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MODEL OF VEGETATION EXTENSIVE SYSTEM OF FILTERS USED IRRIGATE CROPS

BĂDAN DANIELA NICOLETA¹

Abstract: *This paper is based on the design of an extensive system of filters vegetation that serves a town with 1,400 inhabitants. In this work I present methods of water purification in rural / urban and viable solutions to implement filters planted with macrophytes based on biological treatment. Depending on the throughput rates of the village wastewater system parameters are established extensive filters. Sewage plants are lower in rural areas usually experiencing considerable seasonal and even daily variations in terms laden with pollutants and sewage flow. The adoption of such methods would bring many benefits to rural areas locally to reduce without the consumption of energy costs if the topography makes it possible plant location and thus decreasing the risks of environmental pollution with the possibility of effective treatment of wastewater. These sewage treatment plants in rural and urban areas must be manageable and exploitable. Ensuring good quality and quantity, purified water is considered a valuable especially in rural areas being reused in agriculture.*

Keywords: *extensive systems, water treatment, sewage plants, rural*

JEL classification: Q15, Q25

INTRODUCTION

Romania ranks twenty-first in Europe, being a country rich in water resources, so that an inhabitant has 1,700 m³ of water for one year. For a good use the water used for drinking, industrial, recreation, agriculture, resources, both underground and surface waters, can not be used without investment for river improvement works and treatment plants.

The composition and quantity of wastewater, determines to a large extent, both the size of treatment plants and the quality of surface waters, emissaries, the most commonly used, which can intervene in the election process and purification scheme.

After the receipt into receptors, polluted waters are subjected to natural processes of self-purification, which means gradually reducing the harmful effects on the environment, including self-purified receptors.

Through self-purification means all natural treatment processes by which receptors are brought back to their qualitative characteristics that you had before receiving wastewater. Self-cleaning ranges, water features remain constant even if. Self-purification capacity is not unlimited receptors. For this reason, there is an ongoing decline of this capability, especially when the ground is envisaged for irrigation or infiltration, or even surface and especially lakes.

Extensive purification processes are processes for purification of waste water are very close to natural water purification processes (processes of self-cleaning) to which, as the was previously indicated, the main role is played by micro-organisms (bacteria).

Extensive wastewater treatment systems have a very natural (no aspect of industrial plant) fits perfectly into the natural landscape without it affecting anything. Such systems Extensive wastewater treatment were developed in different European countries (France, Germany, Spain, Holland, etc.) generally to serve certain objectives (eg small communities) with a population of less than 500 population equivalent. Establishment of extensive water treatment plant to serve the village with a population of more than 500 pe up to 5000 pe can be considered possible but taking into account some specific precautions. In our country, the research in this field is at an early stage.

In extensive systems of vegetation wastewater treatment principle is achieved mainly aerobic biological treatment occurs in the granular particles from fine to coarse. There is to be a renewal regular washing of the filtering layer or to be evacuated sludge produced in the biological

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filters. Instead sludge produced upstream of the filters (filter surface or primary sedimentation facilities) must be evacuated.

MATERIALS AND METHODS

This paper is a synthesis of data and materials of thesis based on an extensive bibliography "Extensive filters vegetation systems" developed at the University Politehnica Bucharest, Faculty of Biotechnical Systems Engineering.

This work represents a synthesis of data and materials from diploma thesis based on an extensive bibliography "Extensive filters vegetation systems" elaborated at the University Politehnica Bucharest, Faculty of Biotechnical Systems Engineering. Schedule according to which we calculate water flow is MathCad, which is a software mathematically in the category of advanced devoted to solving mathematical problems with procedures symbolic computation and methods numerical analysis having an robust option programming and interactivity very fluid with other software: Matlab, Origin, MS Excel, Office, etc.

RESULTS AND DISCUSSIONS

In the the research aspect was designed treatment plant that treats wastewater from extensive in a town with a population of 1400 inhabitants. The village is divided into two areas within the locality runs sales:

Table 1. Industrial area

Data	Milk and cheese factory	Fur factory
Production [of / day]	7 t/day	1 t/day
Personal [person]	120 pers	180 pers
Offices	10	10
Group I	40	60
Group II	40	60
Group III	-	50
Group IV	-	-
Group V	-	-
Group VI	30	-
Buildings	7	9
Maximum volume	20 000 m ²	16 000 m ²

Table 2. Zoological-technical area

Date	Cattle breeding	Farmed birds
heads	1000	40 000
Personal [person]	120	70
Offices	10	5
Group I	50	20
Group II	60	45
Buildings	25	7
Maximum volume	10000 m ²	12000 m ²

In order to determine wastewater flows to rural center taken extensive system of treatment shall be taken into account:

- consumption of drinking water of the village;
- characteristic values of requirements and requirements of water supply from residential areas, industrial and agricultural areas of the center;
- characteristic values of total water supply requirement of the center areas.

Current wastewater flow taken over in urban centers and urban processed by treatment plants is not constant during the day, showing fluctuations depending on the manner in which water

supply is consumed in urban centers. Therefore using multiple characteristic values that define this notion fluctuating flow namely:

- $Q_{u\ zi\ med}$ - the average daily flow expressed in the unit feature [m^3 / day] or the unit S.I. [m^3 / s] is the average value daily flow rates of a waste water produced in the urban center during a year;
- $Q_{u\ zi\ max}$ [m^3 / day , m^3 / s]- maximum daily flow rate is the maximum value daily flow rates of wastewater produced in the urban center over one year;
- $Q_{u\ orar\ max}$ [m^3 / h , m^3 / s] Hourly maximum flow of wastewater is the maximum value hourly flow rates of wastewater produced in the urban center throughout the day;
- $Q_{u\ orar\ min}$ [m^3 / h , m^3 / s]- Hourly minimum flow of wastewater is the maximum value hourly flow rates of wastewater produced in the urban center throughout the day.

Wastewater flow of the center urban / rural is determined by the consumption of drinking water to the urban center, its characteristic values successive following algorithm: : is calculated characteristic values of requirements and requirements of water supply in residential areas, industrial and agricultural center's urbanis calculated the characteristic values of of the requirement total water supply to the urban center, then calculate the characteristic values of the wastewater flow to urban center.

The needs for water supply for populated residential area of the center is expressed by the following characteristic values are be calculated as follows:

$$Q_{zi\ max} = \frac{1}{1000} \left(\sum_i \sum_j N(i) * q_j(i) * K_{zi}(i) \right) + Q_{ci}$$

$$Q_{zi\ med} = \frac{1}{1000} \left(\sum_i \sum_j N(i) * q_j(i) * K_{zi}(i) \right) + Q_{ci}$$

$$Q_{orar\ max} = \frac{1}{24} \left(\frac{1}{1000} \left(\sum_i \sum_j N(i) * q_j(i) * K_{zi}(i) * K_o(i) \right) \right) + Q_{ci}$$

where,

K_{zi} - the coefficient of daily flow unevenness;

K_o - the coefficient of hourly variation is adopted for each of the differentiated areas of the village;

$q_{(i)}$ [$l / \text{day person}$] - medium daily flow specific category j of needs water for area residents and the village;

Q_{ci} [m^3 / day] - water flow necessary for fire; it can be calculated analytically based on the provisions of STAS 1478-90 taking into account the configuration of systems for fire.

Table 3. Throughput rates of needs and of the requirement of the village water supply

Fluctuating water flow	Industrial area (Milk and cheese factory + Factory fur)	Zoological-technical area (Cattle Breeders + aviary)	Residential area
medium daily flow ($Q_{zi\ med}$)	396.107 m^3/day	180.411 m^3/day	992.503 m^3/day
Maximum daily flow ($Q_{zi\ max}$)	399.044 m^3/day	246.852 m^3/day	1049.330 m^3/day
Maximum hourly flow ($Q_{orar\ max}$)	18.315 m^3/h	22.078 m^3/h	75.361 m^3/h

The flow of water needs for animal care should include supplies water to use biological animal needs technological water for manure removal, washing and disinfection halls, cooking, maintenance of technical installations, the necessary objects annex the halls of farming.

The characteristic values of flow requirement of total water supply of populated areas respectively total flow rate average daily $Q_{s\ tot\ zi\ med}$ [m^3 / day , m^3 / s], debit total maximum daily

$Q_{s\ tot\ zi}$ [m^3 / day , m^3 / s] hourly maximum total flow $Q_{s\ tot\ orar\ max}$ [m^3 / h , m^3 / s] is determined by the following relationship:

$$Q_{s\ tot\ zi\ med} = Q_{s\ zi\ med} + Q_{sI\ zi\ med} + Q_{sZ\ zi\ med}$$

$$Q_{s\ tot\ zi\ max} = Q_{s\ zi\ max} + Q_{sI\ zi\ max} + Q_{sZ\ zi\ max}$$

$$Q_{s\ tot\ orar\ max} = Q_{s\ orar\ max} + Q_{sI\ orar\ max} + Q_{sZ\ orar\ max}$$

Where,

$Q_{s\ zi\ med}$, $Q_{s\ zi\ max}$ și $Q_{s\ orar\ max}$ - debits daily of the requirement of water supply to population centers;

$Q_{sI\ zi\ med}$, $Q_{sI\ zi\ max}$ $Q_{sI\ orar\ max}$ - debits daily of the requirement of water supply for industrial area;

$Q_{sZ\ zi\ med}$, $Q_{sZ\ zi\ max}$ $Q_{sZ\ orar\ max}$ - flow daily of the requirement of water supply in the area inhabited zoological-technical center.

Table 4. Flows characteristic requirement total water supply of populated center

Water flow	Population center
Total average daily flow	1569 m^3/day
Total maximum daily flow	1695 m^3/day
Hourly maximum total flow	115,754 m^3/hour

Waste- water flow of the center urban / rural is determined by the consumption of drinking water to the urban center, the characteristic values of its being performed following algorithm successively calculating characteristic values of requirements and requirements of water supply in residential areas, industrial and agricultural areas of the center is calculated the characteristic values of total water supply of the requirement of the urban center, then calculate the characteristic values calculated wastewater flow of the center urban / rural.

The characteristic values of the flow of wastewater in central urban / rural are established by similar characteristic values of total water supply of the requirement of the center populated with the following relationship:

$$Q_{u\ zi\ med} = 0,8 * Q_{s\ tot\ zi\ med}$$

$$Q_{u\ zi\ max} = 0,8 * Q_{s\ tot\ zi\ max}$$

$$Q_{u\ orar\ max} = 0,8 * Q_{s\ tot\ orar\ max}$$

$$Q_{u\ orar\ min} = \frac{1}{24} * p * Q_{u\ zi\ max}$$

Where,

p = a dimensional coefficient depending on the number of inhabitants of the populous center.

Table 5. Wastewater flows characteristics of the locality

Wastewater flow	Populated center
Average daily wastewater flow	1255 m^3/day
Maximum daily wastewater flow	1356 m^3/day
Hourly maximum wastewater flow	92.603 m^3/hour
Minimum hourly wastewater flow	14.127 m^3/hour

Following wastewater flows whereabouts of the village taken from the extensive system of treatment is determining the dimensional parameters of the system.

Designing an extensive system of filters vegetation consists of two steps. Each stage is divided into 3 groups and 2 groups .A group is divided into 10 compartments.

For higher efficiency of these systems is required in advance a good mechanical treatment. Pre-treatment can be performed by primary sedimentation in decanter.

In stage I of vegetation filters with vertical flow granular filler material is used with various grain gravel placed in layers. The active layer has a thickness of 40 cm, and a particle size between 2-8 mm gravel supporting layer is made up of gravel with an intermediary grain size

between 10 - 20 mm, and is based on the drainage layer, consisting of gravel all but a coarse grain size between 20-40 mm.

In the second stage refines the treatment of the first stage. Said filler layer of sand with a thickness of at least 30 cm.

First step surface is determined by the relationship:

$$S_{tr I fw} = S_{Ifw} * p$$

$$S_{tr I fw} = 1,5 * 1400 = 2100 m^2$$

in which :

S_{Ifw} - Specific surface for stage I

Second step surface to determine the relationship

$$S_{tr II fw} = S_{II fw} * p$$

$$S_{tr II fw} = 1 * 1400 = 1400 m^2$$

in which :

$S_{II fw}$ - Specific surface for stage I

Plants that can be grown on the granular layer: ScirpusTypha, Reed (especially the variety Phragmites australis) is best used in temperate climates because of resistance to the conditions encountered (periods of flooding water filter, periods of dryness waters high organic load) and the rapid development of roots and rhizomes systems. Vegetation filters are also known commonly used filters with reeds. The recommended planting density is 4 plants / m².

From the analytical data shows that 1,400 residents average daily wastewater flow is 1255 m³ / day which is evenly distributed over an area of 3,500 m². In vegetation filters the research in various bibliographic reference sources in the field found that these treatment systems implemented (eg Sveti Tomaž, Slovenia such an area was built for 250 people with an average daily flow of 38 m³ / day of wastewater) seem to be a reasonable solution to the settlements below 2,000 inhabitants.

SWOT analysis

Strong points

- Technology a little costly;
- Low or zero energy consumption (the use a pump can be avoided if natural inclination is sufficient);
- The possibility of effective treatment of domestic wastewater;
- Adaptation good at servicing locations with seasonal variations in production of domestic wastewater (locations holiday, camping, caravans, hotels);
- There is no need for personnel highly trained maintenance;
- Easy operation and maintenance;
- Lack of electromechanical equipment (possibly a pump);
- Adaptable to seasonal changes;
- Removal of pathogens good;
- Partially removing nutrients;
- Fit harmoniously into the landscape;
- Lack of noise pollution;
- Minimum sludge management.

Weaknesses

- It is a large area of land required for establishment;
- The risk of insects and rodents within plants;
- The need for regular maintenance (cutting annual plant exposed part, manual removal of weeds before emergence and growth of plants);
- Use filter systems with vegetation vertical flow to service targets greater than 2,000 pe remains unchecked, in terms of control of hydraulic and cost compared to traditional methods that focus on building a water treatment system with filters vegetation with high capacity vertical flow can be

considered only after serious studies related to adaptation base model and after setting the conditions to be met to ensure the hydraulic control system;

- The construction of treatment systems with extensive horizontal flow filters vegetation location or objectives to serve over 4,000 pe can be considered only if they have thoroughly analyzed all the design parameters, in particular hydraulic parameters.

Opportunities

- Method of wastewater treatment without energy (natural);
- To successfully adapt to climate change is necessary concepts and approaches for sustainable water saving and closing the water cycle locally;
- The use of sludge as fertilizer in agriculture and irrigation of treated water system which leads to lower costs for maintenance crops.

Threats

- Barriers to implementing application technologies include difficulties in obtaining local permits required for construction, because currently there are no guidelines and regulations regarding treatment systems Decentralized wastewater and reuse of treated wastewater.

CONCLUSIONS

In the current context of climate change with periods of drought, low rainfall areas can be provided with water necessary to irrigate crops using this method. These systems are an alternative that should be developed, promoted and implemented to provide advanced water treatment in both rural and urban areas.

For small towns in rural areas is enough raw water to be treated naturally: lagoons, filter systems with vegetation, such systems use extensive treatment to improve the quality of waste water for agglomerations of over 2000 inhabitants is pending technology Development. At the same time their use is quite effective solution for treating wastewater originating from settlements rural / urban small capacity, it is considered a method which treat wastewater sufficiently used in households and reused in agriculture.

Promoting wastewater for irrigation of crops in Romania is still not very developed idea is not knowing the meaning of it pursuits. Test runs on experimental fields were held in Bulgaria, France, Germany, Italy, Poland and Hungary on the assumption that this method is optimal in terms of maintenance and protection of the environment and to cover the deficit of water / rain.

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