Transients in Public Water Supply in Győr-Moson-Sopron County

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Abstract: *Transient is a flow condition in which the velocity and pressure change rapidly with time. Transient operating states place such extreme loads on the pipes that they might cause burst water pipes. To highlight the importance of transient phenomena, I present the measurements carried out at Pannon-Víz Zrt and their results in my study. By this research, I aim to raise awareness about the dangers of transient phenomena in water supply systems. Furthermore, I wish to improve the operational safety and efficiency of water supply systems.*

Keywords: *Transient, flow condition, pressure, pipes, measuring instruments.*

1. Introduction

A transient operating state is a kind of flow in time and space which is initiated by the impacts of some occurrence started from a steady state and lasts until the development of another steady state [1]. In extreme situations, transient phenomena can endanger the soundness of the pipe itself. The main reasons of the occurrences of transient phenomena are, for example, a sudden change in flow or, isolating pipeline sections. If the valve openings and closings, pump start/stopping are not carried out slowly enough in the systems of large water pipes at pumping stations, they might generate quick changes in pressure. Due to the reasons mentioned above it is necessary to analyze the transient states developing in the system.

2. The venue of the measuring process

Pannon-Víz ZRt, the largest water and sewage service in Győr-Moson-Sopron county, operates several regional drinking water supply systems. My measuring instruments were installed at the booster station in Táp, and the reservoir at kindergarten in Táp. I applied 2 pieces of TRAREC® measuring instruments to monitor the transient state in the pipeline system. Model number LL1-12079 got installed at the booster station in Táp and LL1-12078 at kindergarten in Táp. The distance between the two measuring devices is 1190 meter. Figure 1 shows the distance between the two measuring instruments.

Fig. 1. Measurement venues

Fig. 2 shows the position of the two measuring instruments.

Fig. 2. Measurement venues

2.1 Describing the measuring instrument

The applied measuring instrument is TRAREC® (TRANSIENT RECORDER).
Main characteristics of the measuring instrument [2,3]:
• patented measurement and evaluation system
• normal or high-frequency measuring method
• selective data storage for long measurements
• variable parameters for different applications.

Figure 3 shows the TRAREC® measuring instrument.

Fig. 3. TRAREC® measuring instrument

Table 1 shows the parameters of the measuring instrument.

Table 1: TRAREC® the parameters of the measuring instrument [4]

Pressure sensor	0 -15 bar; (maximum 40 bar)
Accuracy	0.1%
Measurement frequency	50-1000 measurements / sec
Data storage frequency	1 - 60 s
Data segmentation	20 bit
Duration of measurement	1-2 weeks
Data communication and charging	USB 2

Table 2 shows the calibration data of the measuring instrument and summarizes some measured values.

Table 2: TRAREC® calibration data of the measuring instrument

Parameters of the measuring instrument		
Name	LL1-12078	LL1-12079
Sequence number	12078	12079
Version	1.0	1.0
Serial number	12078	12079
Pressure range (mwc)	211.00 mwc	211.00 mwc
Calibration	0.86111	0.86466
Pressure shifting	-9.58 mwc	-10.20 mwc
Starting date	14.02.2018	14.02.2018
Finishing date	16.02.2018	16.02.2018
Sea level (m)	0.00 m	0.00 m
Frequency of measurements	256 Hz	256 Hz
Frequency of data collection (sec)	1 sec	1 sec

3. Presenting measurement results

I used the PressEval software for evaluating the results of the measurement. Analysing transients I applied a 1- hour method, namely the number of occurrences of transients during an hour was evaluated. Fig. 4 shows the measurements made by the two measuring instruments. (Starting date: 14.02.2018, Finishing date: 16.02.2018).

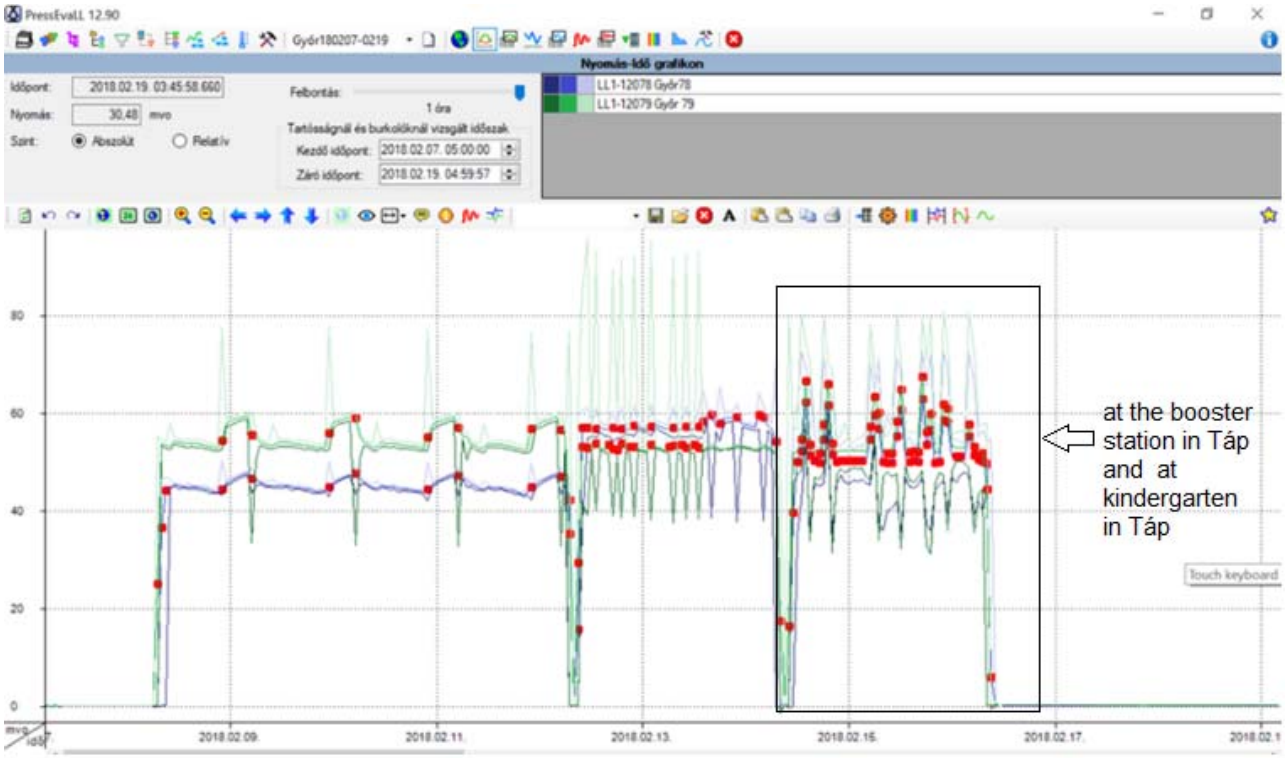

Fig. 4. Program PressEvaLL

In Table 3-4-5. I collected the absolute, minimum and maximum values of pressure changes.

Table 3: Pressure changes

Date (0.2.14-02.16) [h:m:s]		**Absolute change [bar/s]**	
Measurement instrument 79	**Measurement instrument 78**	**Measurement instrument 79**	**Measurement instrument 78**
	19:58:25		0.479
05:34:15		2548	
06:23:18		0.546	
	07:08:08		0.506
07:24:21		1.042	
	08:59:58		2.335
09:07:37		0.695	
	09:23:11		1.601
	10:17:49		0.927
10:33:01		0.998	
	10:54:09		0.898
11:34:23		2.923	
	11:51:33		0.496
17.22:49		0.408	
19:12:04		2.675	
22:26:49		3.027	
04:42:27	04:42:27	2.762	

Table 4: Pressure changes

Date (0.2.14-02.16) [h:m:s]		**Minimum change [bar/s]**	
Measurement instrument 79	**Measurement instrument 78**	**Measurement instrument 79**	**Measurement instrument 78**
	19:58:25		-6.615
05:34:15		-6.942	
06:23:18		-5.359	
	07:08:08		-3.066
07:24:21		-7.326	
	08:59:58		-17.744
09:07:37		-1.625	
	09:23:11		-13.415
	10:17:49		-14.309
10:33:01		-6.528	
	10:54:09		-14.039
11:34:23		-7.697	
	11:51:33		-1.221
17.22:49		-5.459	
19:12:04		-7.554	
22:26:49		-7.227	
04:42:27	04:42:27	-7.897	

Table 5: Pressure changes

Date (0.2.14-02.16) [h:m:s]		**Maximum change [bar/s]**	
Measurement instrument 79	**Measurement instrument 78**	**Measurement instrument 79**	**Measurement instrument 78**
	19:58:25		8.304
05:34:15		39.084	
06:23:18		4.604	
	07:08:08		3.421
07:24:21		7.127	
	08:59:58		14.891
09:07:37		2.053	
	09:23:11		12.151
	10:17:49		15.331
10:33:01		8.638	
	10:54:09		16.878
11:34:23		38.970	
	11:51:33		1.349
17.22:49		5.174	
19:12:04		33.838	
22:26:49		35.734	
04:42:27	04:42:27	36.661	

The process of the transient can be seen clearly from the table. The table demonstrates that the phenomenon of transiency is detectable in the system. The next task is to observe what causes the phenomenon of transiency.

4. Conclusions

The importance of the secure operation of domestic water supply systems is unquestionable. As part of my research, I carried out measurements on pipe sections operated by Pannon-VízZrt., using a sensor specially developed for transient measurements. In my study I intended to draw attention onto the existence of the phenomenon of pressure transiency and its importance. My goal is to reveal what might cause the appearance of transient in the system. Transient, which is a flow condition where the velocity and pressure change rapidly with time, can collapse a water distribution system if that system is not equipped with adequate transient protection devices. It is important to mention that measurements regarding transient phenomena help the detection of critical pipe sections, marking exactly the location where pressure absorbing elements should be mounted.

References

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