

Boiler feedwater pipe failure by flow-assisted chelant corrosion

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Abstract

On 22 April 1996, there was a catastrophic failure in a section of six-inch diameter feedwater line leading from the economizer to the steam drum on a boiler at a private industrial power plant in the Midwest. The rupture occurred immediately downstream from a chelant injection quill. Boiler water depressurized from over 900 psi and flashed to steam as it exited the ruptured pipe. A full investigation into the cause of the failure was carried out over a period of 2 years, involving experts in mechanical design, metallurgy, water chemistry and fluid flow dynamics. The boiler operating history, including water treatment methods, was carefully reviewed. Inspections were also carried out on the equivalent feedwater piping and injection quills removed from five other boilers operating with the same source of feedwater but with independently controlled rates of chelant injection. The failure occurred due to progressive thinning of the pipe wall from the water side to the point where it could no longer tolerate the operating pressures and temperature. It was concluded that thinning of the carbon steel pipe wall had been caused by a specific mechanism, termed here "flow-assisted chelant corrosion". The difference between this and flow-accelerated corrosion (FAC) is presented and recommendations are offered to help avoid similar failures in the future. Other potential causes of the failure including direct erosion and non-flow assisted corrosion were evaluated and shown to be non-causal. © 2002 Elsevier Science Ltd. All rights reserved.

Keywords: Boiler failures; Corrosion; Rupture

1. Description of the boiler

The boiler on which the failure occurred is a coal-fired unit of 275,000 lb/h steaming capacity, manufactured by The Babcock & Wilcox Company in 1962. After about 5 years of operation a larger air heater

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