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Analysis of the Water Loss Volume in a Real Installation

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Abstract
The paper presents an analysis of the ways in which errors in metering the consumed water are produced. The analysis is performed on data obtained by recording the water consumption in each apartment from a block of flats, during several months, and also, by considering the total volume of water indicated by the branch water meter, the one indicating the water consumption for the entire block of flats. Also, the paper contains a study on the sensitivity of the water meters mounted in the apartments from the block of flats considered and on the volume of the water loss in the respective water supply branch, corresponding to the block of flats. The study is aimed to emphasize ways in which errors in metering the consumed water are produced. The paper presents the experimental installation used in the research, which consists of several water meters of the two different types, of the same precision class, which are mounted in the apartments from the block of flats. Data analysis was performed on data collected from the water meters considered, in order to establish the water loss volume, such as to analyse the water loss estimated for a month for each type of water meter considered. In this way, it is possible to estimate the water loss volume for a certain period of time for the block of flats considered and, by that, to find ways to prevent losses in the potable water supply system.

Keywords
water flow, water meter, water loss volume

1. Introduction

In present, a great importance is shown for the rational utilization of any natural resource, including water resources. As a consequence, researches are trying to find ways to reduce as much as possible the water losses, to detect properly the leakages and to use accurate water meters such as to create the appropriate conditions in which any consumer pays correctly for the consumed quantity of water [1-3].

Total water loss represents the difference between the amount of water which is provided and the amount of water which is billed or consumed. The volume of the water loss depends on the pressure in the system, and on how fast the loss is noticed and solved. Also, water loss may be produced by the use of water meters under-registration or illegal connections [3].

The paper presents a study on the water loss volume in a real installation, by considering the data obtained by recording the water consumption in each apartment from a block of flats, during several months, and also, by considering the total volume of water indicated by the branch water meter, the one indicating the water consumption for the entire block of flats (40 apartments). The paper contains also a study on the sensitivity of the type of water meters mounted in the apartments from the block of flats considered and on the volume of the water loss in the respective water supply branch, corresponding to the block of flats. The study is performed by using an experimental installation, which consists of several water meters of the two different types, of the same precision class, which are mounted in the apartments from the block of flats. Data analysis was performed on data collected from the water meters considered, in order to establish the water loss volume, such as to analyse the water loss estimated for a month for each type of water meter considered. In this way, it is possible to estimate the water loss volume for a certain period of time for the block of flats considered and, by that, to find ways to prevent losses in the potable water supply system.

2. Experimental Installation

The experimental installation used in the research is presented as a block scheme in Figure 1. It

consists of six water meters of two types, both types in the same precision class. Three water meters of type I (precision class B) and three water meters of type II (precision class B) are connected in series arrangement [4, 5]. All water meters are in the precision class B and that means mediate precision; they are apartment water meters, with an accessible price, but with a lower precision comparing to the water meters of class C, which are of high precision, being in general branching water meters [6].

Water meters of type I are apartment water meters for cold water or hot water, of precision class B, with nominal diameter Dn15 and minimum starting flow 30 l/h. Water meters of type II are apartment water meters for cold water, of precision class B, with nominal diameter Dn15 and minimum starting flow 30 l/h.

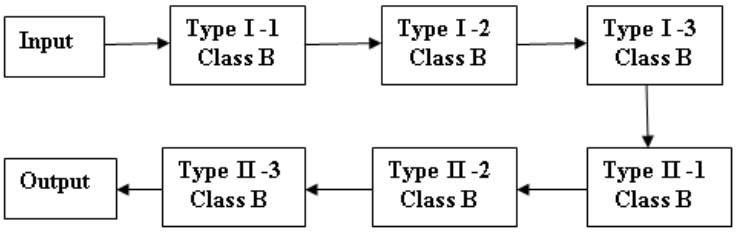


Fig. 1. Block scheme of the experimental installation

Water meters of precision class B are designed such as to start the correct registration of the water consumption from the minimum starting flow Q_{min} = 30 l/h. while in case of the water meters of precision class C, the minimum starting flow is Q_{min} = 15 l/h. Water meters of precision class B are apartment water meters, so, it results that any water consumption which is less than the minimum starting flow, 30 l/h, will not be correctly registered by the apartment water meter. As to the case of a block of flats, although apartment water meters do not register correctly the water consumption due to a water flow less than the minimum starting flow in the apartment installation, the real water consumption will be correctly registered by the branching water meter which is the general water meter for the block of flats. In this way, a difference might be created between the total amount of water registered by the branching water meter of the block of flats and the sum of the amounts of water consumption for all the apartments in the block of flats.

3. Study on the Sensitivity of the Water Meters and on the Water Loss Volume in the Water Supply Installation

The experimental installation described in Figure 1 was used to perform a study, in order to determine the volume of the water loss in case the flow is less than the minimum starting flow Q_{min} = 30l/h. It was considered the case of a leakage difficult to detect by the consumer, when, from time to time, a small drop of water falls from the tap, this being not properly closed; the fact that water pours, drop by drop from time to time, might be not detected or not considered by the consumer [4, 5].

The volume of the water loss depends on the water flow in the installation. This fact was proved by using the experimental installation described in Figure 1. There were considered three cases in which the water flow is less than the minimum starting flow for the water meters considered. In each case it was collected, drop by drop, in a certain time t, a volume of water V = 2 l.

The water flow Q is calculated for the corresponding period of time t, with the formula below:

$$Q = \frac{V}{t}. \tag{1}$$

Table 1 presents the volume of the water loss, volume which is not measured by the water meters and the volume of the water loss corresponding to one hour, for each value of the water flow Q.

Table 2 presents the volume of the water loss for different values of the water flow, for the two types of water meters considered. Figure 2 a and b present the regression lines which indicate the variation of water loss volume as a function of the water flow Q for the two types of water meters.

Table 3 presents the water loss volume calculated for several months, for the block of flats considered. The water loss volume is the difference between the volume of the consumption recorded

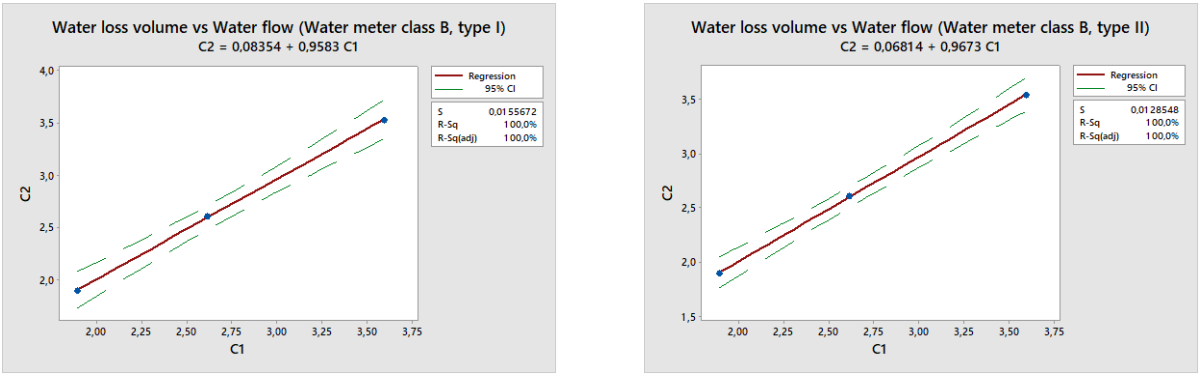
by the branch water meter and the total volume recorded by the apartment water meters. This difference is usually divided to the number of apartments, each part being added to the amount of consumed water for each apartment.

Table 1. Water loss for different values of the water flow Q for the types of water meters considered

Type of water meter	Volume of water recorded [l]	Mean of the volume of water [l] recorded	Time	Actual volume of water [l], for time t	Water flow Q [l/h]	Volume of water loss [l], in time t	Volume of water loss [l], in one hour
I	0.04 0.05 0.03	0.04	33'21"	2	3.598	1.96	3.526
II	0.02 0.04 0.03	0.03		2		1.97	3.544
I	0.01 0.02 0	0.01	45'52"	2	2.616	1.99	2.603
II	0.01 0.01 0	0.006		2		1.994	2.609
I	0 0.01 0	0.003	63'12"	2	1.898	1.997	1.895
II	0 0 0	0		2		2	1.898

Table 2. Volume of water loss for different values of the water flow

Water flow Q [l/h]	Water meter of type I			Water meter of type II		
	Volume of water loss [l], in one hour	Volume of water loss [l], in 24 hours	Volume of water loss [m³], in 30 days	Volume of water loss [l], in one hour	Volume of water loss [l], in 24 hours	Volume of water loss [m³], in 30 days
3.598	3.526	84.624	2.538	3.544	85.056	2.551
2.616	2.603	62.472	1.874	2.609	62.616	1.878
1.898	1.895	45.48	1.364	1.898	45.552	1.366



a) b)

Fig. 2. Regression line – volume of the water loss vs water flow

By looking at the water loss volume and comparing it with the values for the water loss volume estimated in Table 2, losses might be possible to appear due to the fact that some taps are not properly closed. Although the water company is paid for the entire volume of water provided, it is still a serious

loss which needs to be considered. The water installations should be checked, to discover any leakage that may have occurred; the taps which pour should be replaced. Also, it is necessary to promote a more responsible attitude of the consumers towards the water consumption.

Table 3. Water loss volume for the block of flats considered

Water volume	Month1	Month2	Month3	Month4	Month5
Total volume [m³], recorded by the apartment water meters	187.1	150.6	162.3	194.4	183.4
Volume [m³] recorded by the branch water meter	215.7	173.8	183.6	224.1	200.6
Water loss volume [m³]	28.6	23.2	21.3	29.7	27.2

4. Conclusions

The paper tends to present ways in which errors in metering the consumed water may be produced. The analysis is performed on real data and emphasises the fact that the volume of the water loss in a water supply installation depends on the water flow in the installation. In case of water flows less than the minimum starting flow for the appropriate water meters, the water consumptions are not correctly registered by the apartment water meters and so, the water consumption is not paid correctly, so that the water company may have financial losses. Considering all these aspects, it is important to use accurate water meters which will help to produce a more responsible attitude of the consumer towards water consumption, and in this way, it would help to reduce the irrational water losses.

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