



## Short communication

## Analysis on a failed 2.25Cr–1Mo reheater bent tube at upper bank vertical tubes region

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## 1. Introduction

In the past decades, SA213-T22 steel had been widely used in petrochemical and power generation units. After prolonged period of service with various conditions the tubes are becoming the ageing tubes. Deteriorations of the material could not be avoided. The strength of low-alloy steel may change for prolonged period of service. Estimations of change in temperature and oxide scale thickness during service may be used to estimate the remnant life of the component. In particular, estimations of the average temperature in tube metal are important in water tube boiler operation.

Starr et al. [1] also described that oxidation on the steam side of the tubing can induce premature failures due to the insulating effect of the oxide scales elevating tube temperatures. In addition, scale exfoliation could also increase tube temperatures, as exfoliated debris may collect in the bottom of tubes, leading to steam flow starvation. Attention is drawn to a potential problem in which the tube temperature and rate of oxidation increase with time as the oxide scale develops. Chaudhuri [2] described some aspects of metallurgical assessment of boiler tubes. He discussed some failure problems in reheater and superheater carbon steel tubes. Ray et al. [3] reported remaining life assessment and creep analysis of superheater and reheater tubes made of 2.25Cr–1Mo steel of a thermal power plant. The failed tubes had been in service for 17 years with average operating temperature of 540 °C and having design pressure of 40 MPa. The remnant life was predicted through dimensional, hardness and tensile measurements.

Failure investigations on water tube boilers in Malaysia power plants have also recently been reported [4–11]. Othman et al. [4] investigated a failure on a superheater tube due to excessive deformation by the finite element analysis. The analysis showed a good correlation with the findings of the visual inspection on site. Purbolaksono et al. [5] reported an investigation on the failed reheater tube through finite element modeling, dimensional measurements and microscopic examinations. Results obtained from finite element analysis were shown to be in good conformity with the findings from

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