to decrease costs and environmental impact. Condensate polishers should be used only when this appears necessary, thus decreasing pollution risks by regeneration reagents and resin fines, operating costs and wastes, and consequently environmental impact.

The secondary water chemistry may, under certain circumstances, allow a better recycling and a longer ion exchange resin duration. The best all-volatile treatment (AVT) selection is beneficial for reducing the maintenance costs of sludge lancing and of chemical cleaning and for maintaining a sufficient thermal heat transfer, which is the main issue with resistant materials and proper chemistry.

Finally, material and design development also allows a reduction in the monitoring analyses program, and thus costs reduction.

The paper reviews the main useful trends observed from a 58 unit French fleet and worldwide experience.

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**The Mechanism of Action of Isothiazolone Biocides**

Terry M. Williams

Isothiazolone biocides have proven efficacy and performance for microbial control in a variety of industrial water treatment applications. Understanding the mechanism of action of industrial biocides is important in optimizing their use and combating resistance if encountered. Isothiazolones utilize a two-step mechanism involving rapid inhibition (minutes) of growth and metabolism, followed by irreversible cell damage resulting in loss of viability (hours). Cells are inhibited by disruption of the metabolic pathways involving dehydrogenase enzymes. Critical physiological functions are rapidly inhibited in microbes, including growth, respiration (oxygen consumption), and energy generation (adenosine triphosphate synthesis). Cell death results from the destruction of protein thiols and production of free radicals. The rate and extent of killing may be enhanced by various adjuvants including surfactants. This unique mechanism results in a broad spectrum of activity, low use levels, and difficulty in attaining resistance.

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**Mandatory and Desirable Instrumentation in PWR and BWR Units**

Fred Böttcher and Wilfried Rühle

In national and international guidelines, chemical parameters are described that are important for safe and reliable plant operation. Modern light water reactors are equipped with online analysers for those chemical parameters which directly indicate operational or technical incidents. Chemical parameters that represent technical specifications should also be monitored by online analysers. More chemical parameters exceeding the routine surveillance programme are important for long-time integrity of the systems and components or are necessary for design-based peculiarities.

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**Development and Application of Gas Sensing Technologies for Combustion Processes**

Sheikh Akbar and Prabir Dutta

Identifying gas species and their quantification is important for optimization of many industrial applications involving high temperatures, including combustion processes. CISM (Center for Industrial Sensors and Measurements) at the Ohio State University has developed CO, O<sub>2</sub>, NO<sub>x</sub>, and CO<sub>2</sub> sensors based on TiO<sub>2</sub> semiconducting oxides, zirconia and lithium phosphate based electrochemical sensors and sensor arrays for high-temperature emission control. The underlying theme in our sensor development has been the use of materials science and chemistry to promote high-temperature performance with selectivity. This article presents key results of our studies on CO, NO<sub>x</sub>, CO<sub>2</sub> and O<sub>2</sub> sensors.

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**Stability of Gadolinium in Aqueous Solutions in the Presence of Impurities**

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Gadolinium (Gd<sup>3+</sup>) in the concentration range of 0.05–20 mg · kg<sup>-1</sup> is used as a soluble neutron absorber in the moderator systems of many pressurized heavy water reactors. A pH<sub>ap</sub> range of 5–5.5 is specified for the moderator heavy water as Gd<sup>3+</sup> is in solution only in acidic pH conditions. This paper presents studies on the removal of gadolinium from solution at pH values less than 5.5 by the trace level impurities in the water. Studies carried out in normal water (H<sub>2</sub>O) and heavy water (D<sub>2</sub>O) indicated that gadolinium can be removed from solution by colloidal non-reactive silica. The colloidal non-reactive silica, which consists of aluminosilicates, picks up the gadolinium even at pH 4.5. The results of the absorption experiments and X-ray photoelectron spectroscopic analysis of the residue collected after adsorption are presented in this paper.

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**2006' Scientific and Technical Contributions**

As every year, the January issue closes with abstracts of all the articles published in this journal in the last year. Back issues of our journal are – with few exceptions – still available; interested parties can receive PDF files of all articles by e-mail. The order forms may be downloaded from our homepage.

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