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ABSTRACTS

On-Line, Continuous Measurement of Makeup and Cycle Water "Particulates" at Low Parts per Trillion Levels

Robert L. Bryant

The effects of "particulate" material in makeup and cycle waters are frequently seen throughout the steam generation process. Problems such as reduced equipment performance in reverse osmosis or demineralizer systems due to colloidal material in feedwater or deposition of corrosion products on water-touched surfaces resulting in tube failures are often difficult to analyze and mitigate due, in part, to the lack of "real time" particulate monitoring and data collection. This paper presents basic technologies used for continuous detection of particulates at very low (parts per trillion) levels, and how this information can be used to improve boiler reliability. Case histories are presented where on-line particulate measurement defined the source of a problem, quantified the severity of the problem and provided a solution to the problem. It also discusses the possibility of using the measurement in conjunction with other chemistry parameters to optimize corrosion control additives in the steam/water cycle.

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Organic Plant Cycle Treatment Chemicals – A PowerPlant Chemistry Interview

The editor interviews Wolfgang Hater

In the last ten months, nine papers have been published in this journal dealing either exclusively or largely with the behavior of organics in the fossil plant cycle. Surprisingly, the major focus of these papers is not on natural organics, extractables, or leachables from ion exchange resins; organic plant cycle treatment chemicals are the main theme. As you might expect, these papers are not able to address all aspects of this very complex topic. The fact that such papers are written, read, and discussed substantiates the need for more information relating to this subject. For this reason, PowerPlant Chemistry has decided to contact major suppliers of organic plant cycle treatment chemicals and ask them the questions that we have received from our readers. This time, our interviewee is Wolfgang Hater representing BK Giulini GmbH.

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Condensate Polishing and Combined Cycle Gas Turbines – Technical and Financial Justification and Appropriate Technology Selection

David Addison and Les Lloyd

Whilst the technical justification for the inclusion of a condensate polisher in a combined cycle gas turbine (CCGT) new generation project is simple and straightforward with the benefits of condensate polishing clearly understood, very few projects worldwide are specified and constructed with a condensate polisher. This situation often arises because the robust financial justification and cost benefit analysis required for the inclusion of a condensate polisher in a project often cannot be completed with the required level of detail to withstand the intense financial scrutiny of new CCGT projects.

Available condensate polishing technologies are reviewed with budget estimates provided for each key technology type. Technical and financial justification methodologies for the inclusion of condensate polishers in CCGT projects are outlined and discussed. The cost of condensate polishing in a new CCGT project is shown to be approximately 1 % of the cost of a standardised, new CCGT unit.

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A Higher Chromium Weld Overlay Alloy for Waterwalls and Superheaters

Larry Paul and Gregg Clark

The use of corrosion resistant weld overlay materials has proven to be a very effective method to extend the life of boiler tubes in coal-fired boilers. In order to properly select the best material as a weld overlay, the demands placed upon the material need to be understood. The required material properties for a weld overlay can change with boiler design (such as once-through versus drum boilers), tube function (evaporator versus superheater tubes), and for various regions within the boiler (such as elevation or proximity to over-fire air ports). Material properties that need to be considered include the physical, mechanical, and corrosion properties, as well as the cost and ease of fabrication. The score card in some of these areas has been less than desired for certain weld overlay materials. Nonetheless, there are usually multiple material choices that will work in most cases. When multiple choices are available, asset owners will generally select the material with the most experience. Since its introduction in 2003, Alloy 33 has continued to gain positive experience as a weld overlay in coal-fired boilers and is therefore gaining acceptance within the industry.

In the furnace region where combustion occurs, the waterwall tubes are exposed to high heat inputs along with corrosive combustion gases and deposits. These conditions can cause rapid corrosion by a mixed sulfidation/oxidation mechanism. The corrosion rates increase further if low NOx combustion practices are used, since this causes a reducing atmosphere that forms more corrosive sulfur species such as H_2S gases and FeS deposits. The corrosion rates increase with tube metal temperatures, which are controlled by the local tube pressure as well as the operating practices (i.e. heat flux rates). In the highest pressure units that operate above the water triple point (supercritical plants) cracking can sometimes also be an issue. This cracking is caused by a corrosion fatigue mechanism and is generally referred to as "circumferential cracking" in the industry. After 5 years of operation in multiple boilers, the high chromium Alloy 33 continues to perform very well with excellent resistance to both corrosion and cracking.

In the convection pass of boilers, high temperature corrosion can severely limit the life of tubing, particularly if a coal ash corrosion (molten salt) mechanism is operating. Some recent investigations have identified carburization and sulfidation as serious problems for convection pass tubes. Corrosion problems in the convection pass area seem to be aggravated by low NOx firing; the completion of combustion further up in the boiler fundamentally changes the corrosive environment that superheater and reheater tubes face. Fortunately, the resistance to all of these forms of corrosion has a common thread: increasing the chromium content of a material increases resistance to carburization, sulfidation, and coal ash corrosion. Because of its high chromium level Alloy 33 has been gaining increasing interest for use on high temperature convection pass tubing. Alloy 33 has been seen to resist corrosion in oil-fired boilers, black liquor recovery boilers, and of course in coal-fired boilers; the previously mentioned corrosion mechanisms operate in these other boiler types as well. Alloy 33 has now been in commercial service for over 3 years and continues to gain positive experience in the field.

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Cycle Chemistry for Eskom's New 4 800 MW Supercritical Stations

Kenneth J. Galt

Eskom has begun building two giant new power stations: one, Medupi, in the Limpopo Province, and the other, Kusile, in the Mpumalanga Province of South Africa. Design and specification of a third station, as yet unnamed but designated Coal III, also to be located in Limpopo Province in the vicinity of Medupi and the existing Matimba Power Station, are already at an advanced stage. Each of these new stations consists of 6 x 800 MW (approx.) supercritical boilers with air-cooled condensers; the first units are scheduled to come on-stream in 2011, 2012 and (tentatively) 2014, respectively. The paper discusses the evolution of the cycle chemistry to be applied at these stations as well as its control and monitoring.

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PPChem 101 – Boiler and HRSG Tube Failures
Lesson 1: Boiler and HRSG Tube Failures – Introduction and Background

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 first lesson is intended as the introductory lecture of this course. For this reason, this lesson does not include any details related to individual tube failure mechanisms. This is reserved for the following lessons, which will deal with the individual mechanisms introduced in this lesson.

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