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WATER SUPPLY NETWORKS AND PIPELINES

The hidden costs of resorting to intermittent supplies

Intermittent supplies through municipal piped water networks can be due to a lack of hydraulic capacity or severe deterioration in the network, but they can also be a result of rationing imposed as a last resort during water shortages. ***Bambos Charalambous*** *explains the hidden costs of intermittent supplies, and underlines the contribution that well-maintained networks that allow losses to be minimised can make when there are pressures on resources.*

Intermittent water supply may be defined as a piped water supply service that delivers water to users for less than 24 hours in one day. It is a type of service that, although little found in developed countries, is very common in developing countries. In an intermittent supply situation the consumers secure their water supply through the use of ground or roof tanks, which are filled during the time that the supply is provided. Intermittent water supply is enforced not only in cases where there is water shortage, but also where the hydraulic capacity of a network is such that it is not possible to satisfy demand, as well as in cases where the networks are severely deteriorated.

The pressures that exist on water resources are highlighted by the water stress indicator (Figure 1, World Water Council, 2008), which measures the proportion of water withdrawal in relation to total renewable resources. As can be seen from the map, a large proportion of the densely populated part of the planet has a high to very high water stress indicator. It is therefore imperative to develop appropriate water management approaches in order to manage our water resources efficiently and effectively.

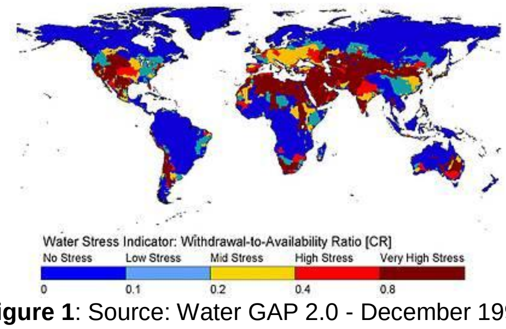

Figure 1: Source: Water GAP 2.0 - December 1999

Climate change adds to these concerns. It has been affecting the average weather patterns that we were all used to and engineers and scientists have to take this into consideration in present and future planning. As an example, in Cyprus, the largest island in the eastern Mediterranean, the precipitation records of the last 100 years indicate an overall decrease in the mean annual precipitation of about 15%, but annual variation in precipitation varies considerably from the mean with long periods below average, affecting significantly the annual water resources of the island. This pattern is very similar across the Mediterranean basin and there are cases in recent years where cities were even forced to ship water from other countries in order to combat the crisis. For instance, the town of Lemesos in Cyprus was supplied daily by tankers with water from Athens in Greece for an eight month period in 2008/2009 to overcome a serious water shortage problem caused by prolonged drought. During the same period Barcelona in Spain was also being supplied water via tankers in order to relieve a similar water crisis. This phenomenon seems to be growing to global dimensions.

Faced with such pressures, there is the prospect that water authorities will increasingly wish to resort to delivering intermittent supplies. Usually during drought periods water authorities impose water restrictions to both domestic and agricultural supplies. At the same time they move forward with the construction of treatment units to treat domestic effluent for agriculture, and if this measure is not sufficient they resort to the construction of desalination plants to produce potable water for satisfying domestic needs, thus adding to the water balance and reducing deficit. However, in most cases water authorities seem to overlook the obvious, which is to manage the water networks in the most efficient and effective way in order to minimise losses.

The contribution of water loss minimisation

Reducing losses from distribution networks is of the utmost importance and water utilities must recognise this and respond positively.

Efficient and effective water loss control should be recognised as a first priority for improving potable water supply. Decision makers at all levels in water utilities must understand that any water loss control strategy, in order to be effective, must be a continuous activity based on a long-term strategy and should form an integral part of the utility’s vision. The success of the strategy will inevitably depend on the commitment and dedication at all levels within the utility and of course on the adoption of appropriate strategies and techniques. A successful strategy is one that maintains the distribution network in a proper working order, reducing and maintaining leakage at an economic level, and of course providing the required level of service to all consumers.

The effects of intermittent supply

In this context, intermittent supply does not constitute an efficient and effective strategy for managing distribution networks, irrespective of the problems and factors which lead to such a modus operandi. Intermittent supply may seem to be the ‘short’ term answer to water shortage situations, but inevitably it has an adverse effect on the integrity of a water distribution network and evidence is provided below to substantiate this based on real case studies.

In many instances there is no indication how long intermittent supply measures will be in place. The hydrological conditions in each case could impact adversely on water supply for years, in which case conserving limited water resources as much as possible may not be the long-term solution, but it may be necessary to add to the water balance new unconventional water resources. In many countries water shortage problems have been overcome through desalination of brackish or saline water. Of course exploring every potential water source available may be the only solution in many instances, but conservation is always one of the least expensive and quickest solutions to ensuring that water will be available when needed.

Analysis of case study data has shown that there was a large increase in the number of reported pipe breaks during periods of intermittent supply. In order to quantify this, a comparison was made between the breaks reported before intermittent supply was applied and those reported immediately after the measures were lifted, as shown in Table 1.

Table 1. Effect of intermittent supply on reported pipe bursts

Description	Number of reported breaks		
	Before	**After**	**% increase**
Mains	1 in 7.14 km	1 in 2.38 km	300
Service connections	15.5 in 1000	29.7 in 1000	200

This comparison showed that the number of breaks on mains increased from an average of 1 in 7.14 km of mains to 1 in 2.38 km of mains – an increase of 300%. Similarly the number of reported service connection breaks increased from an average of 15.5 in 1000 connections to an average of 29.7 in 1000 connections – an increase of approximately 200%.

Of course, in addition to the reported breaks, there are a significant number of breaks caused by the frequent emptying and refilling of the network, which do not come to the surface since the network is not pressurised for any significant length of time to force the water to come to the surface or allow for location of these breaks through active leakage control. Based on case study data, calculations have shown that the increase in leakage due to the intermittent supply measures was of the order of 9% of the system input volume. This figure was substantiated in an analysis using a ‘top down’ and ‘bottom up’ approach before and after intermittent supply was applied.

Figure 2 shows the total Minimum Night Flow before (blue colour) and after (red colour) the intermittent supply. It is obvious that there has been a significant increase in the Minimum Night Flow, which could only being attributed to the additional breaks the network suffered during the intermittent supply period. These unreported breaks will have to be located using active leakage control activities and repaired in order to reduce the level of leakage to the level prior to the application of intermittent supply measures.

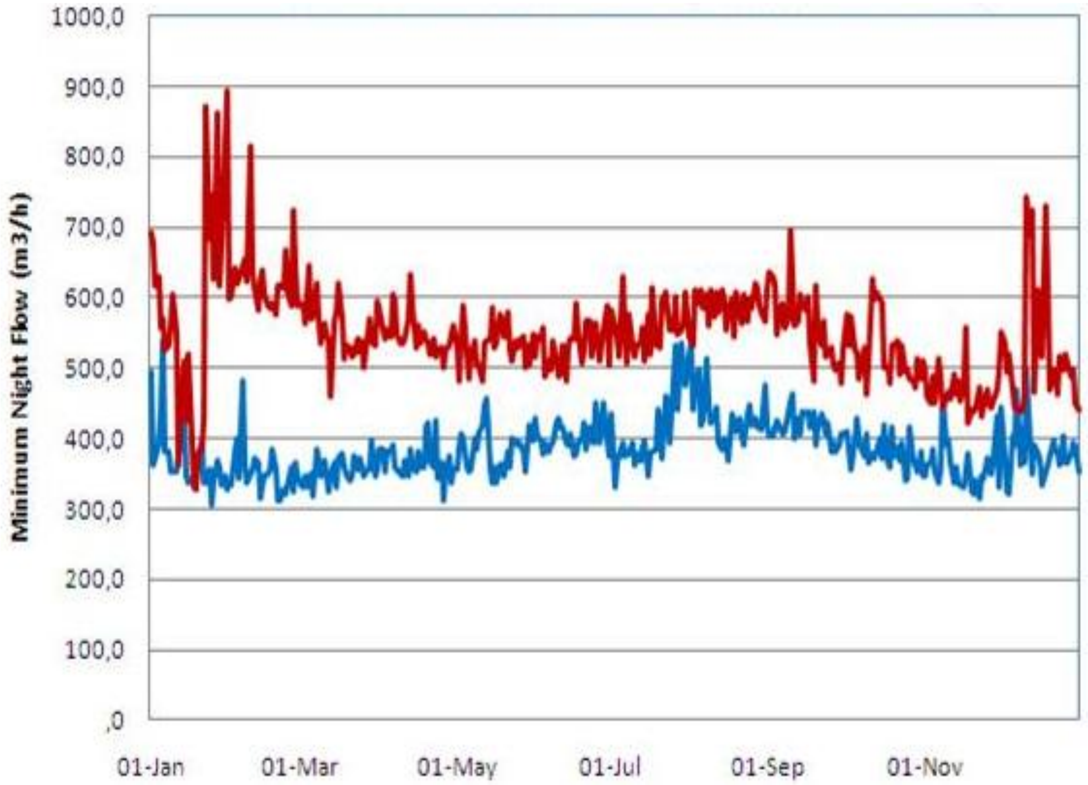

Figure 2. Minimum night flow before and after intermittent supply

Further evidence from the case study to substantiate the increase in leakage due to the intermittent supply measures is given in Table 2, which shows an increase of 12.8% in the system input volume after intermittent supply compared with before, without a corresponding increase in customer consumption. In fact the customer consumption was slightly less than that of the year before the intermittent supply measures were applied.

Table 2: System input volume vs customer consumption

Year	System input volume	Customer consumption
Before intermittent supply	0	0
Intermittent supply	-17.5%	-9.2%
Intermittent supply	-9.1%	-8.9%
After intermittent supply	+12.8%	-1.2%

It is therefore evident that no matter how good a network is, intermittent supply operation has definitely a detrimental effect on its integrity, and in addition the amount of water ‘saved’ is later ‘lost’ and in greater quantities through increased levels of leakage.

Furthermore, numerous complaints are received from dissatisfied consumers regarding quality problems and of course lack of pressure during intermittent supply. Needless to say, intermittent supply causes serious disruption and upheaval to the daily activities of people both at home or at work.

Cost of intermittent supply

The implementation of intermittent supply has a direct financial cost to the water utility in addition to the loss of revenue due to the decrease in the sales of water. The direct costs include, amongst other additional operational costs for opening and closing sluice valves to implement water rationing: repairing reported breaks caused to the network due to the frequent emptying and filling of the pipes; and locating and repairing unreported breaks through an intensive and concentrated effort in order to minimise the running time of the additional leaks. The cost of water which is lost through the additional leakage caused by the intermittent supply operation depends on the running time of each leak and the cost of water. It is however a major cost to the utility and one which will continue to burden the utility until the additional leaks are found and successfully repaired.

Conclusions

It is evident from the results presented in this article that although intermittent water supply may seem to be a solution to a water shortage situation, in overall terms the water balance is adversely affected. Supplying smaller quantities in an intermittent manner causes such deterioration to the network that when continuous supply is re-established additional quantities are lost through increased leakage, which in fact places an added financial burden on the utility.

It is therefore prudent to avoid such operation, especially for networks that have been designed for continuous supply.

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World Water Council, www.worldwatercouncil.org

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