Evaluation of urban water networks - Case study

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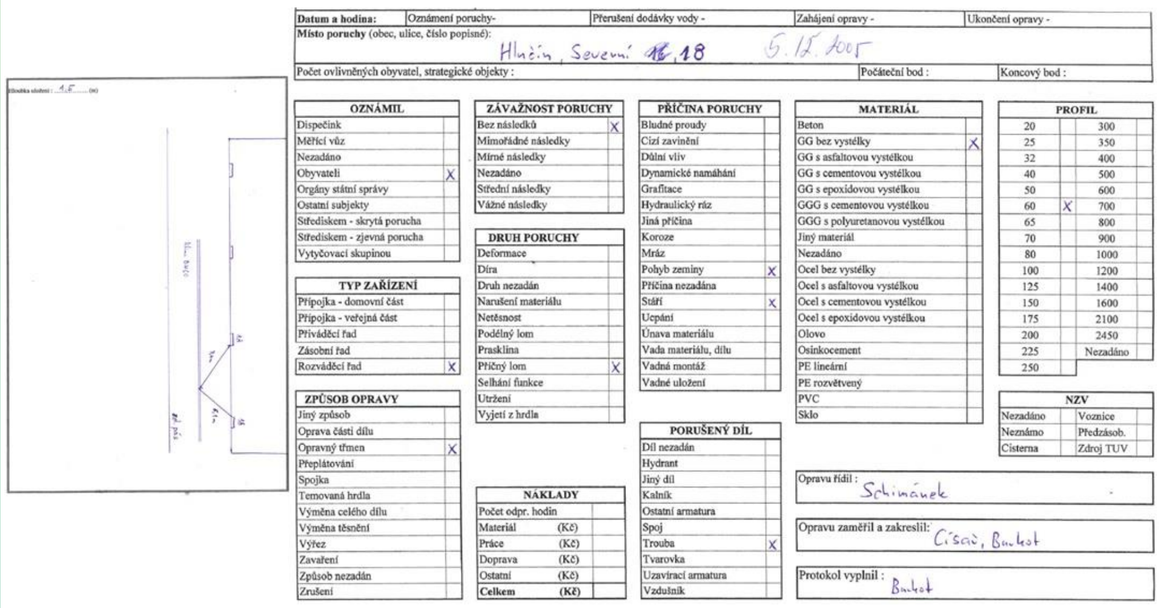
The subject of the paper is the elaboration of the topic of modeling and optimization of the reliability of systems for drinking water supply in the town of Hlucin and the adjacent villages Bobrovniky and Darkovicky. The paper points out modern ways of management and maintenance of these buildings, eg in the form of passportization, unification of various types of documentation, records of failures and accidents, etc. The aim is to point out possible ways to optimize these buildings and overall evaluation of the water supply network, including the suitable renewal schedule design. These practices are essential for the efficient operation of water supply networks, especially nowadays, when there is a shortage of water and it is necessary to promote sustainable urban development through its economical management.



Datum a hodina: Oznámení poruchy- | Přerušení dodávky vody - | Zahájení opravy - | Ukončení opravy -

Místo poruchy (obec, ulice, číslo popisné): Hlučín, Severní 18 — 5.12.2005

Počet ovlivněných obyvatel, strategické objekty : | Počáteční bod : | Koncový bod :

OZNÁMIL	
Dispečink	
Měřicí vůz	
Nezadáno	
Obyvateli	X
Orgány státní správy	
Ostatní subjekty	
Střediskem - skrytá porucha	
Střediskem - zjevná porucha	
Vytyčovací skupinou	

ZÁVAŽNOST PORUCHY	
Bez následků	X
Mimořádné následky	
Mírné následky	
Nezadáno	
Střední následky	
Vážné následky	

PŘÍČINA PORUCHY	
Bludné proudy	
Cizí zavinění	
Dální vliv	
Dynamické namáhání	
Grafitace	
Hydraulický ráz	
Jiná příčina	
Koroze	
Mráz	
Pohyb zeminy	X
Příčina nezadána	
Stáří	X
Uvolnění	
Únava materiálu	
Vada materiálu, dílu	
Vadná montáž	
Vadné uložení	

MATERIÁL	
Beton	
GG bez vystélky	X
GG s asfaltovou vystélkou	
GG s cementovou vystélkou	
GG s epoxidovou vystélkou	
GGG s cementovou vystélkou	
GGG s polyuretanovou vystélkou	
Jiný materiál	
Nezadáno	
Ocel bez vystélky	
Ocel s asfaltovou vystélkou	
Ocel s cementovou vystélkou	
Ocel s epoxidovou vystélkou	
Olovo	
Osinkocement	
PE lineární	
PE rozvětvený	
PVC	
Sklo	

PROFIL			
20		300	
25		350	
32		400	
40		500	
50		600	
60	X	700	
65		800	
70		900	
80		1000	
100		1200	
125		1400	
150		1600	
175		2100	
200		2450	
225		Nezadáno	
250			

TYP ZAŘÍZENÍ	
Přípojka - domovní část	
Přípojka - veřejná část	
Přivaděcí řad	
Zásobní řad	
Rozvaděcí řad	X

ZPŮSOB OPRAVY	
Jiný způsob	
Oprava části dílu	
Opravný třmen	X
Přeplátování	
Spojka	
Temovaná hrdla	
Výměna celého dílu	
Výměna těsnění	
Výřez	
Zavaření	
Způsob nezadán	
Zrušení	

DRUH PORUCHY	
Deformace	
Díra	
Druh nezadán	
Narušení materiálu	
Netěsnost	
Podélný lom	
Prasklina	
Příčný lom	X
Selhání funkce	
Utržení	
Vyjetí z hrdla	

NÁKLADY	
Počet odpr. hodin	
Materiál (Kč)	
Práce (Kč)	
Doprava (Kč)	
Ostatní (Kč)	
Celkem (Kč)	

PORUŠENÝ DÍL	
Díl nezadán	
Hydrant	
Jiný díl	
Kalník	
Ostatní armatura	
Spoj	
Trouba	X
Tvarovka	
Uzavírací armatura	
Vzdušník	

NZV			
Nezadáno		Voznice	
Neznámo		Předzásob.	
Cisterna		Zdroj TUV	

Opravu řídil : Schimánek

Opravu zaměřil a zakreslil: Císař, Burkot

Protokol vyplnil : Burkot

Fault sheets of the drinking water supply system operator; Source: Water supply and sewerage Hlučín, s.r.o.

Analysis of the drinking water supply system failures

In total, approximately 73 km of water supply network is operated in the Hlučín area, of which 52 km is in the cadastral area of Hlučín, 11 km in Bobrovníky and 10 km in Darkovičky. In 2018, a total of 565.426 m3 of drinking water was distributed to the final consumer throughout this system.

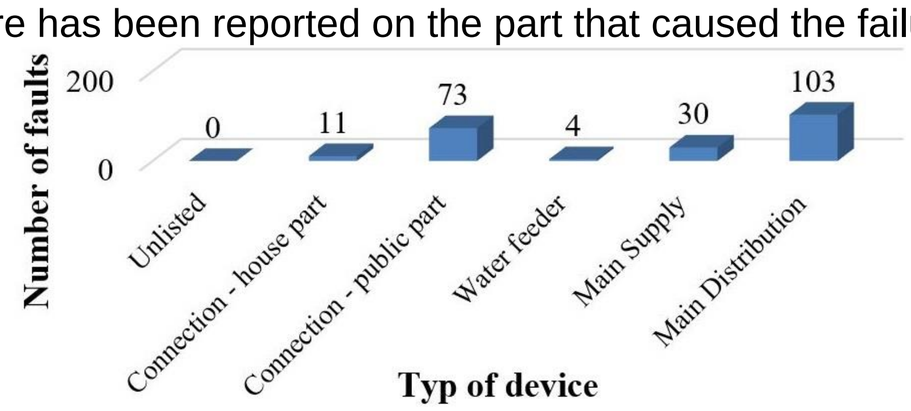
The analysis and statistics of the operation of the system for drinking water supply in Hlučín is processed on the basis of fault sheets of the company VaK Hlučín s.r.o., where a photocopy of one fault sheet is shown. Failure lists were introduced by the operator in 2005, so the statistics are based on data from years between 2005-2018. During the monitored period, a total of 221 failures were recorded in the water supply network in Hlučín, Bobrovníky and Darkovičky. Fault leaves were also kept for the sewer lines and were not distinguished from the water supply system. Often the fault sheets are only partially filled in, they do not contain all the important information, therefore some data may be distorted or idealized for better registration.

STRENGHTS	WEAKNESSES
Almost 98% of the population is connected to the water supply	Unbalanced pressure conditions in the network
Minimal water losses (< 4 %)	Insufficient water accumulation for the Hlučín district
Water quality all hygienic requirements with reserve fulfilling	Sometimes only temporary or cheap troubleshooting
Several water sources and feeders	The reservoir supplying Darkovičky is not owned by the water supply operator
Own collection area	
Sufficient capacity with regard to the development areas of the municipality	
Relatively low failure rate	
The operator's effort to gradually reconstruct the water supply lines	
OPPORTUNITIES	**THREATS**
Replacement of old cast iron and metal pipes with plastic ones	Oversize of the network due to population decline
Construction of a reservoir to increase water accumulation and balance the pressure in the network	Insufficient amount of fire water in crisis situations
Introduction of quality records of failures and prediction of the need for reconstruction of individual water mains	Lowered water quality due to smaller abstractions
Introduction of predictive maintenance of water supply	Increased water loss
Increasing the number of people taking drinking water	Gradual reduction of yield of groundwater sources
Improving water quality	Possibility of water contamination caused by water supply failure or its leakage
	Bad registration and documentation of the water supply network

SWOT analysis

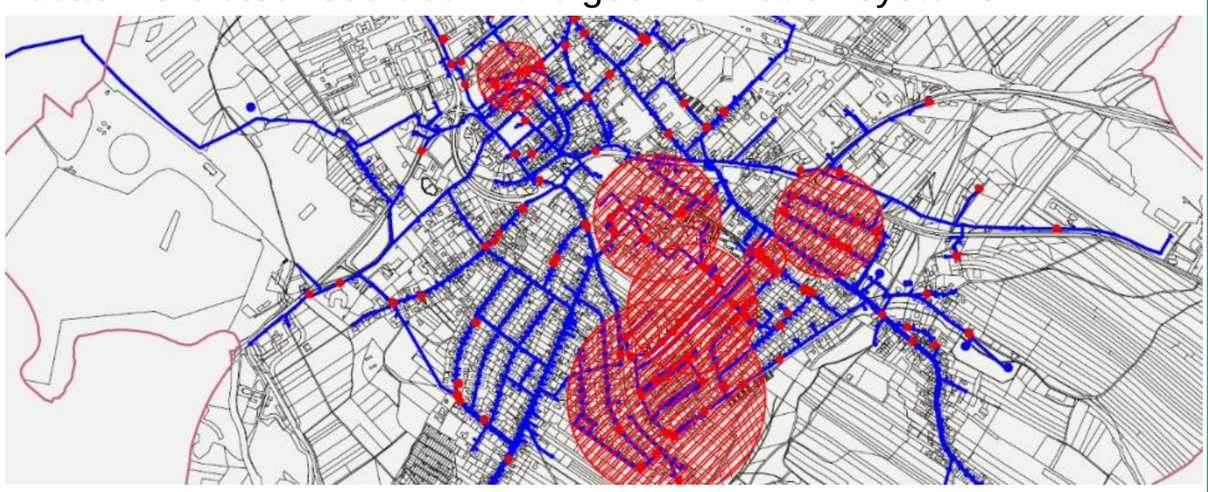
Types of failure pipelines

Water supply and sewerage Hlučín, s.r.o. manages and ensures operation on all types of DWS system equipment. In the network for DWS there are distribution, storage or supply lines, but also connections. The operator also performs and records faults on the house parts of the connections, although they are not owned by itself. However, most faults were reflected in the classic distribution line, then in the public parts of the connections, as well as in the supply line. A number of faults have occurred, when a fault in the oven on the distribution line has also damaged the connection or vice versa. In such cases, a primary failure has been reported on the part that caused the failure.



Number of faults according to broken part (221 fauls in total)

In this case, optimization is understood as a step to improve the operation of the system for drinking water supply in Hlučín, improve its maintenance, minimize its failures and the resulting costs. So far, failures have been recorded only on paper, using ie. fault sheets. The faults recorded on these sheets were subsequently scanned into electronic forms and apparently the faults were also recorded in the geoinformation system.



Representation of critical places on the water supply network of the town

According to the analysis a total of 221 disorders occurred during the monitored periods. Most faults occurred in the cadastral area of Hlučín, which is understandable due to its size. Most failures, specifically 103 failures, were evaluated on the mainline. Cast iron pipes were identified as the most problematic, which were gradually transformed into plastic pipes in the last few years. Among the most common disorders the transverse fracture and leakage of joints appeared. The largest number of failures was recorded between years 2005 and 2008. Thanks to the high-quality database and the responsible approach of the network administrator, the administration gradually focused on a proactive form of management. The change in the approach led to a reduction in water losses in the network system from the original 9% to 4.5%.

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