



## Metallurgical Investigation - Steel Heat Exchanger Tube Failure



### CHALLENGE

This client was experiencing problems due to steel heat exchanger tubes in their boiler failing. This was having significant affect on productivity and resulting in unplanned downtime.

We recommended an investigation to determine the root cause of failure and to identify if there were any underlying corrosion issues.

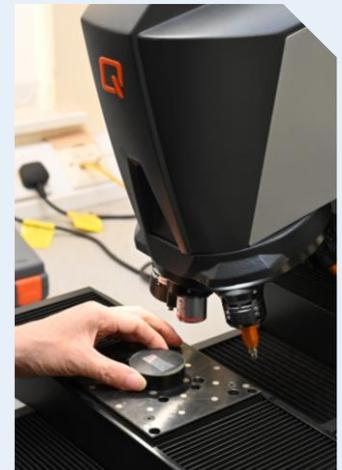
### PROJECT ACTIVITES

The initial visual inspection of the failed tube showed that it was heavily corroded.

The subsequent investigation was carried out in two parts:

#### Part 1 - Characterisation of corrosion products/deposit

- **pH Measurement:** To determine acidity/alkalinity of corrosion products.
- **X-ray Fluorescence (XRF) Analysis:** For elemental composition of corrosion deposits.
- **X-ray diffraction (XRD) Analysis:** For phase identification in corrosion products.
- **Thermo-gravimetric Analysis with Quadrupole Mass Spectrometry TGA-QMS:** For thermal stability analysis and evolved gas identification.



## PROJECT ACTIVITIES....

Part 2 - The failed tube had a 'split' and the tube material at the 'split' and surrounding the 'split' was characterised.

- **Optical Emission Spectroscopy (OES):** For base metal composition verification.
- **Hardness Testing:** To evaluate mechanical property consistency.
- **Light Optical Microscopy (LOM):** For thermal stability analysis and evolved gas identification.
- **Scanning Electron Microscopy with Energy Dispersive Spectrometry (SEM-EDS):** For detailed examination of corrosion mechanisms at the metal/oxide interface

### Advanced Materials Characterisation Centre

<https://www.mpiuk.com/research-development-advanced-materials-characterisation-centre.htm>

## FINDINGS

- Analysis did not show any issues with the quality of the steel.
- The problem was found to be related to corrosion.
- The investigation found significant levels of chlorine containing corrosive salts.
- The corrosion attack of the metal by chlorine, and accelerated corrosion attack by the acidic deposits coming from the flue gas, were believed to be the main reasons for the failure of the tube.