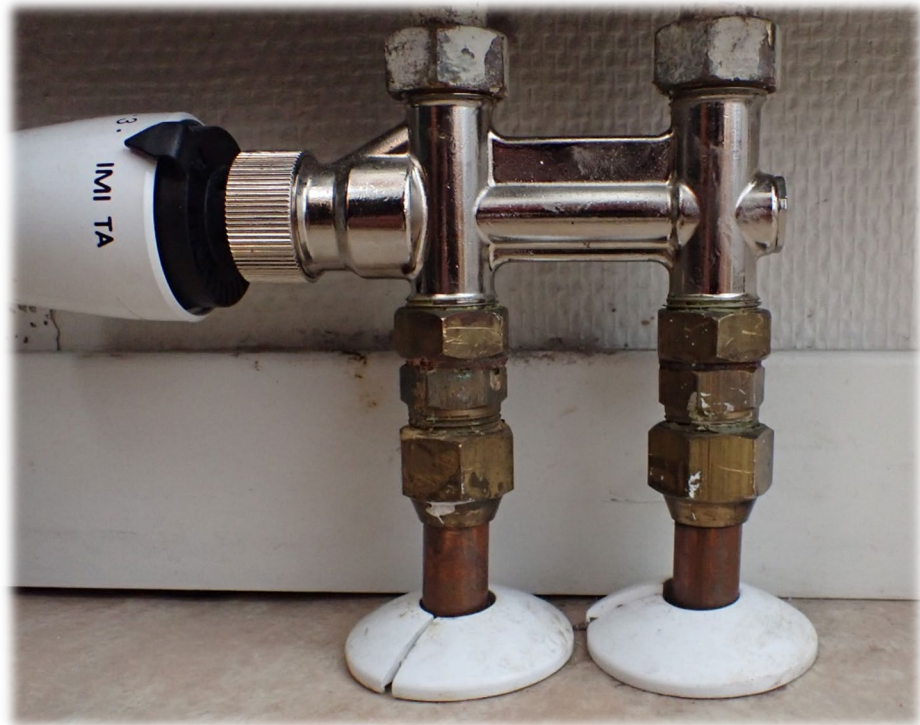
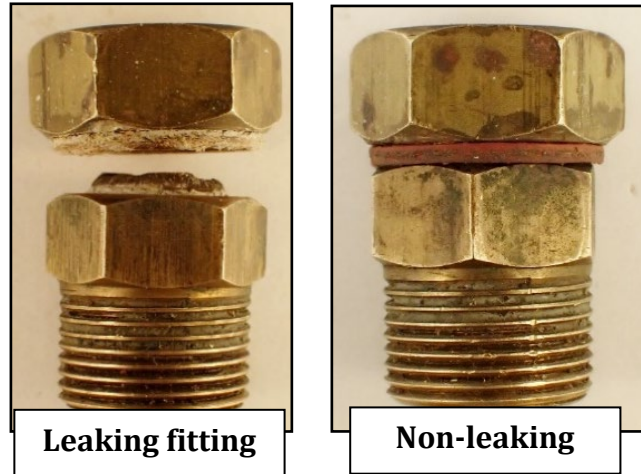


MATERIEX CASE STUDY
LEAKAGE IN RADIATOR FITTINGS



BACKGROUND

About 3 months after the replacement of a thermostatic radiator valve, a leakage suddenly occurred in a pipe fitting between the thermostat and one of the two connected water pipes. At the replacement, the fittings had been loosened but not removed and then reused together with the new thermostat. As there was no information on previous work done on the radiators, the fittings were assumed to be from the end of the 1960s, when the building was built.



INVESTIGATION

The investigation included the following:

- On-site inspection and visual examination of the components
- Chemical composition analysis (XRF)
- Fractography (SEM)
- Metallographic preparation and examination (SEM, EDX) of axial cross sections cut through the fittings

XRF - X-ray fluorescence

SEM - Scanning electron microscopy

EDX - Energy dispersive X-ray spectroscopy

FINDINGS

- The leakage had occurred due to cracking initiated at the sharp corner on the outside of the fitting (Figure 1). Smaller cracks (100 µm) were also observed in the same corner of the non-leaking fitting (Figure 2).
- Investigation in SEM showed that the crack initiation sites were dezincified (Figure 1 and Figure 2). Dezincification is a corrosion process that selectively removes zinc from the brass alloy (if Zn>15%), leaving a porous copper-rich structure with reduced mechanical strength.
- The chemical composition of the fittings was identified as brass CW608N (60% Cu, 38% Zn, 2% Pb).
- The mode of fracture near the crack tip was identified as ductile (Figure 3). As the mechanical strength has been reduced by the dezincification process, the torque used during re-tightening after the thermostat change has probably been sufficient to initiate cracking.

CONCLUSIONS

The leakage was caused by dezincification resulting in a reduced mechanical strength, subsequently making the fittings more prone to cracking. The leakage could have been prevented by using fittings in dezincification-resistant brass instead of reusing 40-year-old fittings of an alloy that is typically not resistant to corrosive mediums that might be used in the specific environment. Brass is particularly sensitive to ammonia, which is found in some all-purpose cleaning products.

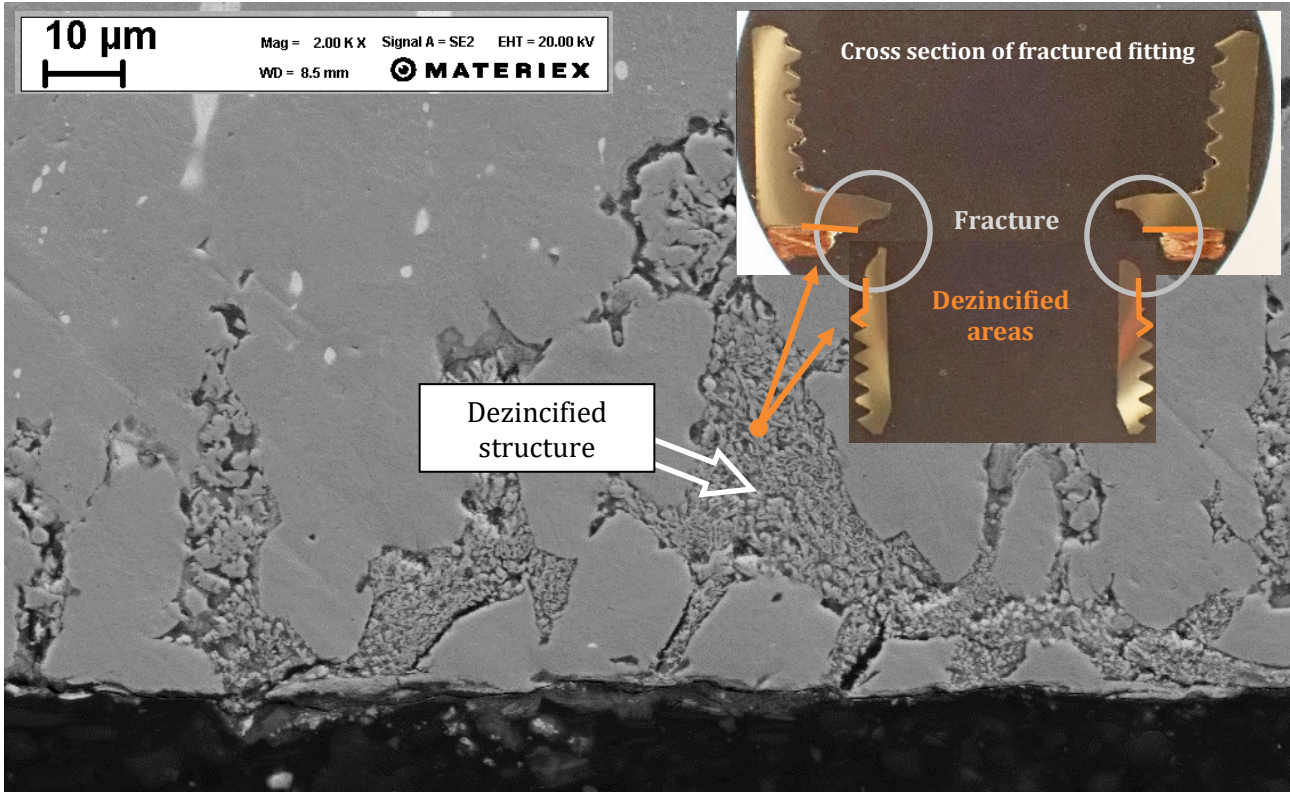


Figure 1. Dezincified surface close to the crack initiation of the leaking fitting (SEM).

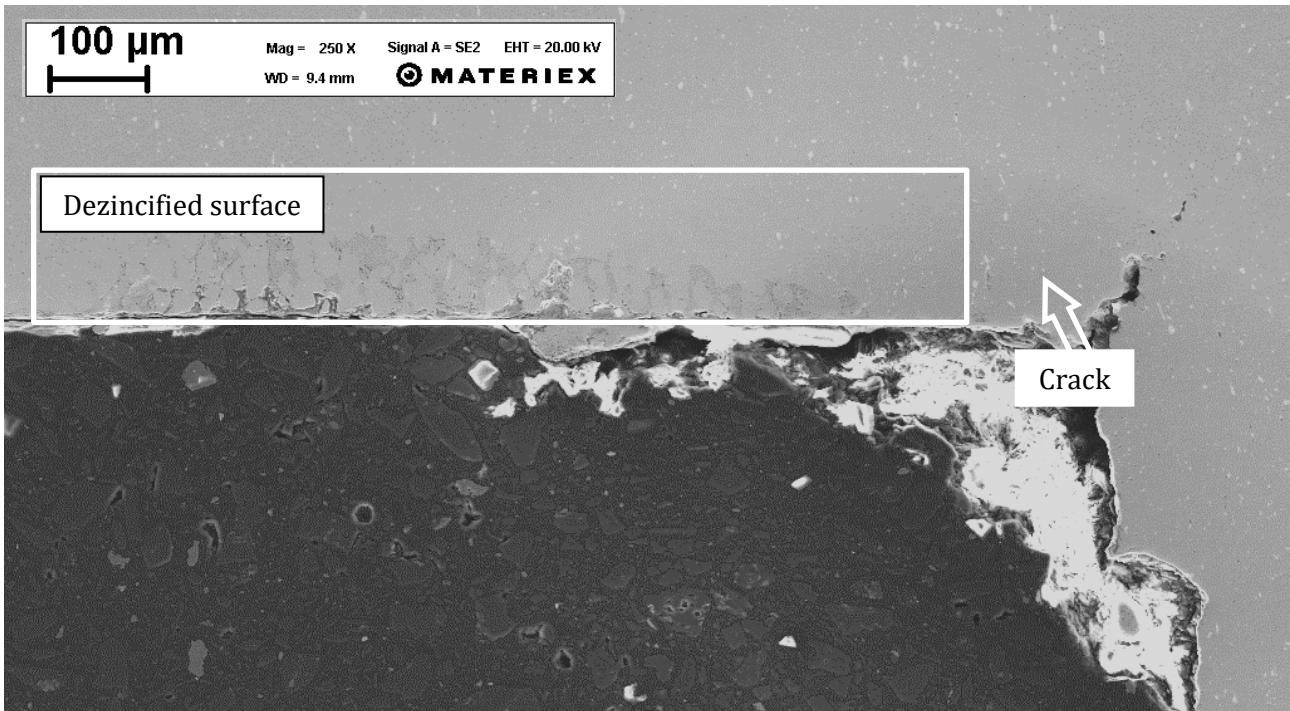


Figure 2. Dezincified surface and cracking in part A of non-leaking fitting (SEM).

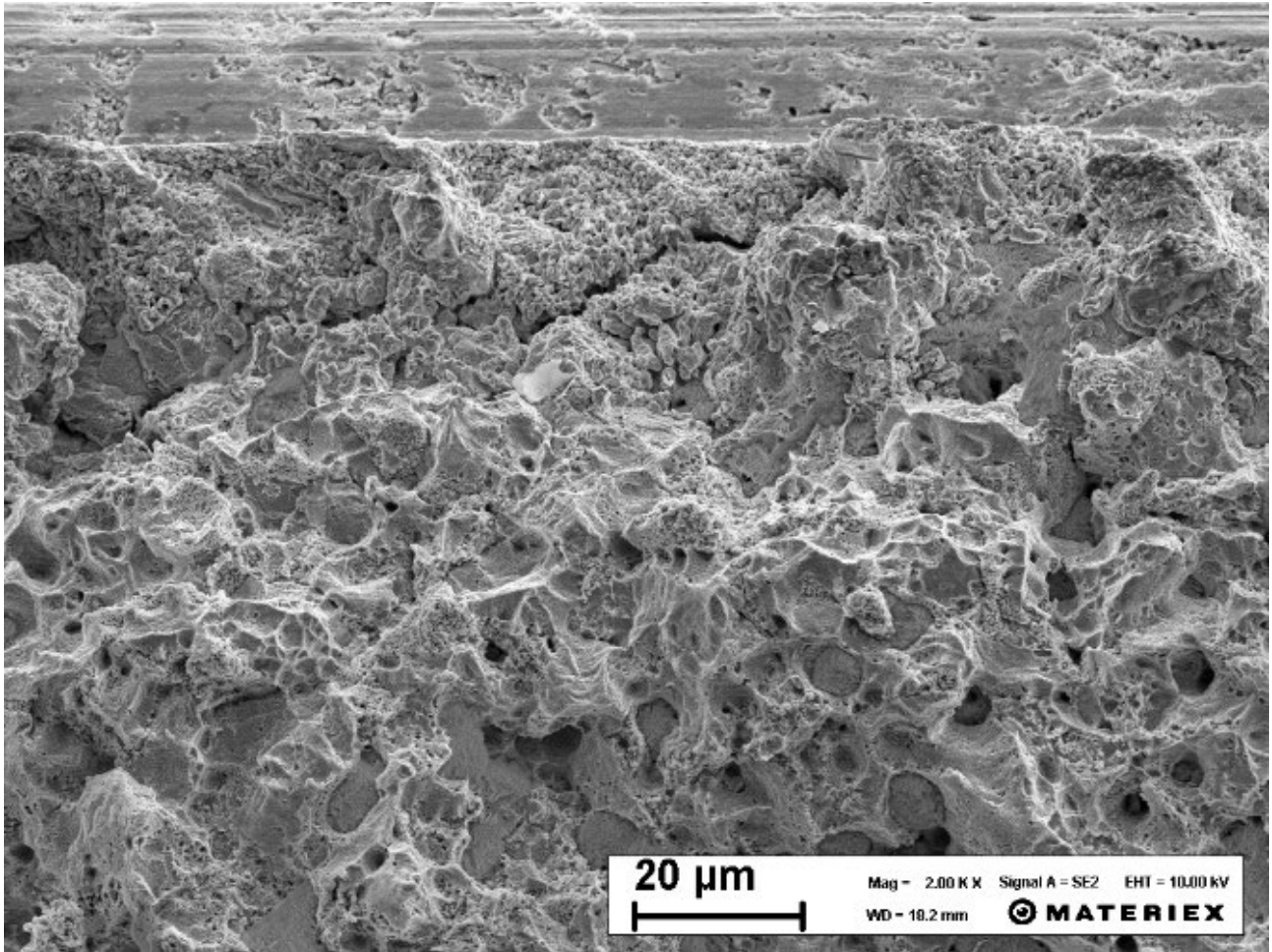


Figure 3. Overload fracture at the crack tip of the leaking fitting (SEM).