Saving Drinking Water

Water is generally a scarce resource, but the problem is more acute in some regions of the world than others. Furthermore, the supply of potable drinking water requires costly treatment in most regions of the world, again with some having a more acute problem than others. With this opening position in mind, it is a universal imperative that water conservation is a priority policy consideration, and that conservation of treated water acquires an even higher priority. Wasting treated water naturally requires an equal volume of raw water to be re-treated, with all the cost that process involves, in terms of money, man-hours, chemicals and energy.

By John Rowe, Secretary-General, ISSF

Against this background it is surprising to learn the extent of treated water that is lost around the world due to the relatively low-technology problem of leaking pipes. Chart 1 shows the extent of water losses arising from this cause in a selection of cities, ranging from a low of about 4% for Amsterdam to rather dramatic a high of about 65% for Tuxtla Gutiérrez, in Mexico. Whilst this is in itself surprising, what is astounding is the number of sophisticated cities which appear on the chart (Oslo, Glasgow, Montreal and Rome, to select but a few). London is not mentioned on the list, but a report in 2012 quoted the leakage rates for three major United Kingdom Water Authorities at between 25 and 27%.

Figures of this magnitude are shocking for three reasons: first, because, as mentioned above, water is, of itself, a scarce resource; second, because the authorities have limited financial resources and cannot afford to sustain these losses; and third, because the cost of the wastage is passed on to the general public through their escalating water bills and that is a pressure vessel which is building up steam!

There is a solution, but it is not readily acceptable, primarily because it carries a high initial investment cost, even though figures available from those who have elected to adopt it have shown that over a useful life cycle, the cost is significantly lower than alternatives, both in terms of reduced maintenance and of pipeline replacement cycles. Add to that the value of reduced water losses, and the reduction in traffic disruptions which result from repairing water pipes and you have an investment which may be justifiable over the full length of a properly planned useful life.

Tokyo Leakage Reduction

Tokyo City Water Board introduced a project in 1980 to address the high level of water losses they were experiencing through leaking pipes, which at that time had reached approximately 17%. They introduced a gradual replacement plan for their water distribution pipes from the exit of the water reservoirs and water treatment plants to the point at which the private and commercial consumers' pipes receive the water. The old and damaged pipes, which were a combination of ductile iron pipes and lead pipes, were gradually replaced by stainless steel pipes equivalent to grade AISI 316. At first, the pipes were connected using conventional pipe connectors, which were also made from stainless steel. But, over time, the development of flexible tubing (which had, until then, primarily been used in the automotive exhaust industry, to provide a flexible coupling between the vibrating engine and the fixed exhaust pipe) enabled the water engineers to introduce this type of pipe to the water distribution system, thus gaining both the flexibility to bend pipes without using the traditional elbows and connectors, whilst at the same time reducing the number of connectors used, saving cost and removing potential new leaking points. As with the automotive exhaust pipe, the flexible pipes brought a further benefit in that they could absorb vibrations without breaking – in this case absorbing the shocks from seismic activities which are endemic in Tokyo.

Chart 2 shows the extent of the improvement in leakage rates in Tokyo between 1980 and 2013, by which time the leakage rate had fallen to 2%.

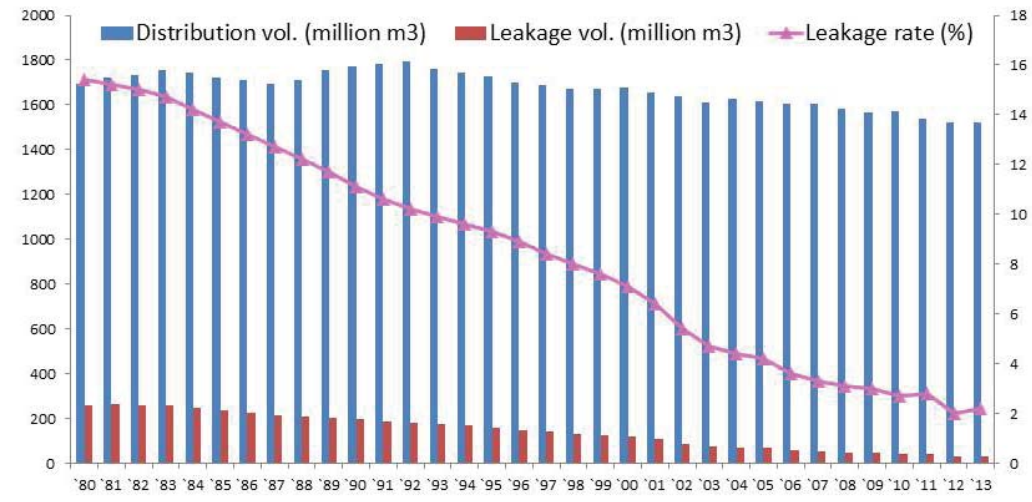
Three-Part Strategy

Stainless steel provides the strength and corrosion resistance to withstand the extent of leaking to which earlier types of distribution pipes had been prone and it does not affect the taste of the water. But replacing the pipes is not enough. A major contribution to the success of the Tokyo leakage reduction came from having a three-part strategy:

1. The replacement of aging water pipes with stainless steel pipes;
2. The introduction of an improvement to their planned inspection process, whereby the city was divided into manageable blocks and each block was inspected for leaks on a planned, systematic basis; and
3. Improvements in leak detection technologies and in repair methodologies.

Chart 2: Decrease in leakage volume and leakage rate in Tokyo (1980 → 2013)

- Volume: 227 million m^3 (260 m^3 → 33 m^3), reduction of △87%
- Leakage rate: △12.8% (15% → 2.2%)



Without 2 and 3, it is arguable that the replacement of the pipes would not have worked on its own. But conversely, improving planned maintenance and detection technologies would have been considerably less effective if lower-grade pipes with higher leakage potential had continued to be used, because the leakage detection teams would simply have been overwhelmed.

Ongoing Projects and Future Action

The success of the Tokyo case caught the attention of the City of Taipei which introduced a substantially similar system. In their case, the starting point had been a leakage rate of 27%. After 10 years, that was reduced to 7%, but there is still further work to be done. A third example is Seoul where the project was initiated in 1987 and the leakage rate has fallen from 27% to 2.5%.

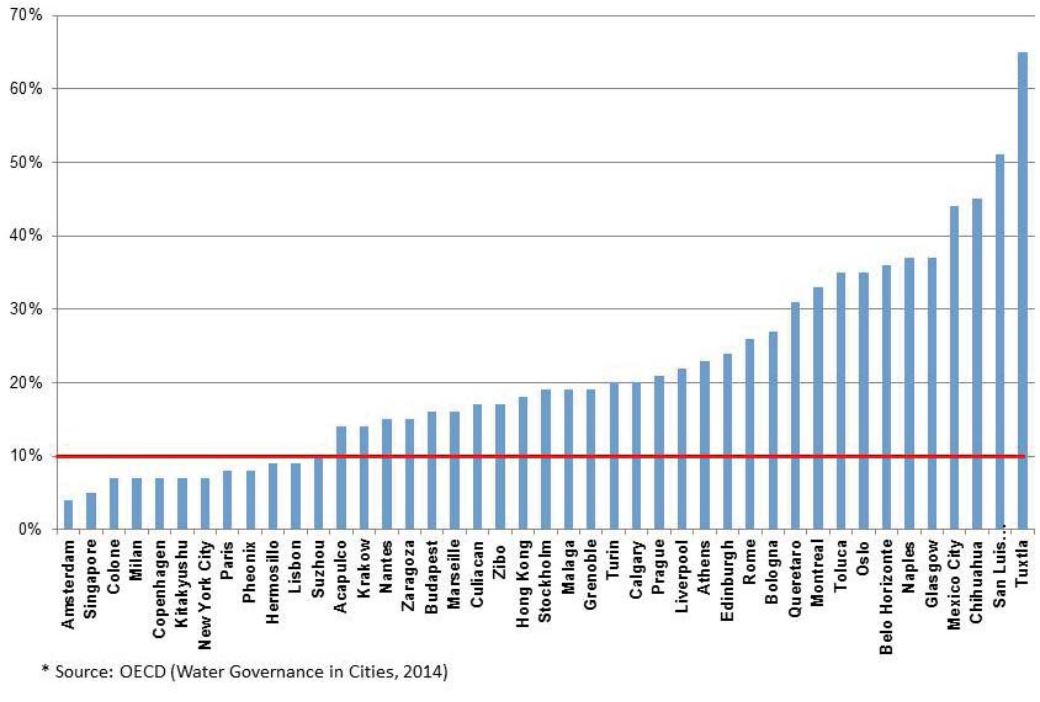
The magnitude of the investment and of the work which will be involved should not be underestimated. Tokyo has a total of 27,000 km of piping. London is estimated to have 20,000 km, while Seoul has 14,000 km. The cost of replacing those pipes is significant, both in terms of material cost and of disruption to road and pathway systems. But when you consider that in Tokyo there has been a saving of 227 million m^3 of water (Seoul is estimated to have a final saving of 473 million m^3), and when you add to those savings the reduced maintenance and replacement cycles, the payback for the initial investment must be justifiable.

The International Stainless Steel Forum (ISSF) is working closely with Team Stainless (ISSF, the International Nickel Study Group, the International Chromium Development Association, the Nickel Institute, the International Molybdenum Association, and Eurofer) to carefully track the progress of these three projects and extract the learning points from which other Water Authorities from around the world may benefit. A presentation and suitable written material will be prepared to assist members in their marketing activities with various Water Authorities around the world.

The ultimate benefit therefore will be two-fold: first, there should be an increase in demand for stainless steel form a hitherto underdeveloped new market sector (which is always welcome); and second, stainless steel will be able to demonstrate yet again its potential as an environmentally sustainable material, contributing in an incomparable way to conserving scarce water supplies.

The International Stainless Steel Forum (ISSF) is a non-profit research and development organisation based in Brussels, Belgium, which represents the interests of stainless steel producers around the world and also of those associations whose primary goal is to develop the markets for stainless steel. The work of the ISSF is undertaken largely through five specialist committees: Market Development; Health, Safety and the Environment; Long Product Market Development; Raw Materials; and Economics and Statistics. The ISSF currently has 65 members and represents approximately 85% of the world's production of stainless steel.

Chart 1: Leakage rates in major cities



* Source: OECD (Water Governance in Cities, 2014)