ENERGY LOSS IN THE WATER SUPPLY DISTRIBUTION SYSTEM

1. Introduction-Abstract

Water loss in the distribution networks of many water supply systems has already reached enormous proportions. Therefore, the focus of today’s water supply professionals on water loss is perfectly justified. However, energy loss is rarely spoken of, even though it is often equally large.

This paper focuses on energy loss as its primary interest. It shows that this loss is the result of outdated and irrational concepts of the water distribution systems, their outdated means of maintenance and the water loss from their distribution networks. In the end, the conclusion is that energy loss is, in fact, a real problem pertaining to the water supply, that this loss also includes water loss, and that any action should be directed towards reducing energy loss.

2. Energy Loss Reduction through the Rationalisation of Water Distribution System

In the beginnings of organized water supply, small and conceptually simpler distribution systems were set up. Water was first hoisted into reservoirs (buried, if they were in the mountains, or in water towers, if they were in the lowlands) and then released into the distribution network with the help of gravity, or pumped directly into the distribution network (with or without opposing reservoirs).

With the progress of urbanization, areas of distribution were becoming ever larger, and due to the new larger required quantities of water, water sources were becoming more and more remote. In short, everything was expanding, growing and changing, and it was merely the simple initial concept of distribution that often remained the same. In consequence, the supply pressure in many of water mains is now permanently much higher than necessary, which causes them to unnecessarily consume much more energy than needed, and this excess of energy/pressure (as its loss) is expended/destroyed at the valves of the consumers’ house installations and for the extrusion of water loss from the distribution networks.

Naturally, the rational solution to such a problem is generally not a simple installation/interpolation of a few reduction/regulating valves within the distribution network. This would only concentrate the destruction of energy and move it to different locations, but it would not lessen the loss of energy. The solutions to such problems should be sought in the gradual transformation of the outdated concepts of distribution and in the reduction of engagement of such unnecessary surplus energy/pressure, and not in its forcible destruction, in any way and at any location possible. Such a thing could unburden home installations and partially reduce water losses, but through the destruction and loss of energy, and not through the reduction of its unnecessary engagement and its loss.
Such solutions may be acceptable in some limited and specific conditions, or in the absence of sufficient amounts of water (when the reduction of water loss can be, at least temporarily, acceptable even at the cost of destroying energy), but they certainly cannot be the universal and standard methods in solving such problems.

Unfortunately, even the new large water supply systems are still often designed following the same outdated concepts of smaller systems, and the same problem of the resulting unnecessarily high pressure/energy is resolved in the same way, with the use reduction/regulating valves and through its destruction. Even if this is still somehow understandable in old waterworks, it makes no sense for the new projects (not even when it is presented as any innovation). In new systems, such concepts/solutions result in the destruction of the same energy that has just been engaged.

In short, the problems of unnecessarily high pressure/energy should be resolved by reducing its engagement, and not by destroying it. Unnecessary energy should not be engaged in the distribution system. This would, of course, call for a more complex and flexible concept of distribution systems (based on the principle of adding the energy which is lacking, and not destroying the surplus energy), but this is inevitable, because today’s large and interregional distribution systems cannot be resolved and designed in the same way that small and rural water supply systems once were.

3. Energy Loss Reduction through Modernisation of Distribution System Maintenance

Energy loss in distribution systems also is the result of outdated maintenance methods. Often, most waterworks’ telemetry is still SCADA only of peripheral input-output facilities’ (pumping stations and water reservoirs). Usually, with such telemetry system, there is almost no information about the conditions and effects of water supply within the area of distribution. For example, the current status of any valve within the distribution network isn’t really know and cannot be seen, although several of them can be broken, and partially or even completely closed (without valid reason or conscious intent). This is often merely the result of the sporadic opening and closing of nodal and sectorial network valves during its repair, and the inadvertent omissions by workers, due to which some of the valves remain closed even after the repairs have been finished. Over time, the number of such sporadically closed valve grows, sometimes so much that it significantly increases energy loss and reduce the distribution network’s capacity.

Naturally, the rational solution of these problems does not in adding new energy and/or further building new capacity of the distribution network, but in further development of the telemetry system inside the distribution network (telemetry of pressure and flow at the reference networks locations), detection and localisation of the problematical valves, and their repairing and opening. Due to the traditional way of sizing the water supply systems for some always underestimated maximum long-term needs, their distribution networks are often already oversized, so the potential lack of supply pressure is rarely caused by a lack of their installed capacity. This is more frequently caused by the lack of their actual capacity, which is often much smaller than the installed capacity, precisely because of the uncontrolled conditions of their nodal and sectorial shutter/valve.

The telemetry of flow and pressure within the distribution network, at the same time, is the system’s component for the detection of the real status and for the control of its node and sectorial shutters/valves. When interacting with a mathematical model of the distribution system, such a telemetry system is the most effective support to the modern maintenance of water supply systems. Such support can reduce energy loss and free the installed capacity of the distribution network, and that is certainly more efficient and economical than permanently adding new energy or permanently building up the network capacity.
4. Reducing Energy Loss through Water Loss Reduction

Assuming that the problem is not in the lack of sufficient quantities of water, then the water loss is really loss of energy, engaged in the capturing, treatment, transport and distribution of this water loss (the water itself is not actually lost - with the loss of both energy and the installed capacity of the distribution network/system, it is just moved to other locations). Water loss reduction actually reduces energy loss and frees the capacity of the distribution network/system. So, the water loss detection system, at the same time, also is a component of the energy loss detection and reduction system.

5. Practical experiences

Through his 30 years of consulting experience in water supply, the author perceived that, due to the reasons described herein, the pressure was as much as twice higher than necessary in many waterworks in Croatia, that many lacked the distribution network capacity despite the fact that their already existing nominal capacity were sufficient even for long-term needs, that the average water losses reached as much as 40-50% and that were even higher in many waterworks. All of the above are the reasons of very large total energy losses in these waterworks. Unfortunately, it was also shown that, despite all the efforts, all of the problems were real still only increasing. Although all this might not be specific only to Croatian waterworks, it is absolutely necessary time for them to redirect their reorganization and restructuring, from the prevalent changes of their administrative management and their focus only on building new facilities, towards changing that which is being managed and a more effective rationalization of the already existing systems and modernization of its operational control and maintenance.

6. Conclusion

All of this leads to the conclusion that the energy loss is a broader concept and that it, at the same time, also includes the concept of water loss. Activities pertaining to energy loss reduction also include the activities aiming to reduce water loss, but also the activities of distribution system rationalisation and distribution system maintenance rationalisation. Energy loss reduction covers the whole problematic and all of these activities are performed interdependently and synchronously, so that neither of them can not be implemented at the expense of another (for example, water losses cannot be reduced at the expense of increasing energy losses).

Therefore, the conclusion is that the question of energy loss in the water supply should be opened and the activities to reduce this loss should be initiated. In line with the above, it would be a good idea to begin translating the topic of water loss into the topic of energy loss, and to reduce water loss through integrated activities to reduce energy loss.
Related links:

- [Integrated GPRS Telemetry, AMR/AMI and Leak Detection in Water Distribution Network](#)
  Coprogram Ltd. Zagreb, Croatia
- [Why integrated Telemetry, AMR/AMI and Water Leaks Detection System ?](#)
  Coprogram Ltd. Zagreb, Croatia
- [Integrated Water Supply Distribution System](#)
  Coprogram Ltd. Zagreb, Croatia
- [Modern methods of reducing water losses and causes frequently poor results of their application](#)
  Coprogram Ltd. Zagreb, Croatia
- [IWA/AWWA Balance Methodology and Water Supply Information System](#)
  Coprogram Ltd. Zagreb, Croatia

[Back to list of documents](#)