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Abstracts

Failure Analysis of Austenitic Stainless Steel Piping in Boiling Water Reactors – Root Cause and Remedies

Ulf Ilg

In stainless steel piping DN 150–250 mm (DN, diameter nominal, metric equivalent to NPS, nominal pipe size) of German boiling water reactors, intergranular cracks in the heat affected zones of titanium-stabilized material have been detected. The piping systems are connected with the reactor pressure vessel and characterized by permanent reactor water flow at 288 °C.

Crack susceptibility is based on local sensitization. The present sensitization mechanism is due to a sequence generating free carbon caused by dissolution of Ti carbides followed by precipitation of chromium-rich carbides at the grain boundaries. This occurred during formerly used manufacturing processes about 20 years ago.

All affected piping systems were replaced by an optimized niobium-stabilized austenitic steel with low-carbon content and a high niobium to carbon ratio. Well controlled manufacturing and welding procedures with a good root weld quality were realized. In addition to this, reactor water chemistry was improved.

In the measures above, the total number of stainless steel welds DN > 50 mm within the containment was drastically reduced from about 450 to about 100. All nondestructive tests performed with the piping lines under discussion confirmed a condition without indications.

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Power Industry Application of Condensate Polishing Technology

Kevin J. Shields and Michael A. Sadler

Condensate polishing was originally valued in power cycles as it offered protection against the impurities that entered the steam/water circuits. Its use also shortened the time necessary to start up the units. In addition, polishing permits fossil units to use more effective methods of cycle chemistry treatment. This is now recognized as a very important advantage. There are now various condensate polishing plant configurations in use around the world, but these have not changed significantly for some time. EPRI has initiated an investigation of innovative polishing techniques that may lower capital and operating costs and simplify operation so that future polishing systems are suitable for use on fossil (conventional or combined cycle) plants.

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Degassed Conductivity – Comments on an Interesting and Reasonable Plant Cycle Chemistry Monitoring Technique
Part 3: Degassing of Strong Inorganic Acids and a Final Assessment

Miroslaw Gruszkiewicz and Albert Bursik

This is the third part of a three-part publication focusing on the behavior of typical plant cycle contaminants during degassing in a typical degassed cation conductivity system. A rigorous thermodynamic approach was chosen for the evaluation of conditions in the degassing part of the system. As shown in Part 1, low-molecular acids are not removed during the degassing; carbon dioxide, however, is nearly completely removed (Part 2). In this part of the series, it is demonstrated that the relevant strong inorganic acids are not lost in the degassing device.

Degassed cation conductivity monitoring is not as common as specific and cation conductivity monitoring even though this technique offers some very interesting features. As shown in the case studies discussed, this technique can help to distinguish between plant cycle contamination due to inorganic and/or organic acids and/or their salts and that caused by carbon dioxide. This may be important, e.g., during startup of a unit.

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Avoiding Costly Water Treatment Mistakes in Combined Cycle Power Plant Projects

Luis Carvalho

In a typical power plant, water treatment is a relatively small slice of the operating budget, generally less than 2 % of the total cost of operation. However, its impact on the plant heat rate, net capacity factor and ultimate profitability can range from significant to disproportionately high. One area of particular concern is the high-purity water requirement in various areas of an increasingly complex power plant cycle. This ranges from several boiler feedwater loops to combustion turbine NOx control and combustion air-cooling.

Plant owners, developers, owners' engineers, and engineering/constructor firms often fail to understand the multitude, interaction and complexity of water treatment technologies (both equipment and chemical based) available in the market place today and how best to incorporate them at the design phase of the project. Equipment selection is also often made with complete disregard to the alternate use of more technically feasible and cost-effective chemical-based treatment options. The end result is plant designs unable or barely capable of meeting the performance specifications of critical equipment such as steam and gas turbines even during the start-up phase, leading to start-up delays and legal disputes, and later translating into high water treatment operating costs, plant downtime and potential expensive plant modifications.

This paper discusses water treatment technologies such as membrane separation (e.g., reverse osmosis), electrodialysis and electrodeionisation, and the fading yet unique role that ion exchange can play. It also addresses the critical role that well-qualified chemical water treatment companies can play in avoiding costly mistakes during power plant design, how to best fit chemical treatment options, and what can go severely wrong when the raw water to the plant is not critically evaluated.

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Developments in On-Line Instrumentation

Eric Maughan

In this paper, some useful advice and answers to frequently asked questions are presented with respect to common problems occurring in the on-line monitoring of fossil plant cycle chemistry. Focus is on monitoring of the three most important cycle chemistry parameters, conductivity, oxygen content, and pH.

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On-Site SCR Catalyst Rejuvenation Process as Part of a Catalyst Management Plan

Klaus Weigl, Christopher C. Ayers, Ludwig Gockner, and Josef Tauschitz

The on-site catalyst rejuvenation process is a highly efficient tool to reduce operating and maintenance costs for lifetime extension of catalysts for selective catalytic reduction (SCR) of NOx compared to catalyst exchange and/or additional catalyst installation. Depending on the type of deactivation, the process is fit to the requirements based on our experience. Thus the tailor-made process can handle deactivation types like pluggage, alkali and earth alkaline depositions, and more. One of the important constraints is to perform the rejuvenation on-site within the given outage of the boiler to reduce any additional costs and risks. New results from rejuvenations performed on SCR catalysts from coal and oil fired units are presented. A cost analysis compared to the additional catalyst installation is given as part of a catalyst management plan.

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