

PHYTOREMEDIATION. A METHOD FOR TREATMENT OF DOMESTIC WASTE WATERS IN TOWN OF UKRAINE

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Abstract

Specialist of the Ukrainian Scientific Research Institute of Ecological Problems are working on development and implementation in Ukraine of constructed wetlands since ninetieths years of the last century. At present in exploitation in our contry there are more than 200 such treatment constructions at various stages of implementation: design, development, operation. The units are used mainly for tertiary treatment of domestic waste waters in town. In Ukraine there is a perspective for wide application of Constructed Wetlands for treatment of domestic waste water in towns and regional centres.

Keywords. treatment of waste waters, phytoremediation, constructed wetlands, expenses for exploitation.

Introduction

Changes in social and economic conditions going on in Ukraine for about last twenty years are leading to mass migration of people from small villages, and farms to town or regional centres. Growyh of population in such town creates a range of problems among which there is a problem of treatment and disposal of domestic waste waters.

Under conditions of energetic and economic crises, construction or renovation of traditional treatment units – first of all aerotanks – is hardly possible. So the unsolved problem of treatment and disposal of waste waters often leads to ecological hardships. Moreover, prevailing number of existing treatment units are obsolete and their components need general overhaul. Actually at present it is necessary to reorient from intensive waste water treatment method to simple, low-energy, extensive method, based on natural self-purification processes. Nowadays techniques based on application of higher aquatic plants (HAP) for waste water treatment, so called phytoremediation, are gaining popularity in Europe, USA, Canada, and Asia. The phytoremediation units, called constructed wetlands, are created at marshe – lands cowered with higher aquatic plants. Kadlec & Knight (1996) gave a good historical account of the use of natural and constructed wetlands for wastewater treatment and disposal. According to USEPA 2006 the term wetland is defined as “those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.”

Methods

In Ukraine such treatment units, called bioengineering treatment units (BTU) have been developed at the Ukrainian Scientific Research Institute of Ecological Problems by V.Magmedov, M.Zakharchenko and L.Yakovleva during period 1984–93. Magmedov(1995),Zakharchenko (2006). Constructed Wetlands are combining purification and disinfecting effect, i.e. actions typical for sand or gravel filters, soil treatments units, and bioponds with vegetation (higher aquatic plants).

BTUs are basins of any shape, provided at the bottom and at sides with the antifiltration screen (polyethylene film or clay layer), the drainage (for collection of treated and filtered water) and the layer (sand, gravel), planted with vegetation. Such construction, as a rule, consists of 3–4 BTU cascade. The drainage of any type and structure must provide movement of treated fluid through thick stands of vegetation and the root layer in the filtering thickness. Practically all such units are being situated at land plots unsuitable for agricultural purposes.

In Ukraine, – for the year 2010 – there are more than 200 such treatment constructions (CW-BTU) at various stages of implementation: design, development, operation. But the process of BTU unit's practical introduction is passing rather slowly, in spite of high interest in them. Such retardation is caused by a range of factors, such as:

- agreeing on the drafts of documents may take several years;
- construction is performed by firms having no corresponding experience;
- BTU exploitation is performed with high degree of irresponsibility. And here is acting the psychological factor: as units need a minimal attention, they pay to BTU no attention at all.

Results and Discussion

Taking into account such features of BTU exploitation in Ukraine, we have elaborated a construction for townships domestic waste waters treatment able to operate during 50 years without any expenses for exploitation.

It is known that phytoremediation units are of two main types Kadlec & Knight (1996), Magmedov(2002): with free water surface (FWS), and the subsurface flow movement (SSF). This last type is subdivided into units with horizontal and vertical filtration. Such units are of different design, with applicability under different conditions. In BTU units with horizontal filtration there are no waste waters on their surface. The main problem in exploitation of phytoremediation units consists in necessity to provide regular operation of the mechanical pre-treatment units, that is constant clearing of settling boxes situated before BTU (CW) cascade.

This problem has been solved in a simple way, by using BTU block with free water surface (FWS) instead of regular setting units. The block has a form of a basin or a channel with free water surface

completely covered by vegetation (HAP). Water is purified in the process of horizontal filtration (movement) through the overgrowth.

Calculation of parameters for such complex as a whole is based on the demand that water flows through vegetation should reduce content of solid substances (including flotsam of paper, plastic) in domestic waste waters by 80%, with exploitation period at least 50 years. At that the thickness of sediments on the unit's bottom must not be higher than 0.5–0.7 m compiled in 50 years. After that period the units should be cleaned from sediments, and with vegetation (HAP). And it will be ready to run yet another 50 years.

The domestic waste waters treatment complex also can be constructed from 1–2 BTU blocks uniting the unit with free water surface (FWS) with that of subsurface flow movement (SSF). Such construction is provided with the sand filtering layer and the basic gravel drainage layer (10–15 cm, with drains). The filtering layer should be always covered with water 0.4 m thickness in summer and up to 0.8–1.0 m in winter. At the end of such complex is the unit with free water surface (FWS), acting as a tertiary treatment unit.

For each case it is possible to apply different units with minimal running costs (practically without any expenses). All such units are reliable in operations, and provide treatment of domestic waste waters from townships to normative demands acting in Ukraine, which are more stricter than in West European countries.

Conclusions

In Ukraine, especially under present economic situation, there is a perspective for wide application of Constructed Wetlands for treatment of domestic waste water in towns and regional centres, and at some industrial and recreational sites.

Such units can be observed with the help of Google Earth program (47°23'19.39"N, 32°24' 16.29"E) – 4 FWS blocks + 2 SSF blocks .

References

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