PowerPlant Chemistry®

International Edition ISSN 1438-5325 Volume 12 (2010), No. 6
June

Abstracts

Brackish and Seawater Desalination for Process and Demineralised Water Production for Large Power Plants in the North Sea Region

Rolf Nagel and Jürgen Brinkmann

Large power plants for power generation from fossil fuels are constantly being optimised in order to improve their efficiency. One element of the overall considerations is once-through cooling with brackish or seawater on sites near the sea. In addition to the higher overall efficiency, such sites – thanks to their connection to ocean shipping – also offer infrastructural advantages regarding fuel supply and residual material disposal compared to inland sites. Because the cooling water intake and discharge structures have to be built anyway, they lend themselves to also producing the process and demineralised water from the brackish or seawater. In this case, the use of fresh or drinking water as resources can be minimised. In the following report, we present a pilot study using ultrafiltration and reverse osmosis on a North Sea site with raw water intake from a seaport basin.

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Report on the BIAPWS 2010 Workshop and Symposium on Power Plant Chemistry

Paul McCann and Mark Robson

The British and Irish Association for the Properties of Water and Steam held its annual Workshop and Symposium on Power Plant Chemistry on 20–21 April 2010 at Chilwell, Nottingham. Summaries of the proceedings at the event are provided.

PowerPlant Chemistry 2010, 12(6)

Corrosion Control in HRSGs – The Influence of Flexible Operation Regimes

Geoff Bignold

Many of the combined cycle plants in operation were designed and originally operated for base load operation. However, changes in fuel prices and in the overall margin of plant availability over demand have led to many units operating repeatedly at low load and with many shut-down/start-up cycles. It has become essential to understand and manage the additional complexities that derive from such operation.

On the waterside, the optimisation of the design for full load operation can lead to non-optimal thermal conditions at low load. Short term shut-downs can cause large scale accumulation of condensate in superheaters and reheaters. Longer term shut-downs require consideration of storage regimes that minimise corrosion. Cyclic operation can cause additional transport of iron oxides within the circuit and can occasionally lead to corrosion fatigue failures. There are differences of behaviour between vertical duct and horizontal duct designs, which require different approaches to the storage options.

On the gas side, flexible operation frequently results in surface temperatures that are low enough to yield acidic dew formation. The resulting corrosion product on finned steel tube surfaces is porous and voluminous. It can impact upon heat transfer and lead to increased gas side pressure drop. Acid induced stress corrosion cracking has occasionally been observed. Approaches to the control of these problems remain to be improved to the point at which they can be regarded as solved.

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Simultaneous Oxidation and Carburization under Oxyfuel Conditions

Daniela Huenert, Wencke Schulz, and Axel Kranzmann

The combustion of coal in CO_2-reduced oxyfuel power plants requires creep resistant and corrosion resistant materials which can withstand high temperatures up to 600 °C (873 K) and CO_2-rich atmospheres. Among the heat resistant materials, the 9–12 % chromium steels have been proven to resist high wall temperatures in conventional power plants and are suitable as membrane walls, superheaters and steam piping.

During oxyfuel combustion a flue gas is generated which consists mainly of H_2O (x_{H_2O}=0.3) and CO_2 (x_{CO_2}=0.7). The present paper is focused on the corrosion of 9–12 % chromium steels under oxyfuel conditions in a temperature range between 550 °C (823 K) and 625 °C (898 K).

Depending on the chromium content of the 9–12 % chromium steels, carburization of the base material, perlite formation and carbide formation were observed. Alloys with lower chromium content form a non-protective oxide scale with perlite at the scale–alloy interface. Steels with 12 % chromium have a small growing oxide scale with enlarged $M_{23}C_6$ particles at the scale–alloy interface. The carburization of the base material is found to be increased for the 9 % Cr steel. Higher pressure of the flue gas results in the formation of less resistant scales and causes accelerated carburization of the base materials. However, the carburization has an impact on the mechanical properties at the surface and leads to an embrittlement, which is deleterious during thermal cycling.

Oxidation kinetics, phase analysis of the scale (transmission electron microscope) and carburization depths (microprobe) of the base materials are presented.

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Possibilities of the Acoustic Emission Method for the Detection of Flow-Accelerated Corrosion

Václav Koula, Martin Dráb, and Michal Havavka

The text presents possibilities for the detection of flow-accelerated corrosion (FAC) using the method of acoustic emission on power plant steam piping with steam pressures of 1.5–6.0 MPa and temperatures up to ca. 300 °C. A continuous acoustic emission (AE) signal sampling at the frequency of 2 MHz allows use of the current methods of signal analysis. AE signals were acquired both on steam piping in the unaffected state (without the FAC processes) and on locations where currently active FAC processes have already been confirmed (by measuring of the steam piping wall thickness). Data analysis revealed the spectral time variance (STV) parameter, which allows the detection of the FAC process during power plant operation. Based on this a special-purpose STV analyzer with very simple handling, allowing immediate evaluation of the acquired data, was designed and constructed. Its usage allows steam pipeline sections to be searched for active FAC processes during power plant operation. This helps refine the plans for time-consuming and expensive measurement of the wall thickness of the steam pipeline segments during operational shutdowns of the power plant blocks. It is possible to continue periodical measurements in places of already active FAC and in this way to monitor the FAC trend. Described procedures help reduce the costs for identification of the steam pipeline sections with active FAC and increase the safety of power plant operation.

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PPChem 101 – Boiler and HRSG Tube Failures
Lesson 5: Acid Phosphate Corrosion

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 sixth lesson is focused on acid phosphate corrosion of water-touched tubes in conventional boilers and in the high-pressure evaporators of heat recovery steam generators.

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