Dynamic Pressure Control in the Operation of Water Supply Systems

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Published in International Water & Irrigation Vol. 25, No. 2, 2005 pages 14-16

Water companies and authorities are committed to the uninterrupted supply of water at the required quantity, quality and pressure. In Israel, as in the rest of the Western world, water system planning is based on the assumption of growth in both population and demand, with the objective being the system's ability to cope with peak demand days and hours, for the duration of the system's expected life span. In many instances, the water supply system is adjusted to the daily peak demand hours. Pressure reducers, for example, are calibrated to maintain a consistent pressure at the pressure reduction point, such that it will be sufficient to cope with demand during peak hours. In these cases, there are many periods of operation during which the system is working in a state of "over-production", with excess pressure in the system.

Dynamic pressure control that adjusts to changing conditions throughout the day and from season to season, is an efficient tool that contributes greatly to several aspects of the system's operation:

- Reduction of water leakage, resulting in –
  - Efficient use of existing water resources
  - Delaying need to invest in development of new water sources
- Reduction in number of pipe bursts (up to 50%), resulting in –
  - Reduced water system maintenance costs
  - Extended life span of system pipes and accessories
  - Delaying need to invest in system renovations
- Increased reliability of water supply, together with higher customer satisfaction
- Optimal match between infrastructure size and water supply demand, with reduced investment in infrastructure
- Reduction in energy consumption for operation of water supply installations

The aim of dynamic water pressure control is to achieve uninterrupted pressure regulation such that excess pressure will not be created at critical junctures in the system, while minimum pressure is maintained constant. Pressure is adjusted in accordance with supply, based on pre-set times or other indicators remotely measured at the system's critical junctures. The primary means of pressure regulation are pressure reducing control valves installed at critical points at the entrance to supply zones.

Figure 1: Pressure management system of measurement zone in municipal system in Greece.

The immediate contribution of pressure control is the resulting reduction in leakage and reduced number of burst pipes. Experience indicates that a large proportion of leakage originates at small leakage points, in the small-diameter service lines, at the line connections, and at adapters. It is very difficult, and not economical, to locate and repair these numerous small leaks. Reduced pressure is therefore the most efficient and economical way of reducing leakage originating at these points. Furthermore, ongoing and regulated pressure control that avoids excess pressure and frequent changes in pressure significantly reduces the number of bursts in the system's lines. Studies conducted around the world indicate that it is possible to reduce both leakage and incidence of pipe bursts by 50%.

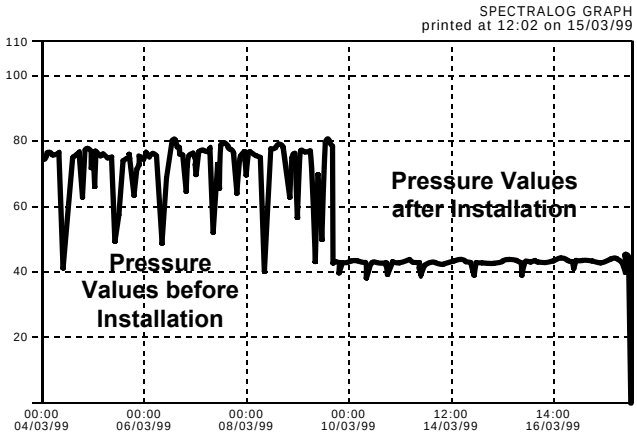

Figure 2: Pressure curve at critical juncture in water system, before and after installation of pressure control system

Project Khayelitsha, South Africa

As part of a comprehensive project in South Africa, a product developed by BERMAD was installed and used with great success. The BERMAD product was a modulated pressure reducing valve with controller, for use in a pressure regulating system and aimed at solving the problem of leakage in the municipal water supply lines. It proved to be an optimal system for minimizing leakage in water supply lines through management of the system's water pressure.

In June 2001 the Cape Town municipality embarked on a project to introduce a pressure management system into the Khayelitsha water supply lines. The main objective was to improve water supply services to this community by reducing excess pressure in the system. Khayelitsha is one of South Africa's largest townships. Located 20 kilometers from Cape Town, it covers an area of 24 square kilometers with a population of 450,000.

At an initial project cost of some $500 thousand, the resulting average annual savings are $2.7 million from reduced leakage and consumption. Reduced consumption is a result of system pressure management, generating approximately 12% savings in supplied water.

The project utilized BERMAD adjustable pressure reducing valves, model 720-4T, together with Technolog control mechanisms. Installed on the city's main supply lines and controlled by the Modulo-One control mechanism, the pressure reducing valves are successfully carrying out their objective of system pressure management.

Figure 3: Khayelitsha township pressure management system with BERMAD pressure reducing valves.

Project Results – Water Savings

Savings due to regular pressure reduction (fixed downstream pressure)

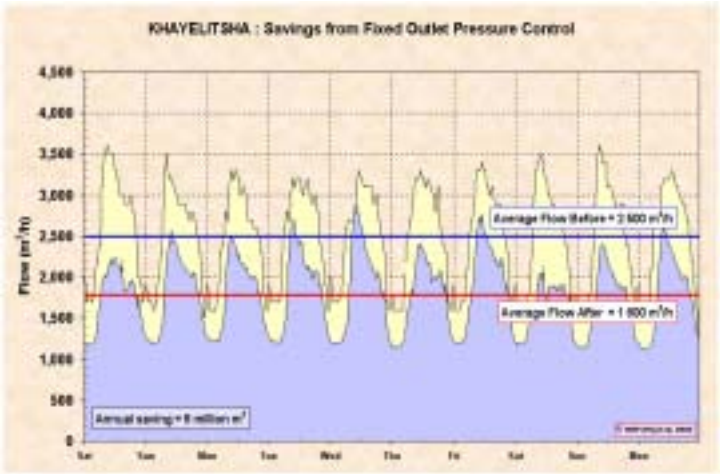

Figure 4: Saving from fixed outlet pressure control

Savings due to dynamic pressure control (fluctuating downstream pressure per consumption demand):
Additional savings from dynamic pressure control over savings from fixed pressure – approximately 300 cubic meters/hour.

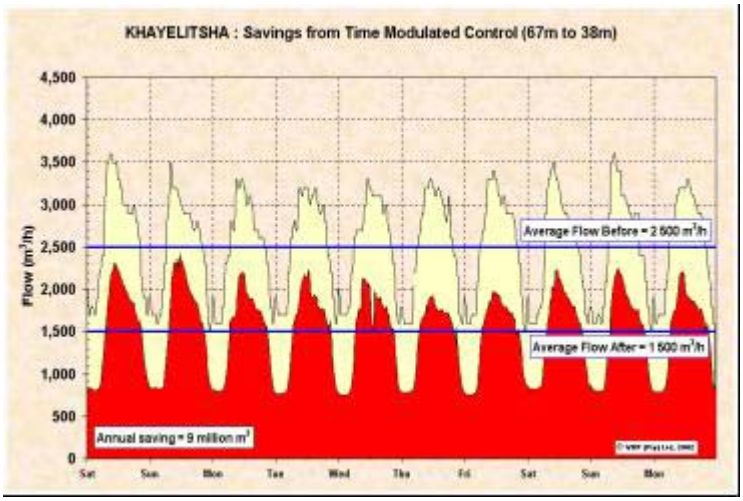

Figure 5: Saving from time modulated pressure control

Hourly savings generated by project: 1,000 cubic meters/hour.

Figure 6: An Olympic swimming pool

The amount of water saved every two hours is equivalent to the amount of water in an Olympic-sized swimming pool.

Daily savings generated by the project: 24,000 cubic meters.

Figure 7: Concrete Water Reservoir

This is equivalent to the contents of two concrete water wells per day.

And yearly savings amount to: 9,000,000

Figure 8: Medium-Sized Reservoir

The equivalent of a medium-sized reservoir each year.

"The Khayelitsha project represents the world's largest and most complex project of its kind, and is hailed by many international experts as the world's most successful project application." Reported by Ronny McKenzie, Manager, WRP (Pty) Ltd.

České Budějovice, Czech Republic

The town of České Budějovice, political, industrial and cultural centre of the South Bohemian region is located 160 km south from Prague, on the junction of the Vltava and
Malše Rivers. The area has become famous abroad mainly due to the traditional production of the Budvar beer. The source of drinking water for the town is the ”South Bohemian Water System”, the system extending to 268 km of water pipelines, bringing the drinking water to about 350000 inhabitants.
1. JVS, the largest water-management organization of the Czech Republic is the operator of the town water-supply infrastructure since 1997.

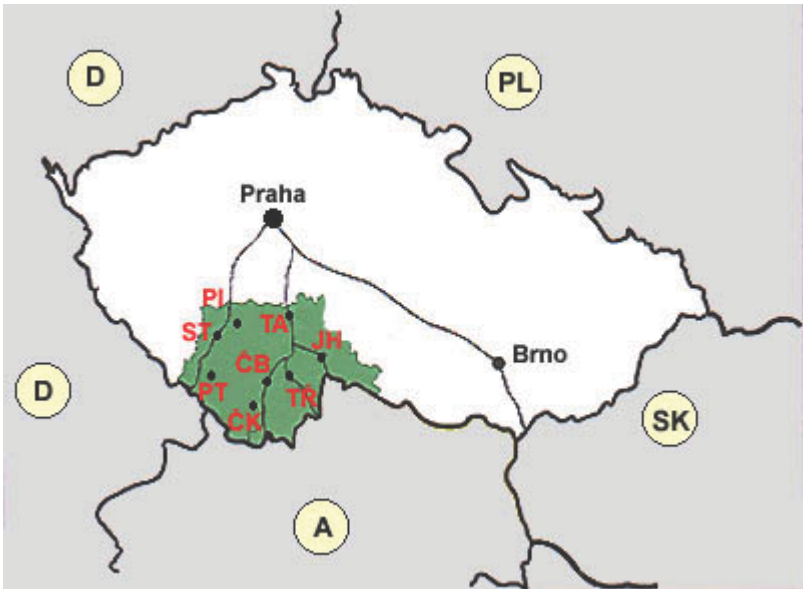

Figure 9: The map of the Czech Republic with the respective localities

The water system of the České Budějovice town was not measured prior to the privatization of public water piping in 1997, and only the balance of the city consumption in the context of the whole system was calculated. Losses of drinking water have been positively distorted by influence of the length of feeding piping and a large volume of consumed water. Thus there was no need to make any corrective measures.
Due to the change of the operator the town water system it was required to determine the volume of the purchased water. The measurements are done in "transfer places" – the connections between the South Bohemia and the city water supply system. Together with creation of the transfer places the water management dispatching has been created, monitoring the main water object of the town network. The first results of its implementation were the enumeration of the volumes of the losses of drinking water within the distribution network. During that time the new operator made diagnostics of the network in order to reduce the problems of leakage. BERMAD was selected as the supplier of the reduction systems to this project. And supplied 9 units of pressure control valves (sizes 150 mm to 300 mm) equipped with BE controllers to control the set point changes according to consumption tables prepared by the operator.

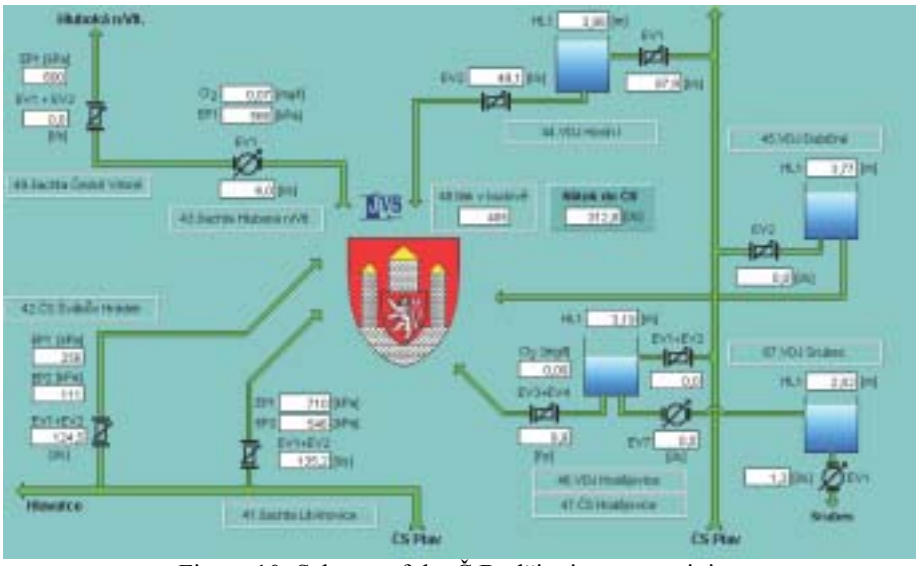

Figure 10: Scheme of the Č.Budějovice water piping

The evaluation of the effectiveness and return ability of the implementation and control of the pressure reducers can be considered in several levels. The main contribution is the economic impact to the existing expense items. The controlled pressure regulation in the water supply systems leads to the decrease of the volume of the non-invoiced water (by means of the volume of water leaked due to breakdowns or leakage of water supply network, by smaller stress of the piping material) and thus it leads to the decrease of the volume of purchased or produced water. Based on this experience the return ability of the investments is about 3 ÷ 4 years.

Another indispensable contribution is a considerably higher control level of the water system within the real-time. The result is the optimization of the water supply network operation, affectivity of all the operational or technical measures on the network and last but not least maximum directness of the reconstructions done.

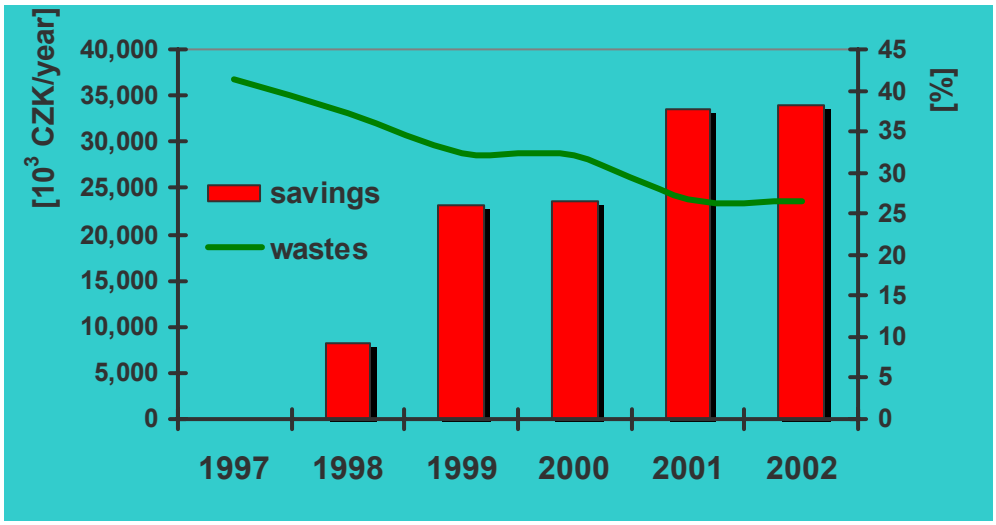

Figure 11: Benefits from the controlled pressures in the network: leakage reduction by some 40%

The report of České Budějovice prepared by: Ing. Vladimír Kadeřábek, NETAFIM CZECH s.r.o., Žatec and Ing. Radek Mára, 1.JVS a.s., České Budějovice 2.2004.