Bulletin Board

New and Improved Submittal Form

You spoke and we listened and in order to better meet your needs, DNFM has made significant updates and improvements to our online boiler submittal form. Starting in August of 2008, the enhanced form is targeted to our power generation customers. New features include a "Plant / Unit" database and reorganized downloadable customer reports. See our Web site for new features and current information!

www.davidnfrench.com

Welcome
Dr. Ram S. Koripelli

We are pleased to announce a new DNFM employee, Rama (Ram) Koripelli. He's a recent graduate from the University of Nevada at Las Vegas, with a PhD in Materials & Mechanical Engineering. His dissertation concerned deformation of a nickel alloy at high temperature for use in heat exchangers for nuclear hydrogen generation. Ram brings industrial experience with a manufacturer of heavy plates and vessels, and with a thermal power station. Primarily, he will work for the David N. French organization, but he will be doing some field work with UDC, too.

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View From the Penthouse
Summer Edition 2008

Cracking at welded attachments

DAVID N. FRENCH METALLURGISTS

View From The Penthouse

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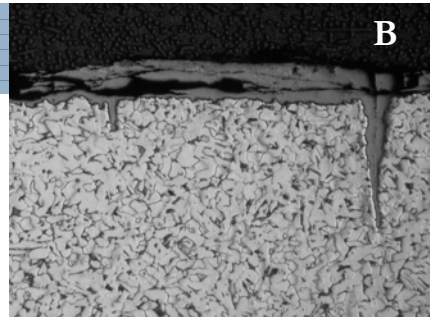
Weld Attachment Cracking

Fatigue

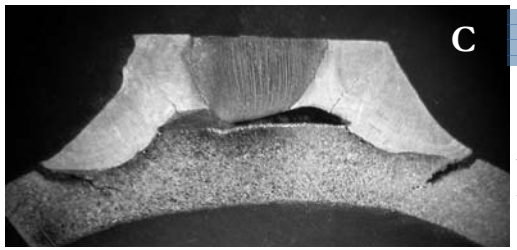
Vibrational stresses occur when tube platens are inadequately restrained against movement driven by the flue gas flow. Fatigue at attachments can result. These fatigue cracks are generally not oxide filled, having occurred over a shorter period of time. In the case shown (A), a crack formed at the toe of a butt weld due to bending, perhaps the result of a 'frozen' slip spacer.

Thermal Fatigue

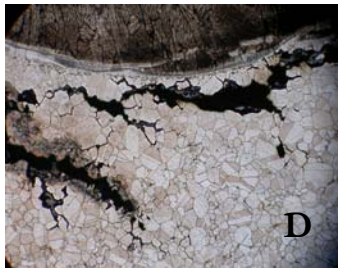


As boiler components are heated and cooled, they expand and contract. Because they may be different lengths and heated or cooled at different rates, they will move relative to each other, slipping at some attachments or creating stress at others. These stresses, applied many times, result in fatigue at the attachment points. The fatigue initiates at a stress concentration point at the toe of a weld, or a notch on the surface. When the fatigue is caused by thermal stresses, the fatigue crack is typically straight and oxide-filled, as illustrated (B).

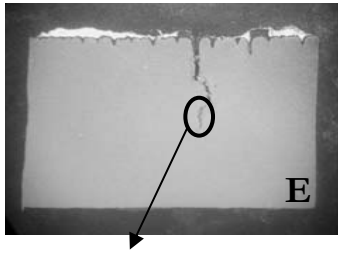
Creep



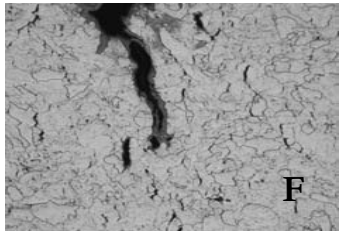
Stresses from attachments can cause creep when the stress is concentrated on one side of the attachment to stainless steel or carbon steel. Deformation is concentrated on the weaker side of the boundary, i.e. the stainless steel side adjacent to the nickel-based weld in the joint shown (C).



At higher magnification (D), the creep in the stainless steel next to the nickel-based weld is apparent.



Creep can also occur due to bending, which resulted in circumferential cracking in the tube shown below (E, F).



Materials Considerations

Stainless steel has a larger coefficient of thermal expansion than carbon steel. If there is a mixture of material types, for example a stainless steel tube attached to a carbon steel tube, then the difference in thermal expansion can be large. This may result in higher stresses at attachments than would occur for components made from the same steel.

Attachments on Stainless Steel Tubes

Attachments are frequently fabricated from materials that are more highly alloyed than the tube. The better materials are chosen to be more resistant to oxidation and corrosion at higher temperature of operation. Welds between the attachments and the tube are then made with nickel-base alloys. But, if a nickel-base weld is used, then the tube will be the weak point, and cracking may occur there (see C). It may be preferable to use a stainless steel filler so that failure is more likely in the attachment.

Nickel-base alloys such as Inconel should be used for welds to attachments on carbon steel tubes. These alloys have a coefficient of thermal expansion closer to that of carbon steel, so the stresses due to temperature differences are reduced. For low alloy steels such as T11 or T22, stainless steel or nickel-base welds may also be used.

Attachments on Carbon Steel or Low Alloy Tubes

A number of attachment designs permit relative movement between the connected components. They need to be checked and serviced or replaced to ensure they perform as intended. The distance spanned by an attachment, for example between two tubes, should be minimized so that temperatures are also minimized.

If possible, attachments should be tapered at the end to reduce the stress intensity there. This will reduce the risk of fatigue crack initiation there.

Welds should be wrapped around attachments. If they aren't, then the attachment can tear away from the tube when cracks initiate at the rough weld termination at the end of the attachment. The edge of the weld should be smoothly transitioned to the surface so there is no stress concentration at the toe of the weld. When the end of the attachment is not sealed, oxides can grow in the crevice beneath the attachments, and the growing oxide can jack the attachment away from the surface of the tube, causing failure.

Topic Ideas ?

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