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A VIEW FROM THE PENTHOUSE: USEFUL INFORMATION FOR THE WORLD OF BOILERS

WATER LANCE DAMAGE

The use of water lances seems to be increasing as the preferred method of removing tenacious coal-ash deposits. Depending on the application, good success with trouble-free operation is reported. On the other hand, damaged and failed tubes are also frequently reported. One of two explanations is possible for the success. The first, of course, is that they are trouble free. The second is that the time of operation or the number of cycles is too short for problems to develop. Thus there appears to be a fine line between success and failure in their use. As is always the case, there is perhaps a built-in bias to my reporting; as I can only attest to what has been submitted for analysis.

What seems clear, however, is that cold water on a hot tube, whether it be at the service temperature of a waterwall tube or at a higher temperature of a superheater or reheater tube, will lead to thermal-fatigue cracks. Cracks form when the surface of the hot tube is rapidly cooled. When it cools it contracts while the underlying portion of the material is still at the elevated temperature. The contraction is "resisted" by the hotter, and hence longer steel, and the surface is then put into tension. Over several to many cycles, these tensile stresses develop into thermal-fatigue cracks.

The general appearance is one of a crazed pattern, see Figure 1. Here there are the remnants of the ash. In metallographic cross-section: circumferential dagger-like fissures develop. All of the cracks are oxide-filled, transgranular, and progress inward until a steam leak develops.

Figures 2 and 3 show damage on a waterwall tube.

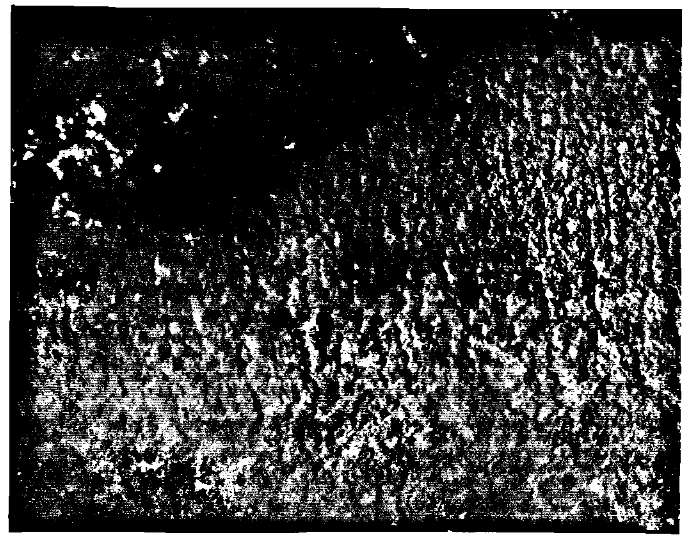

Figure 1

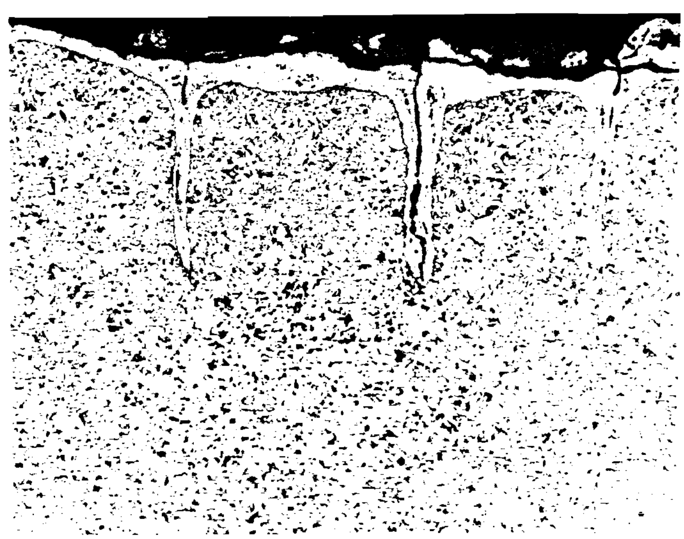

Figure 2

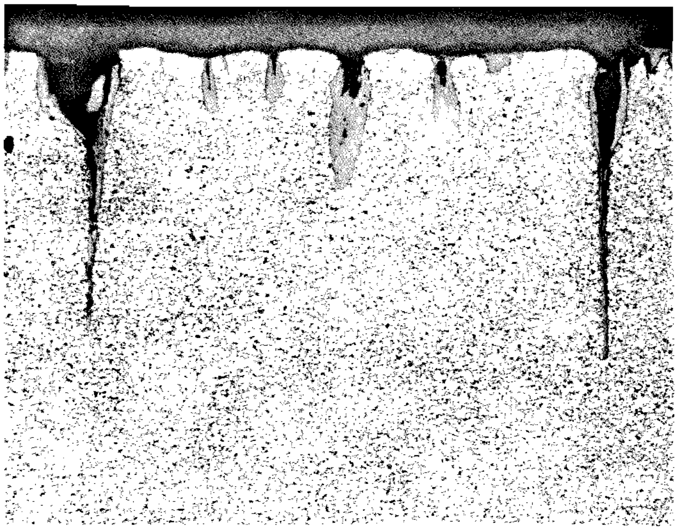

Figure 3

Similar damage develops on steam-cooled circuits as well. Figure 4, from a reheater shows the similar pattern.

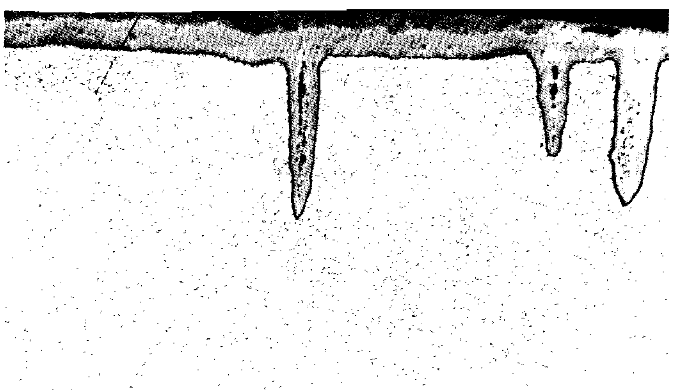

Figure 4

Depending on the severity of the quench by the waterwalls, steam-side cracks may also develop, albeit less severe, see Figure 5.

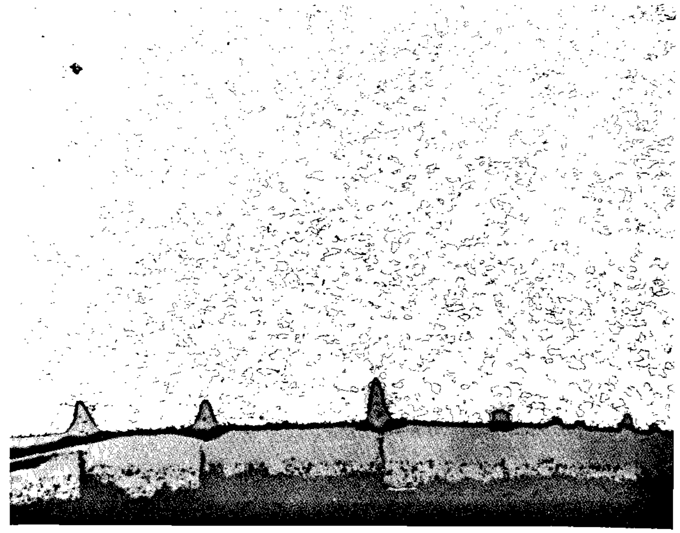

Figure 5

Apparently the secret to success with water lances is not to remove all of the ash, but leave a thin insulating layer in place to prevent the thermal shock on the steel tube.

All of the preceding examples are from water lances, but similar damage may develop from steam-actuated soot blowers early in the blowing cycle. Steam has condensed at the end of the prior cycle. The first fluid on the subsequent steam-blowing cycle is water, and the first tubes or pendants in the path are quenched by the water. Thermal-fatigue cracks form, but only on those elements hit by water. Once steam reaches the nozzle, the rest of the tubes do not develop cracks and damage. To prevent cracking with steam lances, condensate should be drained after each operational cycle.

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