Water for the World

Detecting and Correcting Leaking Pipes

Technical Note No. RWS. 4.0.1

Leaks may occur without detection because they are often relatively small and do not create immediate problems such as washing out a road or draining a water tank. Small leaks can continue for years undetected. Even minor leaks, however, usually get worse, are costly and eventually can cause significant damage. Leaks are particularly expensive if the water has to be pumped or is scarce.

The benefits of a leak detection and repair program include:

1. Water saved. This is particularly important if water is scarce.

2. Money saved. Money is saved by reducing pumping costs and the need for system expansion.

3. Greater system reliability. Most leaks eventually get bigger causing system disruption or breakdown.

4. Improved customer satisfaction. This directly relates to items 1 through 3 above.

Detecting Leaks

A program to detect and correct leaking pipes should begin at the time the distribution system is designed and constructed. Leaks are less likely to occur if the proper pipe selection is made and the system is constructed in accordance with the manufacturer's recommendations and standards of good practice. Should leaks occur, they can be detected and located if the system is fully metered and accurate water production and use records are maintained. Leaks can be more easily repaired if accurate as-built drawings were done, if the system has an adequate number of properly located valves so the problem area can be isolated, and if a stock of spare pipe, fittings, and repair parts have been set aside.

The first step in detecting leaking pipes is to establish a routine leak detection program. This should consist of several elements. First, the pipeline should be walked or driven regularly. Visual observation should be made of signs of leaks such as a slump in the material over a trench, abundant vegetative growth or surface moisture. Any construction activities in the vicinity of the pipeline should be noted and investigated. Valve covers should be removed and the valve box visually inspected for moisture. Special attention should be paid to wash crossings and road crossings. Serious leaks will often occur in those locations.

Second, a water use analysis should be made. This is best accomplished by having a water meter at the source to measure total water production and water meters for each point of use. Water then can be checked by subtracting the amount used from that produced. Since many rural systems do not have flow recording capability, alternate methods must be found. One method of measuring water production is by checking the length of time the pumps run. An estimate can then be made of production if the pumping rate is known. If not, the pumping rate can be calculated by measuring the change in volume at the water storage tank over a set period of time. This should be done when there is no demand for water and the outlet valve can be closed. Once the amount of water produced is known, it can be compared to expected use. If the use is higher than estimated, leaking might be expected. Keep in mind that usage less than expected does not mean there are no leaks.

The following example illustrates water production and use estimation. A water utility wishes to estimate water production and compare this to expected usage. The system has a pump and a concrete water tank that has inside dimensions of 5m x 5m x 5m. There are 40 houses on the system, all with simple inside plumbing. The population served is 240 people.

At 1:00 a.m., the valve on the discharge side of the tank is turned off and the water level in the tank is accurately measured. The depth is 2m. The pump is started at exactly 1:30 a.m. At 2:30 a.m. the pump is shut off and the water level again measured. The water now is 2.42m deep. The level increased 0.42m in one hour.

Convert 0.42m to cubic meters to find the volume:

5m wide x 5m long x 0.42m high = 10.417m^3. Since there are 1000 liters in 1m^3, 10.417m^3 is 1000 x 10.417 or 10417 liters of water.

10417 divided by 60 minutes which is the pumping time = 173.5 liters per minute. The pumping rate is 173.5 l/min.

The expected water use might be 100-200 liters per day per person or 100 x 240 = 24000 l/day to 200 x 240 = 48000 l/day.

Since the pumping rate is 173.5 l/m, this demand should be met with a pumping time of $\frac{24000 \text{ l/d}}{173.5 \text{ l/m}}$ =

138 minutes to $\frac{48{,}000 \text{ l/d}}{173.5 \text{ l/m}}$ = 276 minutes.

If the pump operates longer than 138-276 minutes per day, leakage might be expected. Compare the actual pumping time per day with the expected time of 138-276 minutes per day.

Water production should be recorded routinely once the pumping rate is known. This is done by recording the amount of hours of pumping each day or week. Variances in pumping time should be analyzed taking into consideration the time of year, celebrations, religious ceremonies, or other unusual events. If there is no logical explanation for increased usage, then the line should be visually inspected and customers visited.

Even if individual water meters are not installed or are not read, the customers should be visited at least semi-annually to check for leakage on the property. A large amount of leakage occurs through faucets and flush valves, within individual homes. For this reason, it is important that the residents be aware of the need to keep leaks repaired.

Another likely place for leaks is a public standposts. Valve washers wear out, valves are damaged and occasionally left open. For these reasons, a daily inspection is best for public facilities.

If the above steps have been taken and undetected leaks are still suspected, there are three options available. The first is to uncover the pipeline in areas likely to leak or where leaks are suspected. The second is to obtain leak detection equipment or hire a company that performs this service. If the cost of producing water is high or the available quantity low, then this may be a good alternative. The third is to isolate parts of the system by closing valves and measuring the water lost from storage over a period of several hours. This should be done when water is not being used. A good time is 1:00 a.m. to 4:00 a.m. The exact method depends on the system and how it is valved. A more certain method of detecting flow is to install temporarily a small water meter at locations where the line branches as shown in Figure 1. The meter would be monitored between the hours of 1:00 and 4:00 a.m. as described above.

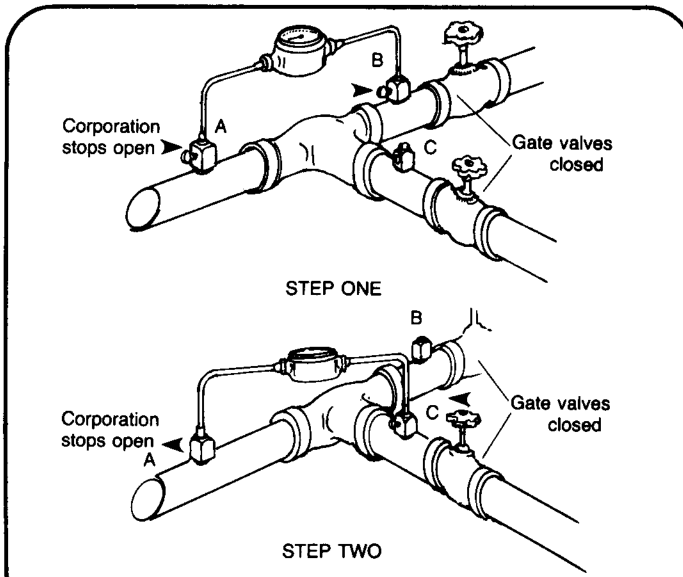

Figure 1. Metering for Leaks

With all valves closed, attach the temporary meter to line A to B and check for flow over an hour's time. Next, connect from A to C and check after another hour's time. Any flow registered on the meter indicates leakage in that line.

Repairs of Leaks

When a leak has been located, it will be necessary to first turn off the water to the section of line under repair. If valving is adequate, few people will be inconvenienced. In other cases, major portions of the system must be shut down. To minimize the time that service is interrupted while repairing a leak, be sure all necessary parts, tools and equipment are available before turning off the water. Whenever old pipes are disturbed, additional leaks may occur or the pipe may break, so be sure extra pipe and fittings are available. Residents should be notified that the water will not be available so they may store some water for essential use.

Leaks can be repaired in two basic ways. The first is to replace the defective pipe, coupling, or fitting. This is difficult, since normally pipelines are installed in sequence from one end to the other. In the case of a repair, however, there is no "free" end to work from so various repair devices and methods have been developed. For a hole or crack in a pipe, repair clamps are available that are wrapped around the pipe and secured with bolts. See Figure 2. If the break is too large to be covered by a repair clamp, a section of pipe must be removed. A new piece can then be installed using an original coupling and a special coupling or two special couplings or repair devices. See Figure 3.

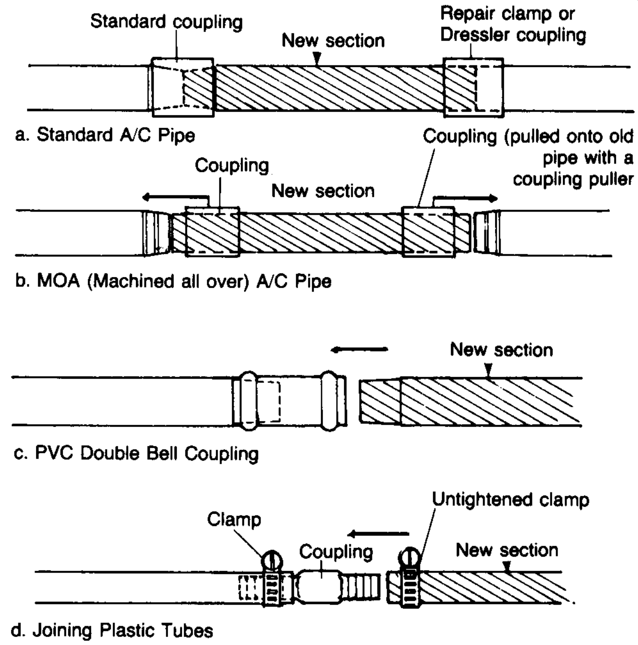

Figure 3. Replacing a Section of Pipe

Asbestos cement pipe is available in a diameter that allows the coupling to be slid back over its entire length. This is known as machined-all-over, MOA, pipe. A length of MOA pipe and two standard couplings can be used to make a repair. See Figure 3b.

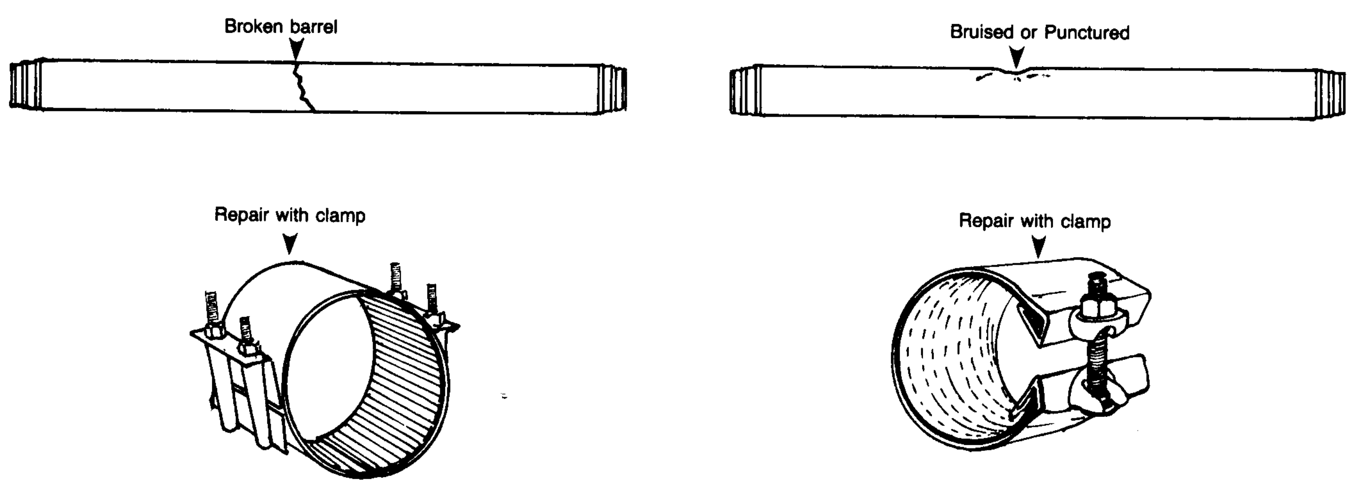

Figure 2. Methods of Repairing Defective Pipe

Polyvinylchloride, PVC, pipe can be repaired with a double bell coupling by the following method:

1. Push a double bell coupling onto the spigot end of a length of pipe as shown in Figure 3c.

2. Then push the spigot end of the next length of pipe into the coupling bell and adjust the positions of spigot ends and couplings so that the reference marks on each pipe are hidden under the coupling end.

In the same way, the double bell coupling may be used to put new pipe lengths into an existing line. After the replacement pipe has been cut to the proper length, mount a double bell coupling on each end. Push each coupling all the way onto the pipe end and position the new length in the line. Then slide each coupling into place, bridging the ends and aligning the coupling over the reference marks.

Because of its flexibility, polyethylene pipe can usually be repaired by simply cutting out the damaged section and installing a new piece with insert couplings and clamps. See Figure 3d.

Disinfecting the Line

After a repair is made, the line must be disinfected and flushed. One way to do this is to place some chlorine tablets in the line while it is open. When the repair is completed, enough water to just fill the line is let in. Do not allow enough water in to wash the chlorine away from the repaired section. After 30 minutes, the line can be flushed. An alternate method is to chlorinate the entire system, as is done when a new system is installed. See "Installing Pipes," RWS.4.C.1.

A sizable quantity of water can be wasted from leaks in household plumbing. This type of leakage will show up as water that is used, not wasted, when metered water production and usage are compared. It is difficult to detect by other means. A public information campaign and voluntary home leakage inspection are probably the most effective ways to reduce this type of leakage.

Technical Notes are part of a set of "Water for the World" materials produced under contract to the U.S. Agency for International Development by National Demonstration Water Project, Institute for Rural Water, and National Environmental Health Association. Artwork was done by Redwing Art Service. Technical Notes are intended to provide assistance to a broad range of people with field responsibility for village water supply and sanitation projects in the developing nations. For more detail on the purpose, organization and suggestions for use of Technical Notes, see the introductory Note in the series, titled "Using 'Water for the World' Technical Notes." Other parts of the "Water for the World" series include a comprehensive Program Manual and several Policy Perspectives. Further information on these materials may be obtained from the Development Information Center, Agency for International Development, Washington, D.C., 20523, U.S.A.

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