Material Integrity Solutions, Inc.

PROJECT BULLETIN

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Remaining Life Assessment of Buried Gas Piping Systems

BACKGROUND

Gas gathering, transmission, and distribution systems consist of miles of various size buried piping (*Fig. 1*). These piping systems are susceptible to a number of damage mechanisms including internal and external corrosion, fatigue, stress corrosion, and "denting" or gauging on external surfaces.

A major gas company hired MIS to evaluate one of their gas gathering systems for internal corrosion problems and fatigue.

Figure 1: Installation of a typical

DISCUSSION

The gas gathering system in this evaluation was a network of 970 miles of 2" to 20" piping. This system had experienced a range of problems from pin hole leaks to catastrophic rupture of the line. This piping system had internal corrosion damage (*Fig. 2*) that was being addressed by addition of inhibitors and replacement of sections with most damage. However, the main concern for this system was fatigue crack initiation and growth at areas of corrosion damage due to daily cycling of the system.

Since full inspection of this piping system was not economically feasible, our client, per our recommendation, pressure tested this piping system at 1.5 time its maximum allowable operating pressure (MAOP). Piping that failed during this testing was replaced and the remainder was analyzed for its remaining life. The approach taken by MIS to evaluate

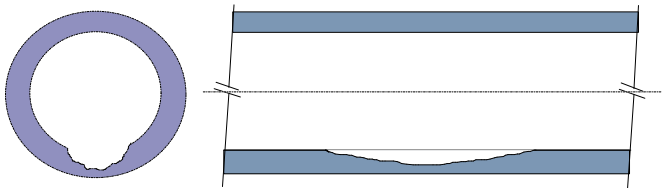

Figure 2: Depiction of internal corrosion damage in piping

the integrity of the piping network and its remaining life included:

- Estimation of maximum flaw size that could exist in the piping from the pressure test.
- Stress analysis of the piping network with flaws for all operating modes per:
  - ⇒Plastic instability (collapse) mechanism approach.
  - ⇒Thin shell theory.
  - ⇒ANSI/ASME Code B31.8 (App. L) and B31G.
- Fracture mechanics analysis of the piping network for:
  - ⇒Critical crack size for a variety of flaw geometries including through-wall longitudinal and circumferential cracks.
  - ⇒Flaw (crack) growth by fatigue under daily cycling and internal corrosion.

A spreadsheet was developed to perform most of the above required calculations. The results from these analyses were used to estimate the remaining life of the piping network.

CONCLUSION

A simple and yet effective method for estimating the remaining life of buried piping systems was developed. This method was applied to evaluate a large gas gathering system consisting of various pipe sizes that had experienced failures. The results of this approach showed that the majority of this piping system had extensive remaining life under fatigue loading. As a result, the client was able to keep most of its existing piping network saving millions of dollars in unnecessary