DEVICE FOR WASTERWATER TREATMENT IN CONSTRUCTED WETLANDS DAUZUC

Introduction

Many studies around the world have been devoted to climate change and the impact of climate change on water resources. It is necessary to assess the specific effects and the need for adaptation and mitigation of the effects for the water systems and their impact on the economy and the life of the people. There is, therefore, an urgent need to establish an overall picture focused on water supply and wastewater treatment in urban and rural areas.

The range of challenges related to climate change is very high, depending on geography, economy, administrative capacity and demography.

Water extraction and wastewater treatment fall into two major types of systems: formal established by the governing or local and informal governance structures. In most of the rural or suburban or urban areas associated with urban sprawl, water extraction and evacuation fall into the informal system.

Formal and informal systems have different capacities to respond to the problems that climate change will bring. Both systems provide water delivery to the population and waste water evacuation. Formal systems with many financial and technicalmeans can generally respond more easily to climate change than informal ones. Given the financial constraint and impossibility to plan the resources they support, informal systems are less able to cope with changes in both demand and supply of water expected to be brought about by climate change.

Functions of the formal system include storage, supply, distribution and treatment of waste water and its disposal or reuse. The infrastructure includes, in general, water and sanitation facilities, water storage facilities, rainwater collection systems, drinking water and waste water treatment equipment, pipelines and pumps, local distribution systems and other installations. Urban water infrastructures in the formal system should be built beyond the boundaries of expanding cities. That is why the city's internal distribution system may sometimes include regions that are regulated separately.

Many of these facilities, structures, sources of supply and waste disposal mechanisms are vulnerable to the negative effects of climate change. Urban water consumption can be affected by changes in water availability due to rainfall increases or decreases, mean temperature increases, increase or decrease in water levels in rivers and lakes.

An important objective of urban water suppliers is to provide safe drinking water in quantities that meet the requirements for commercial and industrial enterprises for agriculture and household consumption. These tasks are not always met, even in the absence of climate change. Sewage treatment plants are neither ecologic nor economic , in Europe, even in the absence of these changes.

There are no storage systems required for water reuse including: local tanks, ponds , constructed wetland, as well as aquifer storage and recovery systems. Wastewater management should be to integrated into all irrigation systems and include at least one reuse of wastewater. Because of this, climate change will certainly result in water shortages in agriculture due to prolonged drought periods.

Wastewater treatment, distribution and disposal are also directly affected by the effects of climate change, by increasing the energy costs of transporting and treating larger volumes of wastewater and rainwater entering treatment facilities in areas where, and at times when, which precipitation grows or during periods of drought

Formal Wastewater System in Large Cities of the U.S. and Canada receives wastewater and treats it at several primary, secondary and tertiary levels, the water resulting from each treatment having a direct reuse degree. Waste water treatment facilities include water pollution control facilities, combined sewerage installations, water and mud pumps, laboratories, sludge dewatering facilities, and sludge transport systems.

Especially in eastern Europe, water systems for part of rural areas but also for suburban areas are informal. In these systems, water supply as well as wastewater treatment and disposal are not provided at large scale, in centralized, managed engineering systems in line with long-term plans, but rather include a mix of local improvisations: informal water markets. Lack of centralization leads to lack of planning and maintenance. These limitations, in turn, indicate that informal systems are more vulnerable to climate change than formal ones, where planning and more financial resources for infrastructure, development and maintenance can be used. The localities under 2000 inhabitants are not subject to regulations included in a European directive nor have the possibility to develop their own sewerage and water supply network through distinct projects from the localities of over 2,000 inhabitants. That's why systems were designed and built for the latter, with sewerage lengths that include the distances between localities, often tens of kilometers. We can not talk about efficiency or durability. The costs of these, very large projects, will never be amortized by charging subscribers. If we add the fact that a mechanical - biological treatment plant can not function at the required treatment parameters, unless the number of inhabitants used for the design is at least equal to the one using the sewerage system and the population in the rural area vary it can be appreciated that most of these treatment plants only work formally. In addition, due to lack of technical supervision and maintenance, they are degrading at an accelerated pace, with no real reconditioning possibilities.

For this reason, we can speak in the case of many rural localities of informal systems that include the extraction of groundwater from wells and drilling wells and the disposal of waste water, not directly or indirectly through so-called septic tanks in soils communicating the groundwater canvas or in surface waters and partially with vidanje trucks with discharge not in purification stations but in even in natural emissaries, existing sewage, on the soil or in surface waters.

Climate change predictions for Europe suggest an increase in high-intensity rainfall alternating with drought increase due to the increase in annual average temperature Therefore, it is reasonable to accept that the number of variations in demand and supply of water are likely to increase with such scenarios. The biggest challenge to adapt to climate change in water supply and sewage treatment is in the informal system.

Concrete action at the level of communities, which are best placed to monitor and implement policies and programs in the informal system, lacking. Thus, there is a need to develop policies to ensure adequate monitoring and modeling of demand-side adaptation strategies and water supply. A new water policy has to be drafted and must include informal water markets and the administrative capacity to implement the policy.

Some of the hazards associated with water supply in the informal system currently include:

- the shallow wells are located in areas with health risks (near cesspools, or septic tanks)
- improvised landfill sites often have the same water level dynamics as wells.
- wastewater is directly or indirectly discharged into the canvas of water and partly by vacuuming, transport and discharge on the ground or in surface water.

Urban growth is characterized by incomplete urbanization and a severe shortage of key infrastructure (water, sewage, drainage and electricity). Over the past twenty years, in Eastern Europe there has been a rapid expansion of urban areas and the associated population. It is all the more difficult to see how the formal system will be able to respond to future demands for water management and, in particular, waste water, if water consumption increases due to higher temperatures.

If the past is an indication, the role of the informal water market will increase due to the adaptability and high rate of response to stress, both in urban areas and in rural areas. The real solution to the problem is not the cancellation of these markets, which is impossible in the coming decades, but the use of environmentally friendly technologies, such as natural biological treatment, in constructed wetlands.

Constructed Wetlands (CW)

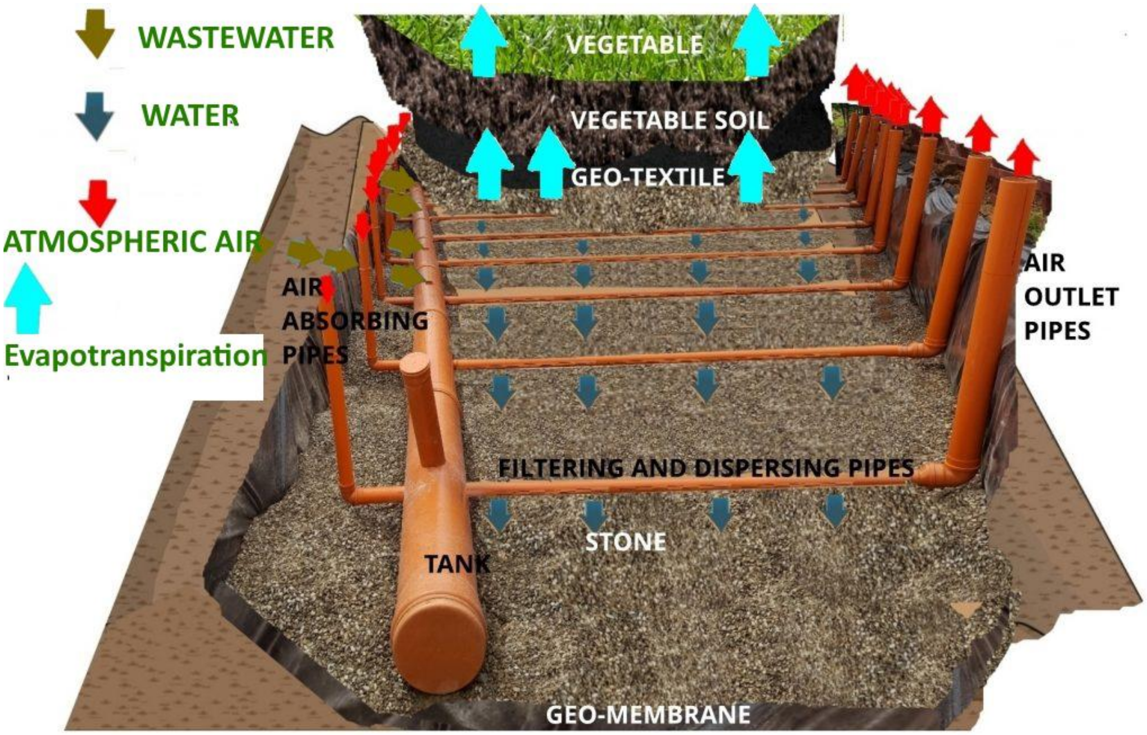
The constructed wetlands (CW) are used for the biological purification of domestic wastewater, for compost and leachate from landfills, discharges from farms / farms and industrial wastewater.

In a CW, hydro-logical , geotechnical and biological constructive parameters that influence the processes in relation to the purification can be artificially modified, this implying the control of certain processes, as compared to their deployment in nature. The use of CW is a relatively simple, cheap and robust solution for wastewater treatment. As a natural purification system, CW requires a larger area compared to the mechanical biological treatment plants. But CW have much lower investment, operating and maintenance costs and bring additional benefits such as tolerance to load variation, ease of reuse and recycling, providing habitat for many organisms, and a more aesthetic look than traditional water treatment plants. The constructed wetlands can be divided into two main types:horizontal subsurface flow constructed wetland (HF-CW) with horizontal discharge and subsurface constructed wetland vertical-flow (VF-CW)with vertical discharge . For HF-CW the oxygen for aerobic processes is mainly obtained by diffusion into water, from the atmosphere.

The amount of oxygen transported through roots to the underwater area is low. Anoxic and anaerobic processes play the most important role in HF-CW. Organic matter decomposesboth aerobically and anaerobically, resulting in the reduction of CCO, CBO5 and MS. The insufficient amount of oxygen results in incomplete nitrification and the lack of reduction of ammoniacal nitrogen. Today, the most commonly used are subsurface constructed wetland with vertical-flow with sequential loading, because it eliminates ammonia nitrogen by complete nitrification and denitrification .

The water is intermittently charged and infiltrated into the substrate, then drips down vertically, where it is collected at the bottom through a drainage network. The air returns the system to the next charging stage and a high oxygen transfer rate is achieved subsurface constructed wetland vertical-flow with sequential loading are therefore suitable when nitrification and other strictly aerobic processes are required. subsurface constructed wetland vertical-flow with sequential loading uses waste water pumps and automation systems and septic tanks (mechanical-treatment).

DAUZUC , based on the inventions of "Septic tank with self-draining", and "Device for Increasing the Efficiency of Constructed Wetlands" EP19158442.4 **eliminates these components, without : additional investment costs , electricity consumption and exploitation costs.**



DESCRIPTION

The device is composed of naturally ventilated tanks, with filtering and dispersing pipes, communicating with the surface of the soil through air absortion pipes, through which air is absorbed due to the natural smoke effect, and through the air outlet pipes through which air is evacued . The filtering and dispersing pipes has, on the underside of the circumference, rectangular slots interrupted at the base by a drainage channel. Above the filtering and dispersing pipes there is a waste water pipe with a discharge on them. The equipment is placed in a CW with a gravel bed, covered with a geo textile membrane filter, placed under a layer of vegetal soil. All components are placed in a pool made of PVC or PE foil. The process is continuous and consists of:

Mechanical treatment in tank:

When the waste water falls in the tank , on the filtering and dispersing pipes, because of the Coanda effect, the liquid flows to the slots, where a large part of the gray water and also the liquid fraction of the black water penetrates and flowing on the drainage channel, in the CW. In the tank are retained until liquefaction or dissolution in liquid due the turbulence created at the fall of wastewater, only large solids, sand, grease.

Biological treatment in tank:

In the tank, the anaerobic digestion of biodegradable materials alternates with aerobic digestion, depending on the variation of the waste water flow and the build up of the CW. Aeration is achieved by the air circulation between the absorption pipe and the outlet pipe , but also due to the disorder created by the wastewater in the fall and by the influx of water entering the tank from the wet area built through filtering and dispersing pipes. This influx also enriches the content of aerobic microorganisms with those in the wet built area. In the tank occurs and the anaerobic phase and denitrification for the elimination of the gaseous nitrogen on the outlet air pipes, after the nitrification in the built-up wet zone and the anoxic phase of phosphorus removal.

In CW :

The aerobic digestion of the biodegradable materials takes place by the stationary bio-media existing in the soil and in the gravel bed which, due to the variable flow of the waste water and the variations in level and absorption in the multilayer CW, is submerged alternately aerated at each exceedance offiltering and dispersing pipes level by the water inside the tank and the outlet in CW and its withdrawal due to soil absorption. Aeration inside the gravel layer and in the soil is enhanced by both convection caused by the water infiltration motion through the granular medium and by air diffusion from the surface to the granular material layer by absorption into porous media. Ammonium nitrification (biological oxidation) also occurs due to chemical autotrophic bacteria but also to the decomposition at its base, by aerobic microorganisms when dissolved oxygen consumes oxidized nitrogen instead of oxygen, and by anaerobic microorganisms. They convert nitrites and nitrates into gas as nitrogen (N2). Due to organic soil loading and permanent aeration, phosphorus removal is also taking place.

CW also purifies the waters through two filtration processes, namely:

- superficial filtration of the treated water, whereby medium-sized solid suspensions are removed by retention in the pores of the gravel bed until the effluent is portion wise dissolved. Since the solid suspensions retained are of both mineral and biological origin, it results that by the superficial filtration process the suspended materials and a significnificant part of the organic load of the treated water are eliminated;
- the final filtration of treated water, whereby the solid suspensions are almost entirely removed from the water overflow of the geotextile membrane level which only allows the passage of clean water.

Bio-degradation and disintegration of organic compounds and filtration is continued by the aerobic microorganisms in the vegetal soil, which are also activated by the absorbed air.

The purification performance obtained is as follows:

- CBO5 reductions of 90% -98% (less than 25mg / l), CCO (less than 120mg / l), and solid SS suspensions (below 30mg / l)
- complete virtual nitrification;
- denitrification 70-80%
- phosphorus reduction 60-70%
- partial elimination of faecal bacteria (reductions of 1,000 times the number of faecal bacteria for every 1 m of granule layer thickness).

Purified water is finally absorbed into the upper layers of soil and eliminated by evapotranspiration (ET) sweating and use for plants irrigation at the root. By sterilizing water can also be used for surface irrigation.

Increasing the coefficient of ET by remodeling the natural soil

ET is a complex process of water vapor transformation through a series of physical processes (evaporation in the liquid phase and sublimation in the case of snow and ice) and biological (perspiration). Water transformation into vapors occurs at the surface of the field, in the field (at low depths) and in the vegetation cover (natural or cultivated).

Evaporation can affect all forms of liquid water: • meteoric water in the atmosphere, retained by the vegetation cover and fallen water on the surface of the ground; • groundwater in the soil profile, the capillary area and even the shallow groundwater aquifers. The evaporation process consists in "detaching" the molecules from the surface of the water or the wet ground under the action of solar radiation and their passage into the state of vapor that returns to the atmosphere. In all cases, the evaporation rate is influenced by: the evaporating power of the atmosphere, the type of the evaporating surface, and the ability to supply the evaporation.

The evaporating power of the atmosphere refers to its state in the vicinity of the evaporating surface and its ability to cause evaporation. Factors that determine evaporating power are: atmospheric saturation deficiency, air and water temperature, barometric pressure, water chemistry, altitude, and so on. The evaporating wetlands are studied in terms of water availability and their ability to supply evaporation. In this respect, in hydro geological research it is interesting to evaporate to the surface of a land lacking vegetation, as well as in conditions of different humidity states: • soil (soil) saturated with water; • unsaturated land; • For aquifer at low depth.

If the land is saturated with water, the evaporation rate is equal to that of a free water surface. Apart from the physical characteristics of the land (porosity, granulation, saturation), evaporation at the surface of a vegetation-free land also depends on the depth of the groundwater aquifer.

When the piezometric level of the groundwater aquifer is at a low depth, the evaporation reaches maximum values, determined by the evaporating power of the atmosphere, because the supply of the evaporating surface is made continuously by the ascending capillary movement of the aquifer water.

Through experiences can determine the depth from which evaporation becomes insignificant, this being the critical depth under which no salts are added to the soil profile.

The evaporation process also depends on the humidity gradient distribution as well as on the water-vapor mass diffusion component. Evaporation in the ground ceases when the hygroscopic humidity is reached is in equilibrium with that of the atmosphere and can not be eliminated by evaporation.

Transpiration is the physiological process of transforming groundwater (mainly from the soil profile) into vapors (through vegetation) that return to the atmosphere. It is influenced by both physical factors (atmospheric evaporation, meteorological factors, soil humidity) and physiological factors (plant species, age or stage of vegetation, development of the root system and leaves, rooting depth). Plants, through their roots, can absorb water from the soil up to depths of 0.30 to 1.50 m for crops, but up to 10 m for trees. Research has shown that root systems can grow to the upper limit of the capillary area generated by the groundwater aquifer. Some root systems can reach a total length of 100m and even 1000m, thus contributing to a significant increase in the amount of sweat water.

Remodeling results for DAUZUC:

1. Obtaining a stagnant water regime by placing in waterproofed pools with PVC or PE membrane or foil.

Stagnant hydronic regime occurs naturally in clayey soils (wetlands) in wetlands, under relief conditions ons (flat surfaces, depressions, slope bases) and favoring excessive water stagnation in their upper part (sometimes even to the surface) not

affecting the groundwater canvas.
2. Increase in soil gas content to 60%
The gaseous component of the natural soil is the air (gas + water vapor) in its pores. It holds between 15 and 35% of the soil volume depending on the humidity. Air is indispensable in the soil, controlling seed germination, plant growth, microorganism activity and most physical and chemical processes. The balanced bonding between the solid, liquid and gaseous phases gives the soil optimal fertility conditions. Air can be present in the soil in several states: - free → affects most of the soil and is in capillary pores and (especially) uncapillary; circulates through the ground and exchanges with the atmosphere; - captive → has a very low influence, is in isolated pores and does not flow through the soil; does not exchange atmospheric air; - adsorbed → is bound to the surface of the mineral particles; - dissolved → dissolved gases in soil water; does not influence aeration.

DAUZUC achieves the absorption of additional air through the absorption and oulet pipes through the natural smoke effect, a doubling of the gaseous component of the soil.

Once the drainage is completed, the large pores of the soil are filled with both water and air, while small pores are still full of water. Gradually, the water stored in the soil is taken up by the roots of the plants or evaporates from the surface of the soil into the atmosphere. Without additional water intake the soil will gradually dry out. Soil contains a very small amount of water (hygroscopic and film water), which is more strongly bound, with a force (over 20 atmospheres), which exceeds that of plant suction (less than 20 atmospheres). Natural soil incorporates less tightly bonded water and capillary water. The available water capacity depends to a large extent on the texture and soil structure. DAUZUC by using a gravel layer of 75% deep granulation adds to this capacity, the volume of the gap between stones, which represents over 40% of the gravel volume.

DAUZUC obtains by soil remodeling, but also due to the heat intake of spilled wastewater and exothermic biological processes of soil microorganisms, evapotranspiration values of 6 mm / day (average annual). The irrigation is carried out according to the requirements related to water analysis indicators for irrigation of non-food crops.

Wastewater supply is made by free fall, while mixing, filtration is ensured by natural mechanical processes such as: "Coanda effect", kinetic energy of sewerage, turbine flow of liquids in cylindrical bodies.

The suplimentary aeration is done through natural ventilation using the natural smoke effect. Similar to the processes in the mecano biological treatment plants, the addition of oxygen in solution favors the multiplication of aerobic bacteria and the consumption of nutrients. Their population is much larger and more diversified and efficient. This process encourages the conversion of nitrogen into nitrites and nitrates, remove phosphorus compounds from the liquid. During this stage, the sludge formed by the bacteria and products of their digestion is let down.

Aerobic microorganisms continue to multiply in the upper part until the dissolved oxygen is consumed. At the bottom, due to the permanent fluid layer, anaerobic microorganisms develop. Many of these and some of the aerobic ones that use oxidized nitrogen, instead of oxygen, convert nitrites and nitrates into gas as nitrogen .

Stabilization takes place in the gravel bed and has the effect of temporarily fixing the solids in suspension to digestion.

The effluent is absorbed by the vegetal soil layer and then by the naturally occurring plants on it.

BENEFITS:

- NO ENERGY
- NO CHEMICALS
- NO SERVICE
- NO INSTALATION FOR TREATED WATER DISCHARGE
- NO TEHNICAL SURVEILANCE
- LESS INVESTMENT AND EXPLOITATION COSTS OVER 80% THAN MECHANICAL AND BIOLOGICAL TREATMENT PLANTS AND 30% LOWER THAN OTHER CW
- THE VALUE OF WASTEWATER COLLECTION WORKS DECREASES SIGNIFICANTLY

CW for the consumed water of 6 EQUIVALENT INHABITANT(IE) (through evapotranspiration and water reuse for irrigation at the root of non-food vegetation during the vegetation period) it is necessary to have an area of 15 sm and 2,5 sm /IE for the built wet area and 10 sm / IE of the irrigated surface at the root.

For CW has not yet developed European standards or norms. The DAUZUC studies and projects are based on manuals and guides of good practice, based on national standards developed in Austria and Germany (ÖNORM B 2505, 2005; DWA-A 262, 2006), international studies and research, and on documents issued by bodies.

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