VIEW FROM THE PENTHOUSE

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VOL. XX, No. II June 2003 **Subject: Affects of Chlorine on Stainless Steel**

Affects of Chlorine on Stainless Steels

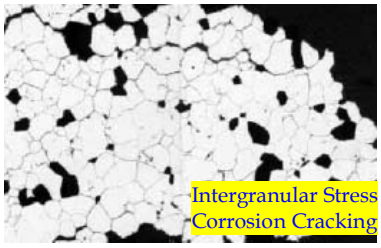
Introduction

Chlorine plays two major roles in the damage and failure of stainless steel components. The stainless steels for discussion are the austenitic grades; commonly 304, 309, 310, 316, 321, 347, etc. These are commonly used in boilers for their high temperature strength and excellent corrosion resistance. However, in the presence of chloride containing species, two forms of damage occur; first, stress corrosion cracking requires both a stress and a chloride concentration of critical amount for stress. Second, in the fireside low melting point species of chloride, for example Zinc, Lead, and Iron will dissolve the protective oxide scales. With the loss of the Chromium rich oxides, corrosion rates can rise dramatically.

On rarer occasions, both problems can occur. For example, when trash burner water washes the superheater, the chlorides dissolve in the water, run down the pendants and collect at the bottom. If the bends have been fabricated without proper heat treatment residual stresses from the cold working may be sufficient to trigger failures by stress corrosion cracking.

Stress Corrosion Cracking

Stress Corrosion Cracking (SCC) needs both a stress and aqueous solution containing chlorides. Two primary sources for these contributing species are; (1) contamination from chemical cleaning and (2) carryover of volatile chemicals from the boiler. The concentration required to trigger the cracking mechanism is inversely proportional to the stress. That is, the higher the stress the lower the concentration and the lower the stress the higher the concentration required for cracking to occur. The applied stresses may be either or both; for example, the hoop stress in a tube from the internal steam-water pressure for a residual stress from cold work. The most common occurrence develops at room temperature where obviously water is a liquid and present. It can occur at higher pressures but again water needs to be liquid for the damage to occur. Removing either the stress or the chlorides will prevent cracking.



Intergranular Stress Corrosion Cracking

Fireside

Low melting point species rich in chloride will dissolve the protective chromium rich scale and lead to rapid wastage. Temperatures above the melting point of the chlorides are required so these species are liquid at the operating temperature. Rapid corrosion from chloride rich species are a particular problem in trash burners and have been a problem in coal fired boilers when the concentration of chlorine in the coal is greater than about 0.25% . With these levels of

chlorine, low melting point species form at operating temperatures.

Fireside (Cont.)

There are similar problems with the combustion of petroleum coke either alone or in combination with coal. Petroleum coke may contain vanadium, sulfur, and sodium which forms low melting point species of vanadium spent oxide, sodium oxide, and sodium sulfate. The lowest melting temperature of these species is around 1000° F well within the operating temperatures of a superheater or reheater. The mechanism is the same; the liquid dissolves the protective oxide and corrosion rates increase dramatically.

Reducing conditions exacerbates the corrosion rate as stable oxides are more difficult to form. Alternating reducing conditions, oxidizing conditions have occurred in some municipal refuse boilers further complicating the problem and exacerbating corrosion wastage.

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To request additional information including an expanded curriculum overview or to reserve a seminar seat, please contact Connie Graves via phone or Email.

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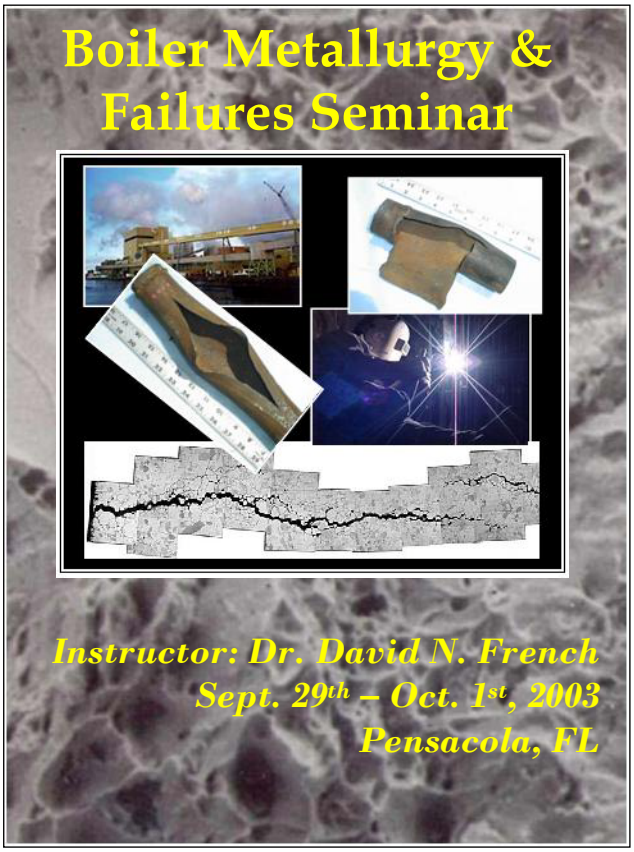
More on this issue can be discussed at the www.davidnfrench.com "forum" or Email us with any questions or comments you may have.



Current Events Bulletin

The seminar curriculum is focused on the basic principles of boiler tube steels and how they react during boiler operation from cold to loaded conditions. A variety of failure mechanisms and Low NOx issues will also be addressed.

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