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CHOOSING THE PRIORITY PIPE SECTION OF WATER DISPOSAL SYSTEM WHICH SHOULD BE RENOVATED

Abstract. The paper presents results of the research work related to the problem of renovation and modernization of water supplying and disposal system. For purpose of finding out the priority pipe string sector which should be renovated, MSUCI has designed an automated program of assigning to each water disposal system section a certain amount of points according to complex estimation system of unit worthless degree. This work was based on taking to a consideration the external factors, which influence pipe condition and efficiency accident-free work greatly. According to the algorithm designed the most worthless condition has the section, which has gained maximum amount of points. In conclusion it was founded that according to the data obtained for a certain site of water disposal systems with the use of this program, the interested organizations are able to make plans on rehabilitation works, pointing out the pipe-line sectors which are to be reconstructed firstly.

Keywords: water, reconstruction, water disposal systems, trenchless technologies.

INTRODUCTION

Pipe-line systems are the vital parts of modern cities' infrastructures, that's why it is so important to maintain the efficient work of such systems in order to keep the ecology save for population. Almost all countries with the high level of life have set the water supplying and water disposal pipe-line systems in-time renovation to be the most important direction to develop.

Underground communication pipes becoming worthless resulted in pressure looses and low capacity, physical-chemical characteristic reduction for transporting water, possible re-polluting the transporting water, ground water and surface water, soils, atmosphere pollution.

Water looses become also one of the reasons of ground water level increasing, which leads to intensive destruction of exploitation buildings and constructions.

The solution for the problem of operative pipe rehabilitation ant reconstruction faces the wide use of trenchless technologies with special equipment. In Europe practice 95 percents of works on underground pipes construction and rehabilitation

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are made with the use of trenchless technologies. In lots of big cities new pipes construction with traditional open excavation methods is forbidden today.

It is especially difficult to make pipeline systems reconstruction works in large cities with high construction area density, transport moving intensity, also full of multifunctional both under-and above ground infrastructure. All these factors set a lot of obstacles before such called open excavation methods of pipeline systems repair and construction.

The process of sewage system renovation includes solving 3 connected to each other objects: choosing the priority sector for reconstruction; finding out an optimal renovation method (trenchless methods take great advantages under the common open excavation methods); providing hydraulic compatibility of existent pipes and new sections in regard with the whole system. Successive and careful systematization and pipe defects analysis are needed to solve the first problem. For this purpose inventarisation and television diagnostic research are used in order to determine dominant external influence factors. The use of special automated computer programs can make the process of carrying out all these investigations easier.

MATERIALS AND METHODS

Our deep investigations concerning this problem, international experience and information exchange resulted in facing the fact that there is still no finished strategy on choosing the priority object for renovation in Europe developed cities. The process of solving this problem, regarded with the similar conditions but with the use of different techniques, comes to the results, which significantly differ from each other. It happens because of domination subjective factors, ways of thinking and making decisions in each strategy. Some cities still don't have any strategy of wide-scale failures removing. The district exploitation organizations of such towns use such-called «fire-brigade» and «hole patch» methods. There are also cities where pipe renovation strategy working out is still in process, it's not finished yet.

The represented program on automatisation the process of determining the priority object for renovation with taking to a consideration all factors, which destabilize the pipe-net work, will make it possible for specialists from other countries to carry out the complex analysis of pipe systems condition. In other words, this innovative project makes a great contribution to the advancement of trenchless technologies world-wide.

Moreover, without the system of choosing the priority renovation object the increasing of accident condition of the whole pipe-line system can't be excluded. In condition of planned rehabilitation work absence, the probable accident appearance grows. This fact results in immediately reaction needed, carrying out fast unfounded rehabilitation work, which leads to substantial material costs.

In addition to this, the process of making all these operations input a great influence on ecology condition and social costs. The use of proposed program gives an opportunity to reduce this influence to the minimum size.

RESULTS AND DISCUSSION

The process of choosing an optimal renovation object of high-brunch long water disposal system is of high social and economical importance. The correct decision on solving this complex and multi-functional question provide ecologically save situation on pipe-disposal systems. So how the introduced program can manage all above factors, let's see below. A non-existent town is taken to a consideration as a basic example (Fig1).

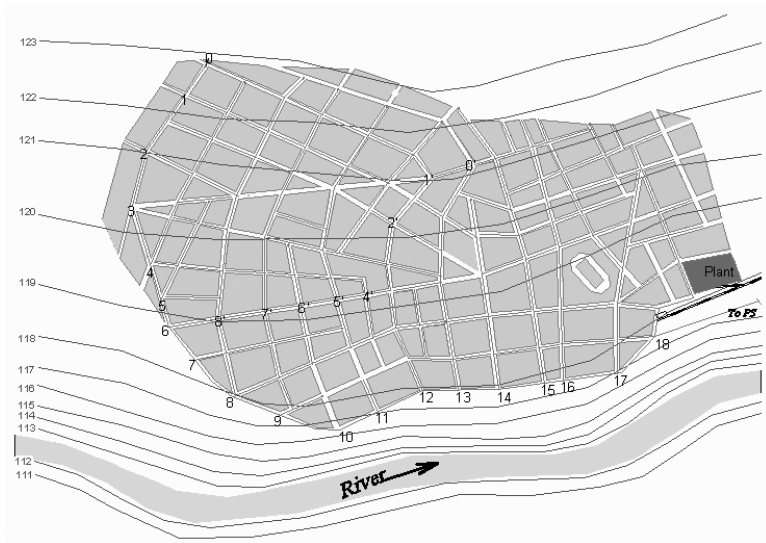

Fig. 1. The plan of the town

The water supplying line in the town is made of cast iron pipes, and water disposal – is of ceramics and reinforced concrete pipes. The pipe-line systems have been being under exploitation for 20 years and now they are to be examined in order to find out the pipe string sector which should be renovated first of all. The water disposal system consists of 112 objects, so it is difficult to represent the whole information about it, that's why we choose a fragment, which comes across the center of the town (Fig. 2).

The pipe diameters and materials for the whole system are known from the data obtained from the local exploitation organization.

For purpose of finding out the priority pipe string sector which should be renovated, MSUCI (Moscow state construction university) has designed an automated program of assigning to each water disposal system section a certain amount of

points according to complex estimation system of unit worthless degree. This work was based on taking to a consideration the external factors, which influence pipe condition and efficiency accident-free work greatly. According to the algorithm designed the most worthless condition has the section, which has gained maximum amount of points.

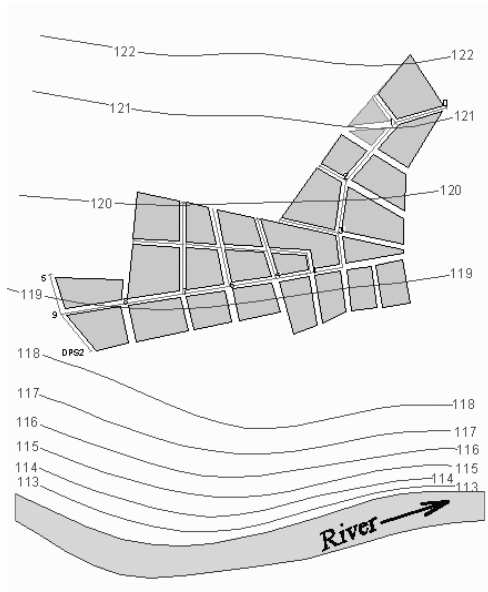

Fig. 2. The researching water disposal system fragment.

The key factors, which considered to be the most destructive for pipeline systems, include pipe diameters and materials, transporting water quality, hydraulic characteristics, the setting year and the lying depth of pipes, soil condition, ground water presence and character. These and others factors are represented in rating passports of different sections.

Fig 3 illustrates the example of such passports. According to the limited chambers, each pipe section has its own number.

In order to fill in all the positions in this passport, one should use the information from hydro-geological map of the area (Fig 4), geological map (Fig 5), the map of transport moving intensity (Fig 6), including design data and teleinspection results with all pipe failures.

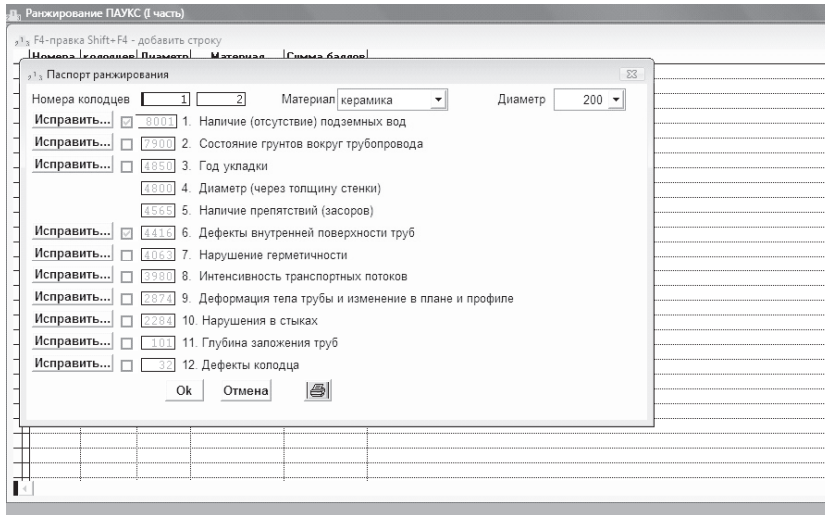

Fig. 3. Rating passport for section number 1-2

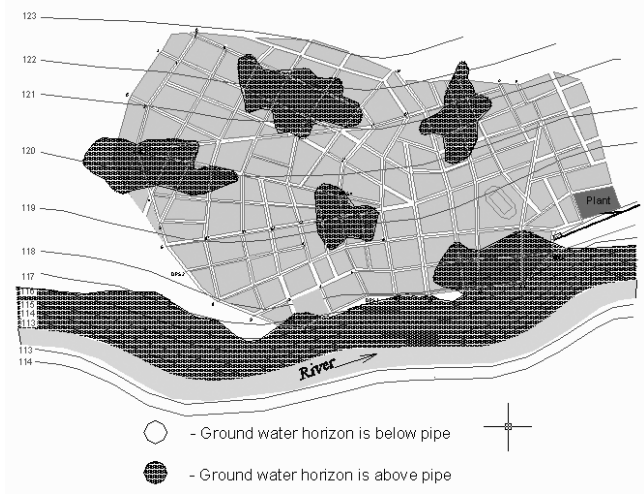

Fig. 4. Hydro-geological map

Fig. 5. Geological map

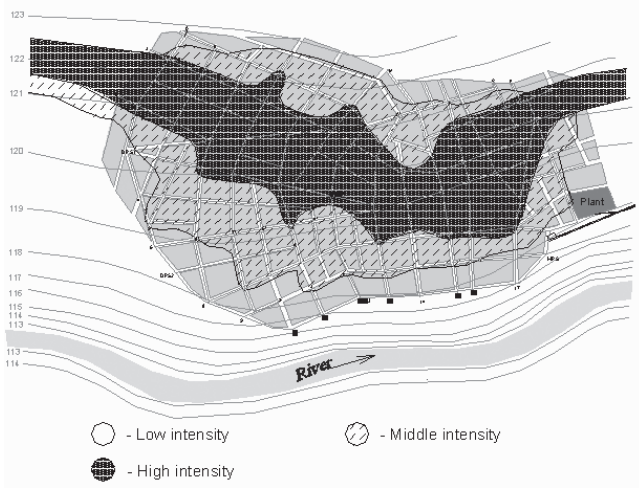

Fig. 6. The map of transport moving intensity

The work of the given automated program results in assignment a certain amount of points to each section of the system. According to these points, all sections of concerned fragment can be divided into 2 parts: the priority renovation sections and ones of perspective renovation.

The final table of pressure-free sewage pipes rating
Material: C (ceramics), I (iron), T (transite), P (polyethylene)

Chambers	Points	Diameter, mm	Material
4-5	52824	400	C
3-4	52574	300	C
2-3	52227	250	C
7-8	48066	600	T
1-2	47866	200	C
0-1	47859	200	C
6-7	47675	500	T
8-9	47574	600	T
5-6	47403	500	T

Fig. 7. The final table of concerned sections' rating

Fig 7 represents the final table of concerned sections' rating. Having analyzed this table, we can make a conclusion, that the section, limited with the chambers number 4 and 5 (400 mm diameter, from ceramics), which is situated at the head of the table, has the maximum amount of points, so that's why it should be recommended for priority renovation. The section number 5-6 has the minimum amount of points. According to the data obtained, the graphic of priority renovation has been made, where each section is represented with its own priority points (Fig 8).

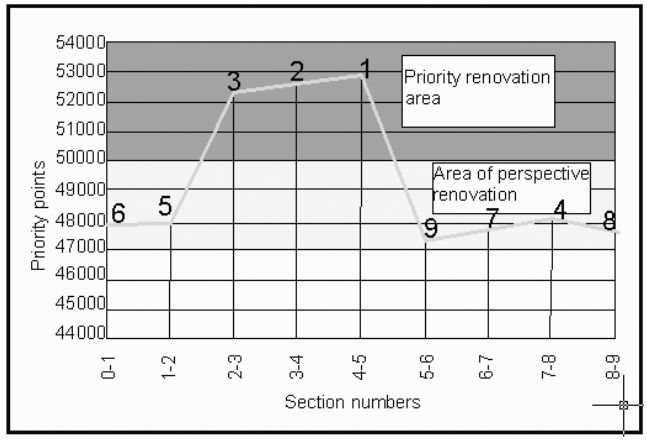

Fig. 8. Graphic of priority renovation.

The graphic also illustrates 2 periods of renovation: the priority renovation area (sections number 4-5, 3-4, 2-3) and area of perspective renovation (sections number 7-8, 1-2, 6-7, 8-9, 5-6).

In practice it is convenient to use rations of relative importance instead of real points. With the use of these rations it is possible to compare the priority of the reconstruction sectors. The diagram of priority distribution among the renovation pipe units is formed based on these data.

CONCLUSIONS

In conclusion I would like to stress that according to the data obtained for a certain site of water disposal systems with the use of this program, the interested organizations are able to make plans on rehabilitation works, pointing out the pipeline sectors which are to be reconstructed firstly. But it's important to remember, that the printouts serve as the basic materials for specialists (engineers), who ought to make the final decision on renovation of this or that objects. In other words, human factor has preferences, while automated program make it possible to carry out the detail complex analysis of pipeline systems situation.

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OKREŚLENIE I WYBÓR PRIORYTETU RENOWACJI SIECI WODOCIĄGOWEJ

Streszczenie. w artykule przedstawiono rezultaty badań związanych z problemem renowacji i modernizacji sieci wodociągowej. W celu określenia priorytetu przy wyborze odcinka sieci, który musi być poddany modernizacji, MUSCI zaprojektował w tym celu specjalny automatyczny program. Przy jego tworzeniu wzięto pod uwagę szereg czynników zewnętrznych mających wpływ na stan sieci i przewodów wodociągowych. Zastosowanie programu umożliwia opracowanie planu modernizacji ze wskazaniem odcinków które muszą być poddane renowacji w pierwszej kolejności.

Słowa kluczowe: system zapatrzenia w wodę, renowacja, estymacja.