C7 A Really Big Corrosion Litigation

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After attending this presentation, attendees will learn the basis of metal corrosion and the dezincification phenomena that occurs with some types of brass fittings. This presentation also will address how a very large corrosion litigation matter was successfully handled.

This presentation will impact the forensic science community by identifying a large and growing area of litigation brought on by the changing nature, due to materials costs, of the brass fittings.

In one housing area, 34,000 homes suffered or were going to suffer severe water leaks due to failure of their plumbing system. A number of corrosion engineers were employed by various parties including tubing and fitting manufacturers, building contractors, plumbers, insurance companies, and homeowners. The plumbing system in question used Kitec brass fittings in conjunction with PEX tubing. The PEX tubing is made by cross linking high density polyethylene. The tubing was PEX-Al-PEX with a layer of aluminum sandwiched between PEX layers to prevent diffusion of oxygen into the water system and, hopefully, prevent corrosion from occurring.

The brass fittings are attached to the PEX tubing by compression rings or clamps. The plumbing system failures involved uniform layer type dezincification, as opposed to pitting type dezincification, with subsequent loss of strength of the brass fittings.

In dezincification, the zinc leaches out, leaving behind a porous copper sponge. The resulting sponge fitting leaks at the connection points. The leached zinc causes build up of bulky mounds of zinc oxide in the water fitting, resulting in constricting and choking the normal water flow. This is referred to as meringue dezincification.

The failed brass fittings were manufactured from a high zinc duplex alloy of 35 - 40% Zinc. The potable water in that area was considered non-corrosive and had a neutral Langelier index, but it appeared to be aggressive to the high zinc brass fittings.

The brass fittings were failing and leaks were occurring in three to six years. Factors that increase dezincification:

- High temperature
- Low water speed (stagnant water)
- Low aeration
- Zn concentrations above 15% in the brass
- High chloride content in the water

The litigation issues focused on the following:

- The plumbing installation was approved by the governing agency.
- The zinc content at 35% was unusually high in the failed fittings.
- The water was considered non-corrosive.
- Fitting manufacturing processes were questionable.
- Poor plumbing installation practices causing physical stress on the fittings.
- The use of an aluminum layer in the tubing was a problem.

Examination of the Cu-Zn phase diagram showed that an intermetallic compound of Cu-Zn formed at high concentrations of Zn. The intermetallic compound was susceptible to dezincification under certain water conditions that normally were not considered corrosive to other metals.

An empirical plot developed in 1961 that correlated water composition in various parts of England with the occurrence of dezincification of brass fittings was found to provide an explanation of the corrosive nature of the water in the housing area of failures.

The "Turner Diagram" plotted chloride concentration versus $CaCO_3$ hardness, and showed that the water used in the area of the homes in litigation was aggressive to brass. The water, in combination with the high zinc content in the fittings, was the cause of the dezincification.

Because copper costs four times more than zinc, more high zinc brasses will be found on the market. These "yellow" brasses will be susceptible to dezincification failure, in particular with soft water containing more than 40ppm chloride.

Corrosion, Dezincification, Brass Fittings

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