

ABSTRACTS

Flow-Accelerated Corrosion in Fossil and Combined Cycle/HRSG Plants

R. Barry Dooley

By the early 1980s there was thought to be consensus on the understanding of FAC along the following lines. Magnetite is the oxide which grows on carbon steel surfaces in the feedwater up to about 280 to 300 °C (536 to 572 °F) under low oxygen (now defined as reducing) conditions. Under most operating scenarios with laminar flow (thicker fluid flow boundary layer) the oxide is protective where its growth is usually exactly balanced by its dissolution of mainly ferrous ions into the flowing water or steam/water mixture. Depending on the temperature its thickness may reach 15–25 µm but at temperatures below about 150 °C (302 °F) it can be very thin. Magnetite growth is controlled by the local cycle chemistries, which at that time were not defined as clearly as today. Wherever turbulent flow conditions exist as a result of local geometries, the dissolved ferrous ions are more rapidly removed from the surface. This process is balanced by an exact growth of more magnetite on the carbon steel surface. This faster oxide removal equates to a faster overall corrosion process (FAC) and thinner remaining magnetite on the surface (can be as thin as a few ångström, or equivalent to an interference film). FAC only occurs in water and water/steam mixtures and not in dry steam, and there is no mechanical damage to the metal as in liquid droplet erosion and cavitation. By the early 1980s the influences of the following factors on FAC had already been identified and, in some cases, quantified: pH, dissolved oxygen, reducing agent (earlier called oxygen scavenger), temperature, mass transfer, and alloying element composition.

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Closed Cooling System Treatment: Using Phosphinosuccinate Oligomers (PSO) as an Alternative to Molybdate

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Recently, there has been much interest in greener alternatives to molybdate to control corrosion in closed cooling water systems. Driving forces such as environmental restrictions and the cost of molybdate have made the use of molybdate less desirable. This paper discusses the use of phosphinosuccinate oligomers (PSO) in closed cooling water systems. The use of PSO and factors affecting the use of PSO are described, based on laboratory work and field studies.

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Using Particle Counters for Pretreatment Optimization, Iron Transport Monitoring, Condenser Leak Detection, and Carryover Monitoring – A Synopsis of Experiences

Robert L. Bryant

Steam generating systems all require clean water. The effects of particulate material in the steam/water cycle on metal corrosion, erosion, cracking, and deposition are frequently observed. However, the physical/chemical mechanisms are often difficult to correlate with a specific plant event, since the periodic "grab" samples from various areas of the water/steam process which are generally conducted do not allow real time continuous on-line particulate monitoring and data collection. This paper introduces the concept of using particulate measuring instruments to monitor the steam generation cycle, and presents case histories of real world plant situations where on-line particulate measurement using particle counters and particle monitors has defined the source of a problem, quantified the severity of a problem, and provided a solution to a problem.

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Mass Transfer and Deposition of Impurities in Steam Turbines

James C. Bellows

Mass transfer is a critical part of the process of deposition of impurities in turbines. Metal surfaces have numerous atomic level irregularities that can act as nucleation sites. Once a deposit crystal is nucleated, the growth is limited by the rate at which material can be brought to the surface. This rate is a function of the steam properties and the properties of the molecule being deposited. The important molecular properties are the diffusivity and the solubility in steam. Absolute deposition rates can be calculated with no adjustable parameters.

Silica is relatively soluble in steam. Its deposition rate and redissolution are presented. The implications for deposition patterns and turbine efficiency are explored. Deposition rates are compared with studies in surface roughness to estimate the rate at which efficiency may be lost.

Sodium chloride is much less soluble in steam than is silica. In most cases, once the sodium chloride is deposited, it will remain on the turbine until it is washed off. The quantities of salt actually deposited will be examined. The corrosion implications of the sodium chloride deposition are examined.

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PPChem 101 – Fossil Cycle Chemistry**Lesson 1:****What Is Plant Cycle Chemistry and Why Is It Important for Steam and Power Generating Plants?**

This is the first lesson of our PPChem 101 program "Fossil Cycle Chemistry." The major task of the program is to help all non-chemists responsible for chemistry-related tasks, all power industry newcomers, and all engineers, whether chemists or non-chemists, to learn the fossil cycle chemistry basics.

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