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Problems and determinants
of operation of sewage system in Bydgoszcz

This work assesses the technical condition of a sewage system in Bydgoszcz and investigates the factors influencing its operation. It was found that the sewage system is built from different materials, among which concrete and reinforced concrete prevail. 45% of the total sewage length is more than 30 years old. 75% of the total number of 98 failures involved connecting sewers, while the failures on sanitary or rain-water sewers accounted for 10% each. Therefore, inspection and diagnosis based on video technique CCTV constitute essential elements in the proper operation of the sewage system.

1. Introduction

Modern management of technical infrastructure should be based on optimum of exploitation and invest plans, which provide eligibility of devices for a long period [Gościński 2005]. In this process very important is also knowledge about technical level of devices. Recently, the video techniques called CCTV [Kuliczkowski i Zwierzchowski 2001], are used more and more to monitor condition of sewage system. Moreover, the computer programs significantly broaden range of given data. [Andrzejewski 2006].

2. Methods

Purpose of this work is the evaluation of technical level of sewage system in Bydgoszcz and the analysis of recent implication of video technique in exploitation of devices. In this research, data has been used from end of 2002 according to Bydgoszcz Water Supply and Sewerage System.

Monitoring of sewage system made with video technique RCA1000 with camera L500, which was made by German company RAUSH GmbH & Co. Description of these devices are available on the website: www.rauschtv.de

3. Results

According to the analysis which was done in end of 2002 in exploitation of Bydgoszcz Water Supply and Sewerage System, there were together 693 km of sewage, what contain: 245 km single sanitary sewage, and 224 km sewerage and 224 km storm water drainage system.

Sewage system in Bydgoszcz is made almost from all different kinds of material used as in past as nowadays. However there is a domination of concrete and reinforced concrete. Pipes from this material are used in 558 km length, what is almost 80% of total length of inspected sewage (tab. 1). Nowadays the use of plastics drastically grow and the length of it is 11%. The change of material structure is also mentioned by Kwietniewski [2004] who estimated total part of plastic pipes in Poland for 10,2%. These tendencies are perceived especially in casing, where on 85% length of changed sewage is used PVC pipes. PVC pipes, as the PE, have appreciable physicochemical and resistant properties what permits to build the sewage with bigger diameters.

As we can see from further analysis of table no 1, ducts with diameters 180–200 mm and 250–300 mm are 67,5% of total length of sewage system in Bydgoszcz. Therefore, it is possible to use there video devices owned by exploitation business. It's also possible to investigate the parallel ducts. They are built from concrete pipes with diameter 400–600 mm for rain ducts, and below sanitary ducts with diameter of 200 mm.

One of the basic criteria of technical evaluation of sewage system is the age. As analyzes show, 45% length of sewage system in Bydgoszcz is exploited longer than 30 years (tab. 1). The bigger and bigger amounts of breakage of sewage system enforced the holder to work on improvement of technical condition.

The effect of it work is 15% total length sewage has exploitation period no longer then 5 years, and on the old part made a renovation by „in situ" method.

The analysis shows that during the period April 2001 until end of March 2002, in the sewage system of Bydgoszcz Water Supply and Sewerage System was 98 damages, what gives average of 14 damages yearly on 100 km of sewage. 75% of breakage found in sewage system. Although they are very annoying for habitants, they don't have a long range.10% breakage involved as sewage and 10% as storm water drainage system. In no more than 5% damages involved builds on sewage, mostly wells of the system.

Table 1. Exploitation periods, used materials and pipes diameters of sewage system in Bydgoszcz (state on the end of 2002 year)

Exploitation periods in years	length of pipelines [km]	[%]	Materials kind	length of pipelines [km]	[%]	Diameters [mm]	length of pipelines [km]	[%]
0–5	103,0	14,9	stoneware clay	22,9	3,3	to 150 (160)	11,2	1,6
5–10	68,0	9,8	concrete, reinforced concrete	558,8	80,6	180–200 (225)	291,9	42,1
10–20	52,0	7,5	plastics (PVC, PE)	79,2	11,4	250–300 (315)	176,0	25,4
20–30	158,0	22,8	asbestos-cement	6,4	1,0	400–600 (630)	137,9	19,9
> 30	312,0	45,0	cast iron	16,2	2,4	700–800	23,6	3,4
			steel	1,1	0,1	900–1000	33,4	4,8
			pipes of type „Hobas"	8,4	1,2	1 200–2 200	19,2	2,8
Total	693,0	100,0	Total	693,0	100,0	Total	693,0	100,0

4. Discussion and conclusions

According to Maj [1999], the basic element of normal exploitation sewage system is its inspection and diagnosis, which is often made by video technique (CCTV).

Knowledge of technical level of sewage system with help of video technique, and especially renovating the most breakable segments, significantly improve the quality of an exploitation company. According to Bylka [2002], infallible flow of water is one of the basic criteria used in evaluating the level of an exploitation company. To evaluate the sewage system, its users are looking at frequency of breakage and time of its renovation. Therefore, there is many different ways of evaluating customer service. This evaluation guarantees maximal time starting from calling the breakage until the renovation is ended.

Czaplinski and Przybyla [1999] in their work on sewage system in Krakow, found out that most of the breakage expenses are concentrated on 20% catchbasin which is called core of system and the ducts of it are called critical ducts. For evaluation of critical ducts the analysis of many data should be made, for example function of the ducts, localization, construction, materials, and diameters. To make this evaluation, very helpful is the video technique. Data from the evaluation of the technical level of sewage are useful to accept an adequate strategy in exploitation. According to Denczew [2004], the adequate strategy in exploitation is a collection of factors which are realizing the confirmed before exploitation strategies. The base of it, are data and information collected during the exploitation of the sewage. Realization of adequate strategies guarantees a high level of reliability. Data from the revision also may be useful in evidence of the devices and planning of the modernization. It may be done with help of the computer system „Wod-Kan" [Kołodzinski 2001].

Analysis made in end of 2002 for sewage in Bydgoszcz with total length of 693 km, exploited by Bydgoszcz Water Supply and Sewerage System led to formulation of conclusions:

• Sewage system is built from different materials, however the dominating ones are concrete and reinforced concrete, what is 80% of total length of exploited ducts. In Recent years, the use of plastics grows drastically, and its total length is already 11%.

• Its found out that 45% length of the sewage system has exploitation period more than 30 years, and 16%of total length has is more than 50 years old. These conditions have an influence on its breakage. In the total amount of the 98 damages, 75% was on the sewage connections and 10% on the sewage. Basic reason of the damages was mostly aging of sewage.

• Video technique and camera (CCTV) are modern devices used in process of controlling and diagnosing sewage system. Data and information received from controls are very helpful in finding an accurate exploitation strategy. That strategy lets sewage system to work correctly, and without damages for a long time.

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Problemy i uwarunkowania eksploatacji sieci kanalizacyjnej w Bydgoszczy

Streszczenie

W pracy przedstawiono ocenę stanu technicznego oraz analizę uwarunkowań eksploatacji sieci kanalizacyjnej w Bydgoszczy. Stwierdzono, że sieć kanalizacyjna jest wykonana z różnorodnych materiałów, przy czym dominuje beton i żelbeton. 45% długości sieci kanalizacyjnej ma okres eksploatacji dłuższy niż 30 lat. Na łączną liczbę 98 awarii, 75% dotyczyło przyłączy kanalizacyjnych, a po około 10% awarii wystąpiło na kanałach, tak sanitarnych jak i deszczowych. Stwierdzono, że jednym z głównych elementów prawidłowej eksploatacji sieci kanalizacyjnej jest inspekcja i diagnostyka, wykonywana przy użyciu systemów wizyjnych (CCTV).

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