Stainless Flexible Service Line
A permanent solution for water loss

PROBLEM

Leakage from water distribution systems is a significant problem in many cities. Water scarcity, seismic events, high water cost, a continued increase in city populations due to ongoing mass urbanization, droughts and climate change are key drivers to addressing leakage. Many of the world's utilities often do not know exactly the extent of the water loss in their system.

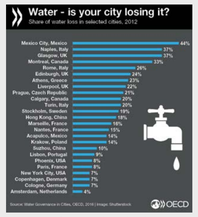

Figure 1: Leakage rate in major cities
Source: OECD (Water Governance in Cities, 2014) - Shutterstock

Both Tokyo and Taipei have determined that some 95% of leakage repairs affect their service tubes of 50 mm (2 inch) diameter or less.

Historically, service pipes there had been constructed of lead, iron or plastics.

Once a service line is in the ground various forces, such as:

- Vibrations from traffic and construction work
- Subsidence
- Seismic events

can cause the pipes to deform, become detached or even break.

The lead lines not only had leakage problems, but there were also grave health concerns which required accelerated replacement of these lines.

SOLUTION

In 1980, to combat the scourge of leaks, Tokyo instituted a three part solution to the problem:

- Replacing the existing service pipes with Type 316 (UNS S31600) stainless steel and the cast iron mains with ductile iron
- Improving leakage detection
- Shortening response time when a leak is detected

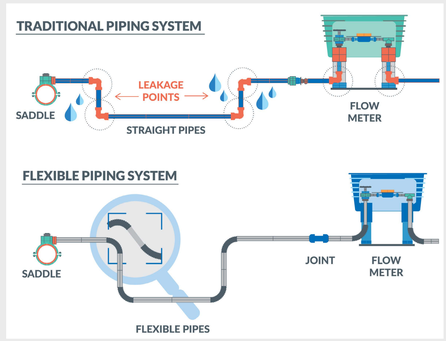

Figure 2: Traditional vs stainless flexible service line

In 1998 stainless partially corrugated pipe (SPCT) was introduced instead of straight pipe and fittings. Corrugations at regular intervals enable bending during installation to accommodate changes in direction without additional joints. It also allows to absorb the stresses from vibrations, subsidence and seismic events. The number of joints was significantly reduced by using a single length of corrugated tube, which proved a cost benefit.

RESULTS

Tokyo reduced its water loss from 15% to around 3% over a twenty-year period and keeps saving hundreds of millions of dollars per year by reducing water loss and repair jobs. They have fewer than 0.2 leakage cases per 1000 stainless steel service connections per year, even though about 70% of their stainless steel service lines are 30+ years old, as of 2023.

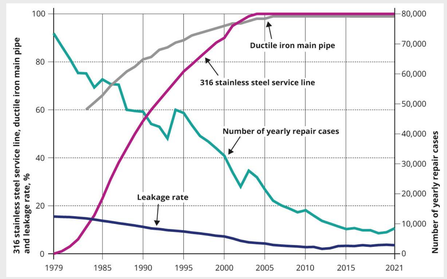

Figure 3: Correlation between repair cases, leakage rates and installation of stainless steel pipes in Tokyo.

Cost reductions also arise from reduced process and pumping energy, reduced water treatment and avoided leakage follow-on cost such as road cave-ins and traffic disruptions.

Tokyo's success at reducing leakage attracted the attention of Taipei and Seoul. In Taipei, a 20-year water loss reduction project, started in 2006, includes the systematic replacement of service lines with Type 316 SPCT and other measures.

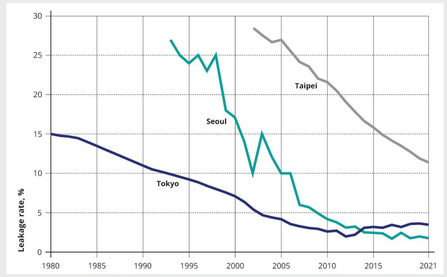

Figure 4: Leakage reduction in Asian cities through use of stainless steel service lines.
(Sources: Tokyo Bureau of Water Works; Ministry of Environment, Republic of Korea; Taipei Water Department)

Taipei's service line replacement in particular has been the largest contributor to leakage reduction from 26% to 11% by the end of 2021. Additional achievements: a reduction of repair cases from around 12,000 to 2,000 per year (only a dozen of them are related to stainless steel, which corresponds to 0.06 leaks / 1000 service connections), decreased energy use and CO_2 emissions.

Furthermore, Seoul was able to reduce the number of water treatment plants by 40%.

WHY TYPE 316 STAINLESS?

Type 316 stainless steel with 2% molybdenum and 10% nickel content has excellent corrosion resistance in a wide range of soils. Tokyo expects service life to be in excess of 100 years.

Cr	Ni	Mo	Mn	Si	Fe
16.2	10.1	2.1	1.2	0.5	bal

Table 1: Major elements in the composition of Type 316 - in weight-%

Type 316 stainless steel is essentially inert in potable water, with negligible leaching of alloying elements, and therefore does not affect the water.

ADVANTAGES

Stainless Steel Characteristics:

- Corrosion resistant
- Durable
- Hygienic and resistant to hydrocarbons
- Strong
- Lower Life Cycle Cost
- Not susceptible to cracking
- Negligeable maintenance costs
- Improved water quality
- 100% recyclable

Flexible pipes:

- Reduced leakage by minimizing the number of joints
- Flexible and easy to install
- Resistant to seismic shocks, soil movement or land slides
- Matching fittings to connect to the water main and valves and meters
- Manufactured to regional and international quality standards

CONCLUSIONS

The corrosion resistance, durability, resilience and reduced number of joints of service lines made of stainless partially corrugated tube have played an important role in stopping leaks.

Management gains accumulated by Tokyo, Seoul and Taipei prove the suitability of stainless steel for service lines even for very large systems. While the initial cost compared to competing materials may be higher, stainless steel has been shown to be a good investment over its entire service life, paying back each year in water savings, reduced maintenance and cost per liter processed.

water | team stainless

Alliance of non-profit organizations demonstrating the benefits of stainless steel for water distribution:

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