MATERIALS & CORROSION

Destructive Condition Evaluation of Steel Pipe and Copper Tube

Steel pipe and copper tube have been used extensively in both water distribution and heating systems in residential, commercial and industrial constructions over the past many decades. These materials were, and often still are, chosen due to their durability and established method of installation. Although both copper and steel perform well in water system applications, they will, by their very nature, suffer the effects of corrosion over time. Localized corrosion can lead to perforation of pipe or tube and the possibility of costly water damage to surrounding structures. General corrosion of pipe and tube wall can lead to an overall compromise to the integrity of heating and distribution plumbing systems.

The prevailing approach to the maintenance of plumbing systems seems to be reactionary rather than prevention based. Sections of plumbing are removed and replaced as problems and leaks occur. Decisions to replace large sections of plumbing systems are often made based on a limited amount of leak history information. Decisions based on limited information can lead to the unnecessary expenditure of maintenance monies prior to the compromise of an entire plumbing system.

By examining the extent and character of corrosion occurring in a plumbing system over a known period of time and combining this with an understanding of corrosion kinetics, it is often possible to develop a more informed approach to infrastructure management strategies.

Levelton has developed testing methods and procedures to examine and characterize plumbing system corrosion. This information can be combined with life cycle information to develop an estimate of additional service life.

We are all concerned about how our infrastructure dollars are spent and finding ways to spend those dollars in the most efficient manner is the order of the day. When it comes to plumbing systems we need to ask:

- What are the direct and indirect costs and consequences of system failure?
- Is there a more proactive strategy to plumbing system management?
- What portions of a system require immediate replacement and what portions will provide additional service?
- Approximately how much additional service can be expected from a plumbing system?

Tubercule formation due to microbiological activity observed on the internal diameter surface of a ductile iron fitting.

Levelton Consultants Ltd. has developed examination methods and gained extensive experience characterizing the corrosion found in plumbing systems in order to assist our clients in answering these questions. This has assisted our clients in planning how and when infrastructure dollars are spent.

The destructive tests and examination procedures described on the following page are used by Levelton to evaluate the condition of plumbing system components.

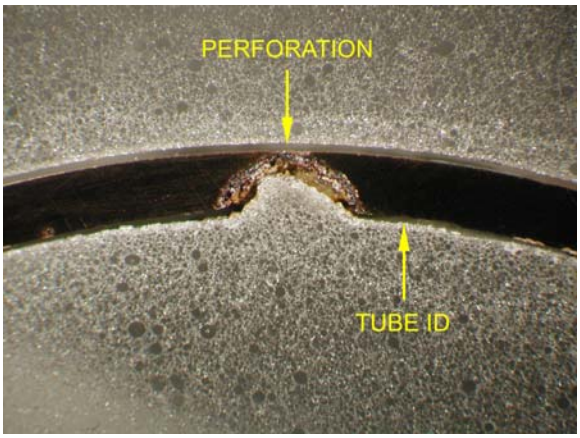
- Visual examination aided by low-powered stereomacroscopy.

- Visual examination aided by low-powered stereomacroscopy of interior diameter surfaces after longitudinal sectioning in the following conditions: as-received; after warm water washing with a soft bristle brush; after cleaning with an inhibited acid solution.

- Point micrometer wall thickness measurements.

Using the above described examination methods and our experience in the area of corrosion engineering, Levelton has been able to develop estimates for additional service life of existing plumbing systems with direct comparison with as-new pipe and tube tolerances.

In additional to our experience in the area of corrosion engineering, Levelton Consultants' Physical and Mechanical testing laboratory has extensive experience in testing many piping materials including asbestos cement (AC), concrete, ductile and cast iron, polymer and composite. Our laboratory is certified to CSA Standard W178.1 "Certification of Welding Inspection Organizations", is a US Coast Guard accepted laboratory for testing of materials and equipment and has extensive facilities including two universal testing machines with tensile capacity to 530 kN [120 kip] and compressive capacity to 1800 kN [405 kip] with a variety of related apparatus for engineering stress-strain and load displacement measurements. Facilities also include a capability for electrochemical and corrosion studies.



Cross-sectional view of internal diameter corrosion pit and perforation of a copper tube.

Cluster of corrosion pits observed beneath a tubercule on the internal diameter surface of a copper water distribution tube.

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