THE OPTIMIZATION OF ENERGY CONSUMPTION IN WATER SUPPLY SYSTEMS

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ABSTRACT

The present paper shows a few solutions of increasing the efficiency of water supply systems, by reducing the electrical energy consumption, which should also be correlated with the implications of the investment and exploitation costs, the extent of used surfaces, the volume and the quality of the built surfaces, taking into account that both the equipments and the surfaces built need a lot of energy for their construction.

1. INTRODUCTION

Each m^3 of water insured for the consumption includes a huge quantity of electrical energy necessary for the transportation, treatment, distribution, different internal technological processes of the water supply system. [1,2].
The practice in water supply systems shows that for 1.000 m^3 of treated water and delivered for human consumption are used 60 up to 600 kW. The very large limits of the interval mentioned (1 to 10) show the huge availabilities existent in the projection of water supply systems, regarding the insurance of a minimum of electrical energy consumption.
Finally, the electrical energy expenditure depends on the specific character of the area, the specific character of the water supply source, the treatment technology used, the means by which the water is transported to the consumer.
Next we will show some solutions which should be taken into consideration in establishing the projecting the water supply system stages in order to obtain a minimum of energy consumption.
The solutions will be displayed in the following stages:

- The elaboration of the water supply system scheme, according to the character of the area and the source;
- The implementation of some treatment technologies with low energy expenditure;
- Bad water management to the consumer.

2. THE ELABORATION OF WATER SUPPLY SYSTEM SCHEME

It is known the fact that huge quantities of electrical energy, used in water supply systems, are spent during the pumping phases.
In this way, when the consumption – per system – is around 500 - 600 kW/1.000 m^3 of delivered water, approx. 200 - 300 kW/1 000 m^3 are used for the treatment station, the rest are used for the pumping. If we take into consideration that in a treatment station, the consumption is due to pumping (reagents pumping, water for washing, etc.), we realize that in a water supply system the energy consumption used for pumping is substantial. On the other hand, there are certain water supply systems, having as sources storage basins, for which the energy consumption has reached 50-60 kW/1.000 m^3 for the water delivered to human consumption. Hence the huge energetic advantage the complex water arrangement

presents, with all the storage basins and their use as water supply source. Besides other pumping phases, there are also other advantages:

- Increasing the degree of insuring the discharge;
- The possibility of employing a more sophisticated treatment scheme;
- A simpler exploitation.

The storage basins – used as a water supply source – have a well established character from this point of view.

3. THE IMPLEMENTATION OF SOME TREATMENT TECHNOLOGIES WITH LOW ENERGY EXPENDITURE

The water treatment problem is directly connected with the quality of surface or underground waters, from which sampling is taken. The better the quality of water (I class category, according to STAS 4706-74), the easier the treatment, thus the electrical energy consumption is lower.

For lower quality waters category, the treatment is more difficult (in many stages) and, therefore the energy consumption is higher. Maintaining a correspondent water quality is a desideratum wished by water management authorities, through the measures of intensifying the rhythm of achieving and operating the waste water treatment plants, water coming form industrial sources and urban zones.

Without going too much into detail we will try to illustrate a few ways, which introduced into today's projecting technology, could lead to direct and indirect methods of saving the energy.

Such a method would consist in using some materials or treatment reagents, which have similar proprieties or which allow appreciable reductions of the classical materials and reagents.

These would be:

- Coarse sand – secondary product from the exploitation of some cyanide deposits, instead of classic quartz sand;
- The use of some adjuvant polyacrylamides type (med sol produced by ICPAO – Mediaş or "Petru Poni" – Iaşi), which used in very small quantities – 0,1÷ 0,3 mg/l – allow reductions of coagulation reagents doses (aluminum sulfate) of the order of ten mg/l;
- The use of some substances with superior treating proprieties as the ozone, powder or granulated activated charcoal, which allow being used as sources of water supply and natural waters with a high degree of pollution. Although the substances mentioned above entail electric energy consumption, sometimes – even substantial, the total energetic balance can be in their favor, especially in the areas where there is no other source of water.

Another method of reducing the electrical energy consumption in treatment plants consists in adopting some treatment technologies or methods of exploiting appropriate for the final purpose, for example:

- The use of suspension decanters by the recirculation of the suspension layer with the help of some hydro-ejectors with reduced load loss (ICPGA or ICB type); this installation type concentrates the mix, reaction and clearing in a sole installation, eliminating the rapid or slow propeller stirrer necessary in usual situations;

- Providing a decanter by-pass pipe and treating the water directly through filters; it can be applied almost all year round, for many water streams in our country; in this way the coagulation reagents consumption are reduced, thus indirect energetic savings are achieved;
- The use of technologies which involve stages of biological treatment, able to replace the stages of high energetic consumption (ozonization, ultra-violet treatment etc.)

4. JUDICIOUS MANAGEMENT OF WATER FOR CONSUMPTION

This is considered to be the area in which there's a need to insist on a change of mentality regarding the way water is perceived. Water must be considered a raw resource that includes a large quantity of energy and that must be managed with the same care the other energy-rich raw materials are managed with: iron, wood, cement etc. [3,6,7,9]

The following are needed to this end:

- Improvements to the way reinforcements, sanitary installations and water distribution networks are built, in order to reduce water loss; presently, in some cities or farms, the loss percentage is as high as 20 ÷ 25%, and even higher in some cases;
- On industrial plants and agricultural and zoo-technical centers a large scale implementation of not only recirculation, but methods of successive use of water, starting with the technological processes that are more demanding with regard to water quality and on to the technological processes that have less rigorous water quality limits.

Maybe, in a not so distant future, modifying the industrial technological processes in order to reduce water consumption on one hand and the pollution level in waste water on the other – in other words, developing "Dry technologies" for different technological processes – will also become a subject of discussion.

In this way, the effect will be more complex, resulting in direct energy savings as well as indirect savings, by protecting the quality of the water sources that will be assumed by the consumers downriver.

5. MEANS OF REDUCING ELECTRICAL ENERGY CONSUMPTION

In order to use electrical energy more efficiently, there are methods that can be applied in the design phase of a water supply system as well as in the case of already operating targets [1,5,7,8,9].

The main means for reducing electrical energy consumption are:

- Choosing the unit power and number in such way as to avoid a close ratio between the unit powers and the total electrical power absorbed by the water supply system; otherwise an over-sizing of the electrical energy supply system occurs in order to provide enough energy for starting the electrical engines, an over-sizing that leads to additional electrical energy loss; also, the units that function simultaneously musts me established in a precise manner;

- Choosing the adequate electrical tension (0,4 or 6 kV) for the pumping mechanisms engines (the 160-315KW range permits options), in relation to the total power absorbed by the target system, taking into account that higher tensions lead to less energy losses in the energy transport system, at the same level of power consumption;
- Using the variable rotation speed of the pumping mechanisms, in the water supply systems that don't have buffer-accumulations;
- Placing electrical energy delivery and distribution facilities (including substations) in the load centers of the energy consumers; the number and size of the distribution points is also correlated to these load centers;
- Using local reactive energy compensation systems (improving the power factor;
- Establishing technological measurements in the water supply system in such way as to reduce – or even eliminate – electrical energy consumption, at peak load times in the power system, when the quality parameters of the supplied electrical energy are low, due to strain;
- Partial or total automation of the technological processes involved in water supply;
- Adequate training for the staff handling the exploitation of the water supply system;
- Eliminating water losses within the water supply system, including consumer premises.

The means for reducing electrical energy consumption must be correlated to the effects on investment and exploitation costs, extent of used surfaces, the volume and quality of the constructions, taking into account that the equipments as well as the constructed buildings involve consumption of energy.

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