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Abstracts

Effects of Water Chemistry on Flow Accelerated Corrosion and Liquid Droplet Impingement Accelerated Corrosion

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Overlapping effects of flow dynamics and corrosion are important issues in determining the reliability and lifetime of major structures and components in light water reactor plants. Flow accelerated corrosion (FAC) and liquid droplet impingement (LDI) accelerated corrosion (LDI (corrosion)) are typical phenomena resulting from both interactions. In order to evaluate local wall thinning due to FAC and LDI (corrosion), a 6-step evaluation procedure for each has been proposed.

(1) Obtain the flow pattern along the flow path with a 1D computational flow dynamics (CFD) code.
(2) Calculate corrosive conditions, e.g., oxygen concentration along the flow path, with a oxygen-hydrazine reaction code for the FAC evaluation. Calculate the flow pattern of liquid droplets in high velocity steam and determine the possibility of their collision with the pipe inner surface for the LDI (corrosion) evaluation.
(3) Calculate the mass transfer coefficients at the structure surface with a 3D CFD code for the FAC evaluation. Calculate the frequency of oxide film rupture due to droplet collision for the LDI (corrosion) evaluation.
(4) Evaluate high risk zones for FAC and LDI (corrosion) occurrence by coupling major parameters.
(5) Calculate wall thinning rates with the coupled model of static electrochemical analysis and dynamic double oxide layer analysis at the identified high FAC and LDI (corrosion) risk zones.
(6) Make a final evaluation of residual life and the effectiveness of countermeasures.

It was demonstrated that the calculated FAC rates had good agreement with the measured rates. Further investigation of the accuracy of the LDI (corrosion) evaluation procedures is currently in progress.

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Cost-Effective New Liquid Halogen Biocide with Better Performance and Reduced Corrosivity
Sang-Hea Shim

Halogen biocides, though widely used and largely effective, are corrosive and are unsatisfactory in controlling surface-attached microbes, such as slime. A newly patented product, composed of stabilized chlorine and unreacted bromide, controls surface-attached microbes, is much less corrosive and is much more cost-effective than other halogen biocides.

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Bulgarian Experience with the Implementation of ^{235}U Enriched Fuel in WWER-1000 Units
Ivan Dobrevski and Neli Zaharieva

This paper reports on the results of the implementation of TVSA fuel assemblies with up to 4.3 % ^{235}U enrichment and an integrated burnable absorber (Gd) (U-Gd_2O_3 fuel with 5 % Gd_2O_3) in WWER-1000 reactors at Kozloduy Nuclear Power Plant in Bulgaria. Data from the first cycle with 100 % TVSA assemblies show that plant staff was able to maintain the coolant water chemistry within the range demanded by the plant's primary circuit water chemistry requirements. Data indicate that the corrosion processes in the primary circuit remained on the same low level as during previous cycles.

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Comparison of Different Technologies for the Quantitation of Total Mercury in Complex Waste Streams
Russell Gerads and Jacob Meyer

Multiple methods promulgated by the EPA for compliance monitoring of mercury in wastewater were investigated and compared to cold vapor inductively coupled plasma mass spectrometry. This study was performed to identify the limitations and benefits associated with each analytical method and to identify how varying waste streams can induce method failures.

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Simulation of a Base Case for Future IGCC Concepts with CO_2 Capture

Christian Kunze and Hartmut Spliethoff

The simulation of complex IGCC (integrated gasification combined cycle) plants is a useful tool for the evaluation of new technologies and the identification of further potential. As part of the HotVeGas project this paper deals with the modelling of an IGCC plant with CO_2 capture using technology believed to be available beyond 2020. The concept developed will be the base case for comparison of emerging technologies and improved process integration. As simulation tools Aspen Plus is used for the gasification island and gas processing while Ebsilon Professional is applied for modelling the combined cycle.

The base design is a dry feed gasifier with full water quench, air side non-integrated air separation unit, 2-stage CO conversion, acid gas removal and combined cycle. The main processes are simulated in detail considering phenomena such as: heat and pressure losses, electrolytic dissociation, non-equilibrium, pH and gas solubility. The models are all verified by manufacturer information. The model developed is found to be capable of simulating complex gasification applications. Furthermore, the optimum quench water temperature should be in the area of 165 °C. In the case of lignite the fluidized bed drying plant condensate as an alternative quench water source reduces efficiency by 0.3 % The compression of the Claus tail gas along with the CO_2 is efficient but reduces the purity of the stream. Therefore recycling of tail gas is recommended. The concept is adapted for generic hard coal as well as lignite and estimates an efficiency of approximately 37.0 % and 39.9 %, respectively.

Finally, an outlook on strategies for developing more efficient and reliable IGCC concepts is given. Major potentials for IGCC improvement are expected for integrated hot gas cleanup, for implementation of membranes and fuel cells as well as for integration of synthesis of chemicals.

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PPChem 101 – Boiler and HRSG Tube Failures
Lesson 3: Underdeposit Corrosion – A General Introduction

R. Barry Dooley and Albert Bursik

University 101 courses are typically designed to help incoming first-year undergraduate students to adjust to the university, develop a better understanding of the college environment, and acquire essential academic success skills. Why are we offering a special *Boiler and HRSG Tube Failures PPChem 101*? The answer is simple, yet very conclusive:

– There is a lack of knowledge on the identification of tube failure mechanisms and for the implementation of adequate counteractions in many power plants, particularly at industrial power and steam generators.
– There is a lack of knowledge to prevent repeat tube failures.

The vast majority of BTF/HTF have been, and continue to be, repeat failures. It is hoped that the information about the failure mechanisms of BTF supplied in this course will help to put plant engineers and chemists on the right track. The major goal of this course is the avoidance of repeat BTF. This third lesson is focused on underdeposit corrosion of water-touched tubes in conventional boilers and in the high-pressure evaporators of heat recovery steam generators.

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