CONSIDERATIONS ON THE VALUATION RAIN - WATERS TO WATERINGS OF THE "GREEN AREAS" OF CITY

CONSIDERAȚII PRIVIND VALORIFICAREA APELOR PLUVIALE LA UDAREA ”ZONEI VERZI” A ORAŞELOR

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Abstract. *Rain-waters have a problem of exploitation in any sewer system. European rules require the development of sewage systems for urban wastewater in Romania. Storm water must be collected and discharged separately from domestic and industrial wastewater. Some of the rainwater can be harnessed in the collection area by using them to supplement the volumes of water required to extinguish the fire. Rain-waters can be used to wash streets and platforms in localities. But an effective recovery of rainwater takes place in irrigation systems of green spaces. The sewer system consists of collectors, main collectors and storage tanks. The irrigation system of green spaces consists of water tanks, pumping stations and pipeline networks for the transport and distribution of water. The watering methods adopted are aspersion, micro-spraying, dripping and underground watering. The case study completed confirms the desirability of using pluvial waste water when watering green spaces.*
Key words: park, reservoir, sewerage, watering system, sprinkler

Rezumat. *Apele meteorice prezintă o problemă de exploatare în orice sistem de canalizare. Normele europene impun realizarea unor sisteme de canalizare separativă a apelor uzate urbane în România. O parte din apele meteorice pot fi valorificate în zona de colectare prin utilizarea acestora la suplimentarea volumelor de apă necesare la stingerea incendiului. Apele meteorice pot fi valorificate la spălarea străzilor şi platformelor din cadrul localităților. Dar, o valorificare eficientă a apelor meteorice are loc în sistemele de irigare a spațiilor verzi. Sistemul de canalizare este format din colectoare, colectoare principale şi rezervoare de stocare. Sistemul de irigare al spațiilor verzi este format din rezervoare de apă, stații de pompare şi rețele de conducte pentru transportul şi distribuția apei. Metodele de udare adoptate sunt aspersiunea, microaspersiunea, udarea prin picurare şi udarea subterană. Studiul de caz realizat confirmă oportunitatea utilizării apelor uzate de tip pluvial la udarea spațiilor verzi.*
Cuvinte cheie: canalizare separativă, rezervor, sistem de udare, parc

INTRODUCTION

Among the human rights enshrined in United Nations General Assembly Resolution 64/292 of 28 July 2010 is "access to drinking water and sanitation". The state must contribute to the realization of this right by providing the

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necessary investment funds for the design and implementation of water supply and sewerage systems. Urban and rural localities must be equipped with centralized, public, sewerage systems at a higher technical level and contributing effectively to environmental protection (ARA 2016).

Compliance with environmental protection requirements requires that sewerage systems be developed in a segregated system. This requirement is particularly appropriate at the present stage, when the precipitations have a severely torrential character on the territory of Romania (Avram and Luca, 2017). Urban sewerage networks in Romania are generally built in a unitary system. Their operation over the last period of time is particularly unsatisfactory, especially in heavy rainfall.

An important source of pollution of the urban environment is the torrential rains and the reduced take-up capacity of the sewerage network. The objective of the paper is to analyze the methods of collecting and capitalizing the meteoric waters within the localities or the locations of economic and social objectives (Bica, 2002).

MATERIAL AND METHOD

Studies and research have been carried out for a series of sewerage networks that carry the meteoric waters. Sewage networks are provided by localities or industrial, economic, administrative and social objectives. The location of the study objectives is affected by the high precipitation intensity, where the effects of the rain cause significant environmental degradation.

The research method has gone through the following steps: a - study of the behavior of the sewer networks within the localities and the impact of the meteoric waters on the mode of operation; b - the study of the behavior of sewerage networks within economic and social objectives at present stage; c - realization of models for collecting and capitalizing the meteor waters from the location of the different studied objectives; e - directions of applicability of researched models.

RESULTS AND DISCUSSIONS

The objectives of the research were many, among which:

- the current behaviour of the urban sewerage sectors carried out in a unitary system and the role of ensuring optimal environmental conditions:

- the current behaviour of the sewerage networks achieved in unitary system at economic objectives and the influence on the environmental protection parameters;

- designing models for collecting, storing and distributing meteorological waters within localities and economic objectives.

The studies and researches undertaken have highlighted the following:

- on the territory of Romania, and especially in the area of Moldova, there are changes in the monthly and annual distribution of precipitation, high torrential rain with large volumes of water (Avram and Luca, 2017);

- sewerage networks built in a unitary system in cities are malfunctioning in the case of takeover of torrential waters; the sewer collectors discharge into the streets and sites, polluting the urban environment (Tucan and Bica, 2017);

- within the localities, commercial complexes, industrial objectives increased the waterproof surface (concrete and paved areas, building) to the detriment of the green areas; the volume of infiltrated precipitations has declined over the last 20 years to 20% compared to 80% (Luca *et al.*, 2010);

- commercial complexes and industrial objectives have large waterproof surfaces, where torrential rainfall overloads the sewerage system made in unitary system (Scripcariu and Luca, 2014);

- the watering of the green spaces within the localities is made from the public drinking water network; this technology is not indicated due to the chemical parameters of drinking water (the residual chlorine content);

- washing of streets and concrete platforms is done with the water from the public drinking water network; the current process involves high costs and consumption of a volume of water needed by the population.

These conclusions point to a new strategy on meteorological water management within localities, or on smaller areas, specific to industrial or commercial objectives.

The rainfall rate for sewerage basins smaller than 10 km^2 has the expression (Blitz, 1970, STAS 1846-07):

(1) $$Q_{max} = m\, S\, \varphi\, i \quad [l/s],$$

where S is the surface of the collection basin for the computation section, (ha); i - average rainfall intensity (l/s,ha); m - the flow reduction coefficient; φ - coefficient of leakage.

The flow relationship analysis shows a change in the value of the leakage coefficient, φ, for the localities and the spaces occupied by the big targets. This requirement is imposed by the intense reduction of green spaces within localities or economic objectives. In this case, the leakage coefficient is determined by the relation (STAS 1846-07):

(2) $$\varphi = \frac{\sum \varphi_i s_i}{\sum s_i},$$

where S_i is a homogeneous surface in the sewer; φ - the coefficient of leakage of S_i surface. For concrete and asphalt surfaces, the coefficient φ is 0.85-0.90 and for parks 0.01 - 0.05.

At the same time, in order to comply with the European Union requirements regarding the design of sewage systems, separate sewage networks for domestic waste water and for meteoric waters should be developed. Sewage sewerage networks exist in Romania, but many of them have a malfunction in the case of torrential rainfall. All European Union Directive requires the collection and local storage of meteoric waters, and then evacuating them to an emissary.

The meteoric waters collected from the land areas of the localities or the economic objectives can be capitalized in the following areas:

- providing local water reserves for fire fighting;

- achieving water volumes for watering green areas;
- the supply of underground water bodies used by water supply system capture constructions.
- building volumes of water for sprinkling and washing of streets, alleys, car parks etc.

The use of meteorological waters must meet the conditions laid down in SR 1846/2-07, ie not to be polluted or to contain pathogens.

The model for collecting - storing - distributing meteorological waters for surfaces related to economic and social objectives (factories, commercial complexes, hotels, parching buildings, etc.) can be structured on two water management systems:

- The I system has the function of taking the meteoric waters from the roof of the buildings and their use in fire extinguishing. It consists of the following components: 1 - network of collectors; 2 - two-chamber storage tank (dispenser + storage volume); 3 - pumping station; 4 - distribution system with fire hydrants.
- System II has the function of taking the meteoric waters from the platforms and the traffic areas and their use in watering the green spaces, spraying the platforms and evacuating the surplus to the public sewerage network. System II consists of the following components: 1 - network of collectors; 2 - disinfectant; 3- fat separator; 4 - storage tank; 5 - pumping station; distribution network with greenhouse watering equipment (fig. 1).

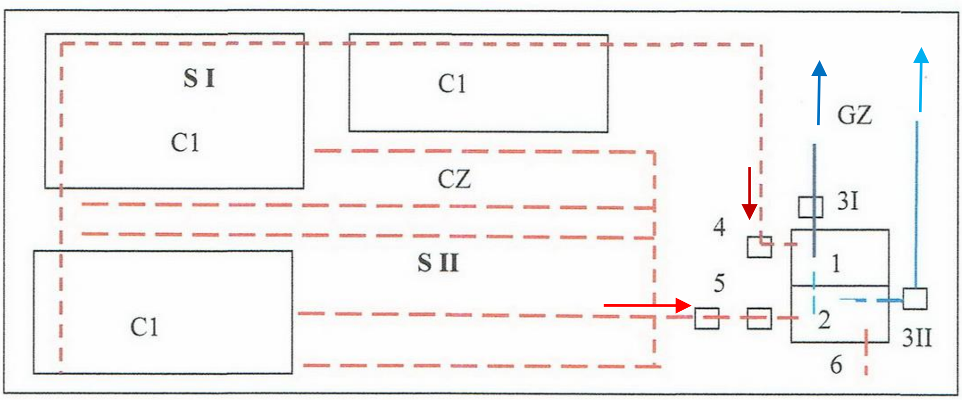


Fig. 1 Scheme of the unitary sewer system at an economic objective with local valorisation of meteoric waters: SI, SII - sewerage systems; CZ - concrete platform; GZ - green area; C1 - terraced roof buildings; 1 - tank for SI; 2 - tank for SII; 3I, 3II - pumping station; 4 - desiccant fireplace; 5 - desiccant and grease separator; 6 - discharge to the public sewerage network.

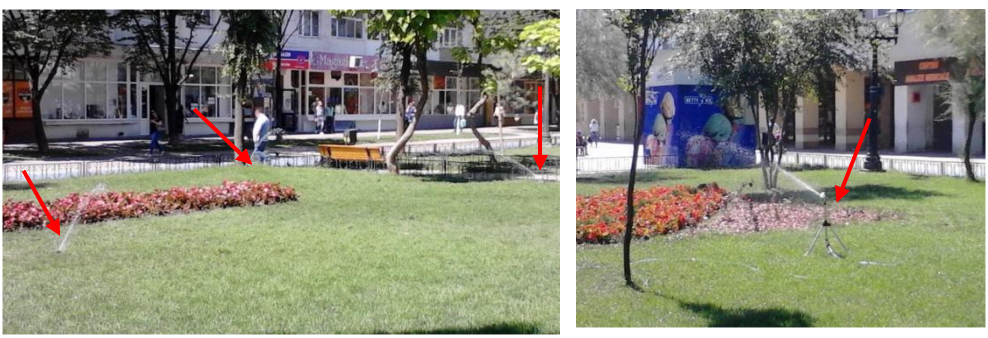
The two systems can present a common tank, but divided into different water volumes (1 and 2, fig. 1). Between the tank chambers, water transfers can be made by using a specialized hydraulic installation.

The model with the two meteorological sewerage systems presented in figure 1 was designed for the location of a factory made in the last period of time in the city of Brasov, Romania. The site area has abundant rainfall (about 700 mm), where their utilization is effective in order to provide volumes of water that can be used for their own purposes. The catchment area has a surface area of about 4.6 hectares and the storage tank has a volume of 350 m^3.

Buildings have a terrace roof, which favors the collection of rainfall without touching the terrain. Meteorological water is transported by closed collectors to a desiccant house and then stored in the first chamber of the tank (fig. 1). Meteor shower is used as a fire reserve. By means of a pumping station water is discharged into a pipeline network equipped with hydrants mounted on the perimeter of the building. The overflow of the chamber (1) expels in the chamber (2) of the tank, and from there the water is discharged into the sewerage network or into an emissary.

The meteoric water fallen on the concrete platforms of the factory (parking, storage area, walkways, etc.) is collected by drains and led to a desiccator, a grease separator and then inserted into the chamber 2 of the tank. The water in room 2 is used to water the green area of the factory and to wash the concrete surfaces. The surplus of water is discharged to the public network.

The irrigation system of the green spaces consists of the components: pumping station for raising the pressure, supply and distribution pipe network, water connections with 12 ... 25 mm connection, fixed and mobile watering equipments (fig. 2). Greening of green spaces is achieved by sprinkling (fig. 2), drip and underground. For sprinkler watering, microsprays, sprinklers and fixed nozzles are used. For pavement layers or large line sizes, drip and underground watering equipment is used.



a b

Fig. 2 Greenhouse irrigation equipment: a - microsurpers placed on perimeter and wetted surface; b - extendable hose displacement sprinkler

Within the sewerage system connected to a sewerage basin of meteoric waters in a locality, a technical and economical analysis can be carried out regarding the collection, storage and capitalization of the waters in order to water the green spaces. Quality parameters of meteoric water in the sewer are those that dictate how it is used. The storage of meteoric water can be done in specially designed underground retention basins / reservoirs in natural lakes and artificial lakes. Retention basins ensure the take-off peak flow generated when the rainfall duration is equal to or greater than the concentration time (NP 133-2013).

The presence of some pollutants requires pre-treatment of meteoric wastewater. At the same time, the collection of polluted meteoric waters allows the protection of green areas by eliminating the possibility of degradation of the emissary or the land. The retention basins allow the discharge of some volumes of water into the sewers of the domestic wastewater network in order to obtain a flow to ensure the optimal transport speed.

CONCLUSION

1. Compliance with European standards requires the development of sewerage systems and the local capitalization of meteoric waters contributes to the protection of the environment in urban and rural localities.

2. The collection and local storage of meteoric waters allows them to be used for wetting green areas in the area of localities and limiting the destructive effects on the environment through wastewater discharge.

3. The use of meteoric waters in the area of localities requires the creation of a specialized infrastructure consisting of sewer collectors, storage tanks, pumping stations and distribution networks with greening equipment.

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