Scientific Bulletin of Politehnica University of Timişoara

Transactions on HYDROTECHNICS

Volume 61(75), Issue 1, 2016

Capabilities to improve the treatment performance for an industrial waste water treatment plant by using constructed wetlands

Denisa Pastor[1] Cristian Stăniloiu[2] Șumălan Ioan[3]

Abstract: The purpose of this paper is to present the study for improving the performance of an industrial wastewater purification plant. According to the valid legislation on industrial water purification procedures NTPA 001 and NTPA 002 for discharging the wastewater in the public sewage network or in a natural course of water, every manufacturing plant is bound to comply the requirements of these regulations. In order to fulfil these mandatory requirements the current wastewater purification plant uses a technology, which allows a complete nitrification, denitrification and also the removal of phosphorus. As an additional purification method it has been decided to use a plant filter in order to improve the performance of the industrial wastewater purification plant, which ensures a high degree of purification, using aquatic plants that have the ability to retain considerable amounts of pollutants, thus leading to the possibility of discharging the clean water directly in nature. After successfully completing the study, it was found that the use of the plant filter has many advantages and it's easy to integrate it into the environment, while providing a habitat for wildlife and also having reduced costs of maintenance and operation.
Keywords: waste water treatment plant, efficiency of treatment, primary treatment, secondary treatment, plant-based water filter

1. INTRODUCTION

Industrial wastewaters are resulting from different industrial processes or from another use of water than the domestic one. In order to discharge the treated water in the nature or the sewage network the technical parameters include in the NTPA 001 and NTPA 002 regulations must carried out.

The industrial wastewater treatment comprises physical processes, (separation by gravity, filtration, transfer between phases, distillation, freezing, frothing and adsorption), chemical, (neutralization, oxidation and reduction, precipitation, coagulation and flocculation, ion exchange) and biological processes, (biologic purification with activated sludge or biological filtration).

To complete the above-mentioned processes is recommended to include the disinfection tread; the most used methods are chlorine based or UV irradiation [7].

2. THE DESCRIPTION OF THE WASTEWATER TREATMENT USED IN AUTOMOTIVE INDUSTRY

In the automotive industry, as result of the technological processes wastewaters are resulting by containing residual pollutants as oils, greases, solvents, stuffs, and emulsions. Its recommended to separate this pollutions from water in order to use that, into closed circuit or discharging in the wastewater treatment plant.

The industrial waste water can also contain heavy metals and other chemical compounds witch by haphazard reaching in the surface water or groundwater can produce major lack of balance of the aquatic ecosystem, eutrophication and other environmental problems.

The waste water treatment plant in this case belongs of an automotive company, it is a compact system, and it is bared on a digital command. The installation works on waste plants by activated sludge principle with small load and aerobic stabilisation of the sludge. The technological scheme of the wastewater treatment plant is presented in the Figure 2.1.

The treatment process takes place automatic in the tank. Recirculation of the biological mass in the tank is ensured by a pump that working with air blast. As complementary parts of the wastewater plant can be mentioned the electric command board and the air blast-engine.

The tank consists in six compartments independently from hydraulic point of view, as follows: inflow, denitrification, aerobic and nitrification, secondary clarifier, treated water tank and tank for sludge store.

The wastewater resulted from manufacturing processes and sanitation needs reach in the wastewater treatment plant, where the brutish materials are retained into tank. The raw wastewater is introduced directly into denitrifying tank where the levigated activated sludge is present along the side with nitrified water from aeration tank. The denitrified waters enter into aeration tank, after that

[1,2,3] "Politehnica" University of Timişoara, Department of Hydrotechnical Engineering, George Enescu Street, no.1A, Zip code 300022, Timişoara, Romania, e-mail:

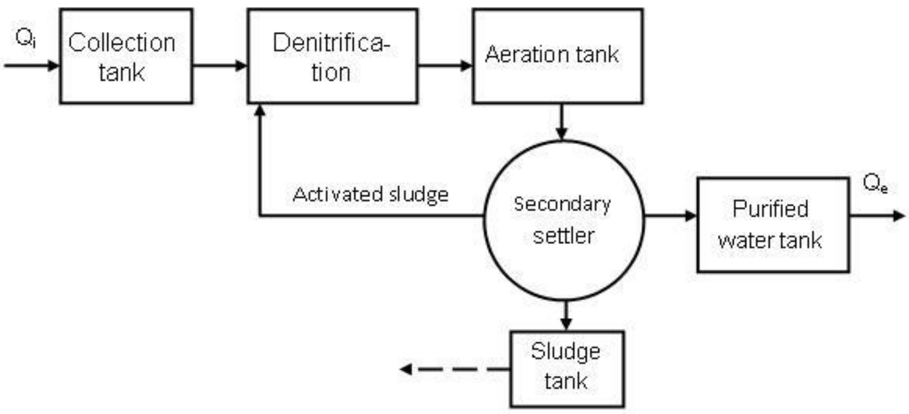

Figure 2.1. The technological scheme of the waste water treatment plant

through secondary clarifier and final the water is discharged by hydraulic ram.

The activated sludge is recirculated into denitrifying tank, the resulted water is conducted into disinfection tank, which hypochlorite solution is automatic dosed [13].

3.CONSTRUCTED WETLANDS FOR WASTEWATER TREATMENT

The majority of the companies are looking to maintain a constant equilibrium between costs, manufacturing process and environmental protection. As a result, in the last years, many methods were attempted in order to obtain good wastewater treatment efficiency.

One of the methods consists in building after the wastewater treatment plants a wetland with aquatic plants, having the goal to retain pollutions, (the process is called phytoremediation). The effluent or drainage waters from such land are collected and conducted to natural water coarse. After end of the vegetation period the plants are harvested, dried and used in the thermal stations, [9].

An efficient method in wastewater treatment with plants consists in soil filters with vegetation as a finally treatment tread. The filters are supplied with wastewater, which has been preliminary treated mechanically or mechanically and biologically by passing through the nitrification stage, [1], [2].

Behind the researches, such soil filter with vegetation was developed in different variants, depending on the form of running water, (horizontal or vertical). To ensure a properly efficiency of treatment, practically a combination between horizontal and vertical filter solution is used. In the cases in which the nitrification ahead is not necessary, especial for wastewater with soft nitrate loading, only a filter with horizontal flow is recommended, [4], [12].

As a filtering material are used sand and gravel. The equivalently horizontal area in which the carbon is reduced must be as 5 square meters per inhabitant, as minimum. In the situation in which the filter is working as a tertiary treatment slade, a minimum of 2 square meters per inhabitant treatment surface being necessary [8].

The surface of the filter with horizontal flow must be performed with a smooth reverse gradient, the uniform distribution of the mechanic treated water is carried out by a holey pipe of 50mm diameter with the orifice of 8mm diameter placed into a drain of 16/32 mm diameter gravel. The filter must be performed according to the Figure 3.1 in which the base layer consists in a 50cm thickness as minimum.

In the Figure 3.2 a filter for a small wastewater treatment plant is presented, (distribution pipe and filtering material).

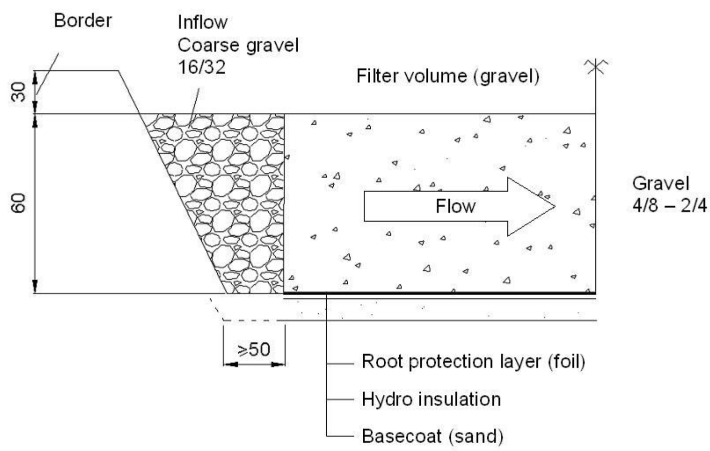

Figure 3. 1. Filter with horizontal flow. Details

Figure 3.2. Plant-based water filter, distribution pipe and filter bed substrates

4. CASE STUDY. THE POSSIBILITY TO INCREASE THE SMALL WASTE WATER TREATMENT PLANT EFFICIENCY BY USING PLANT-BASED FILTER

Behind of researches [5], [6], whit the purpose to find solutions to improve the treatment process of the domestic waste waters by small plants, the reached conclusion was that the biological treatment tread can be replaced by a vegetal filter.

In order to find out the efficiency of the water treatment plant, four different parameters were analysed as following: BOD, COD, totat nitrogen and, total phosphorus. At the entrance in the waste water treatment plant, the concentration values for above emntioned parameters are stated in the NTPA-002 normative as follows: BOD=300 mg/cdm, COD=500 mg/cdm, totat nitrogen =30 mg/cdm and, total phosphorus=5 mg/cdm.

It must be mentioned than after the primary treatment tread, the concentration values for BOD and COD are reduced in 15-20 % and in after the biological tread the loading is given by the following parameters values: BOD=225 mg/cdm, COD=425 mg/cdm, totat nitrogen =30 mg/cdm and, total phosphorus=5 mg/cdm [10], [11].

According to the literature [5], [6], by applying the efficiency treatment formula for the treatment parameters in the case of pant-based water filter, the following results were obtained (Table 5.1).

For the case study, two different situations were considered: normally operating of the waste water treatment plant with the plant-based water filter located downstream of the secondary treatment tread (Figure 4.1)and, accidentally situation when the soil filter is running as a secondary treatment tread. (Figure 4.2)

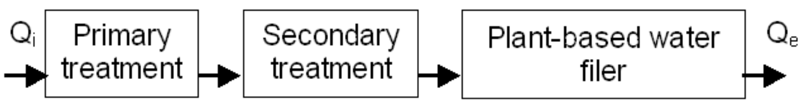

Figure 4.1. Normally operating of the water treatment plant and the soil filter

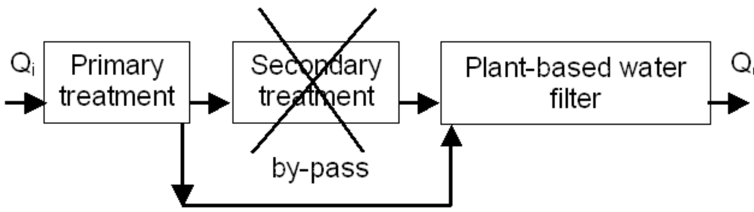

Figure 4.2. The treatment station running in the accidentally situation (the secondary treatment tread is ovoided

Table 4.1. Efficiency of treatment of the plant-based water filter

Chemical Parameter	Efficiency of treatment of the plant-based water filter $GE = \frac{C_i - C_f}{C_i} \cdot 100\%$
BOD	99,37
COD	96.04
NH_4-N	70.05
PO_4-P	88.4

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Table 4.2. Normally operating of the water treatment plant and the soil filter

Chemical Parameter	Inflowing untreated water concentration values mg/dm^3	Out flowing water from the primary treatment mg/dm^3	Out flowing water from the secondary treatment mg/dm^3	Efficiency of treatment of the plant-based water filter mg/dm^3	Out flowing water from the plant-based water filter mg/dm^3	Maximum concentration values NTPA 001 mg/dm^3
0	**1**	**2**	**3**	**4**	**5**	**6**
BOD	300	255	14	99,37	0,08	25
COD	500	425	33	96,04	1,30	125
NH_4-N	30	30	1,32	70,50	0,38	2
PO_4-P	5	5	0,37	88,40	0,04	1

Table 4.3. The treatment station running in the accidentally situation (the secondary treatment tread is ovoided)

Chemical Parameter	Inflowing untreated water concentration values mg/dm^3	Out flowing water from the primary treatment mg/dm^3	Out flowing water from the secondary treatment mg/dm^3	Efficiency of treatment of the plant-based water filter mg/dm^3	Out flowing water from the plant-based water filter mg/dm^3	Maximum concentration values NTPA 001 mg/dm^3
0	1	2	3	4	5	6
CBO_5	300	255	by-pass	99,37	1,60	25
CCO	500	425	by-pass	96,04	16,83	125
NH_4-N	30	30	by-pass	70,50	**8,85**	2
PO_4-P	5	5	by-pass	88,40	0,58	1

5.CONCUSIONS

The following results must be mentioned as:

-once the waste water is passing through each treatment tread (including the secondary one) the concentration of the pollutants is gradually decreasing and by using a plant-based water filter a high treatment efficiency is reached;

-in the case of by-pass (ovoiding the secondary treatment tread) the pollutant concentration in the soil filter is greater than in the first case and that why the risq of surpassing the limits prescribed in the NTPA 001/2005 is remaining.

The advantages of the plant-based water filter consists in the following aspects:

-in some specific relief conditions, with adequate slope, a such water treatment plant can work without external energy supply (no pumping is necessary);

- a high stability and easy maintenance;

-a good efficiency of water treatment;

-the cost of exploitation and maintenace are low;

-the performance of the soil filter in the horizontal or vertical flow of the water with permanent or seasonal vegetation can be adapted depending of the terain conditions.

The plant-based filter water treatment is not a perfect solution. There is also some disadvantages like:

-the building costs are greater in comparison whith a clasic waste water tretment plant;

-engaged surface of the arrangement (3 sqm/ equivalent inhabitant as minimum).

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