

Comprehensive Inspection Solution for Boiler Water Wall Tube Corrosion

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A substantial number of domestic coal-fired boilers, most of which have been in operation for numerous years, are susceptible to corrosion and tube ruptures within their high-temperature environment, often resulting in unplanned shutdowns. Despite the annual planned maintenance shutdowns, which involve routine inspections of water wall and furnace tubes to detect potential corrosion and erosion, the current non-destructive testing methods are generally localized. This approach, particularly with the considerable height variation of the water wall tubes (ranging from approximately 10 to 25 meters), may overlook segments with severe corrosion during localized ultrasonic thickness gauging. Although the experience of inspection teams reduces the chance of defect oversight, the demand for a comprehensive and effective inspection technique remains a priority for boiler operators. This study utilizes the characteristic of guided waves to propagate over a certain distance along pipelines, initiating an exploration into a comprehensive inspection solution for water wall tubes. Finite element simulation results demonstrate the suitability of utilizing a 120 kHz frequency for shear horizontal mode (SH0) testing on the fire side of water wall tubes. This mode effectively screens for localized corrosion within a 3-meter range. In the field of on-site boiler inspection, electromagnetic coils are employed to generate guided waves within water wall tubes. The gathered signals from each electromagnetic guided wave testing (EMGWT) are consolidated into a distribution map, indicating suspicious signal locations. Pulse eddy current testing (PECT) is employed to identify potential issues with guided waves without requiring surface preparation. If PECT reveals anomalies, the affected surface is polished, and phased array ultrasonic testing (PAUT) is conducted to quantitatively measure the remaining wall thickness due to corrosion. The theoretical exploration and on-site inspection outcomes affirm the feasibility of this approach, aimed at enhancing operational safety for boiler water wall tubes and mitigating the risks of tube ruptures and leaks. This comprehensive inspection solution amalgamates three advanced detection technologies, each capitalizing on its unique inspection characteristics to facilitate corrosion screening, corrosion scanning, and wall thickness sizing. Through the integration of these technologies, the overall inspection strategy ensures the utmost level of reliability.