TECHNICAL AND ECONOMIC ANALYSIS OF THE COMBINATION PEAT FILTERS + TRICKLING FILTERS

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Abstract

Most of the hundred of Peat Filters placed in Andalusia present a poor performance, mainly due to the high organic load applied (about 175 g $BOD_5/m^2.d$). As the results obtained have not been as satisfactory as supposed, many of the Peat units are now being replaced by another treatment technology, without first studying the feasibility of employing them in alternative uses. In this study the use of Peat Filters in combination with Trickling Filters has been assessed. The main conclusions of this study are: (1) the additional area needed to complement an existing facility based on Peat Filters with a Trickling Filter (including the secondary clarifier) is around 7% of the original area; (2) excess sludge production is reduced by 70-80%; and (3) the implementing costs of the proposed combination supposes an increase of 12% of the initial budget.

Keywords: peat filters, trickling filters, wastewater treatment, small agglomerations

Introduction

Peat Filters were widely implemented in the 80's in Andalusia in small populations. However, the poor results obtain along these latter years have encouraged the removal of Peat units and their replacement by other technologies without studying alternative uses for those filtration systems. That bad performance was related to the large organic load that was used in the design and dimensioning of the Peat Filters (175 g $BOD_5/m^2.d$). In fact, some studies have demonstrated that Peat Filters can produce a good-quality-effluent (Salas, 2008) if the organic load employed for their design is similar to the ones used for other filtration systems (constructed wetlands or sand filters).

The aim of this work is the assessment of the potential reuse of existing Peat Filters units as a previous treatment of a Trickling Filters. Both technical and economic issues are analyses: the efficiency of the proposed combination, the excess sludge production and latter management, the extra surface required for its implementation and the related costs.

Methods

In this study a 24 m^2– Peat Filter unit, which is implanted in the Experimental Plant of Carrión de los Céspedes (Seville), has been used (Salas *et al.*, 2005). This filter is divided in two identical parts. The filtration bed presents the following configuration (from the bottom to the top): a 30 cm– gravel layer, 10 cm of fine gravel, 10 cm of sand and, finally, 40 cm of dark peat. The Trickling Filter installed after the peat unit consists of a cylindrical reactor whose dimensions are 2.0 m diameter, 5.0 m height and 3.0 m height of plastic–bed. The components for the fixation of the bacteria are made in polypropylene and have a specific surface of 120m^2/m^3. A secondary clarifier is set up after the Trickling Filter. The flow diagram of the whole treatment is shown in figure 1.

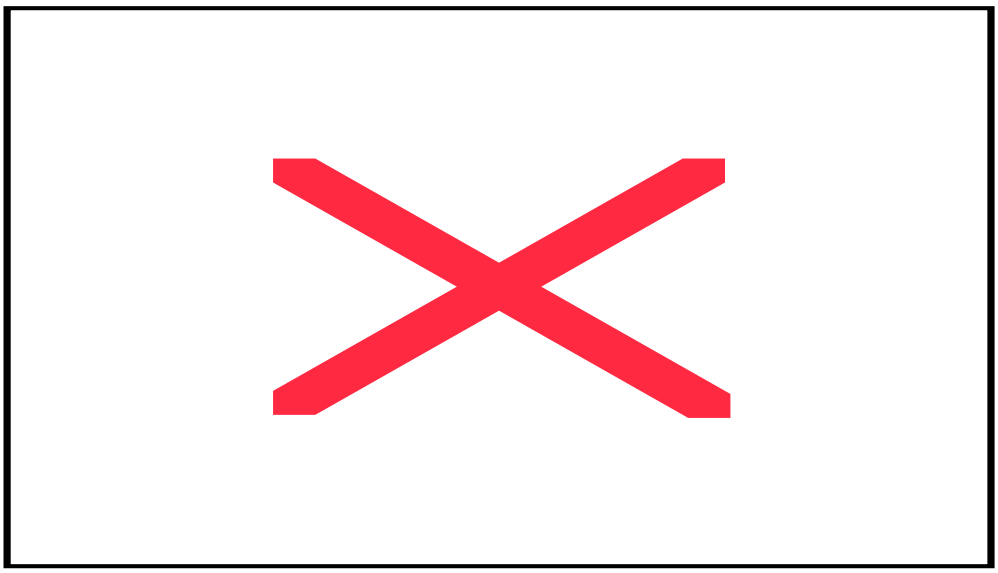

Figure 1. Flow diagram of the combination Peat Filter + Trickling Filter.

The organic load applied to the Peat unit was 0.173–0.227 kg BOD_5/m^3.d. Three different volumetric loads were imposed to the Trickling Filter (0.33, 0.19 and 0.10 kg BOD_5/m^3.d). Each stage was prolonged along three complete cycles of operation of the Peat Filter.

Periodically, samples from the influent stream, the effluent of both the Peat and the Trickling Filter, and the effluent of the secondary clarifier were taken. The physical–chemical parameters determined for monitoring the performance of the proposed combination were: suspended solids (total and volatile), organic matter (COD and BOD_5), Nitrogen Kjeldahl, ammonia, total phosphorous and phosphates. In addition, the sludge layer created on the top of the Peat Filter was sampled and analysed. All the determinations were made according to Standard Methods (APHA, AWWA, WPCF, 1995).

Results and discussion

Table 1 summarises the operating conditions of both the Peat Filter and the Trickling Filter along the assays.

Table 1. Operating conditions

Influent	**Assay I**	**Assay II**	**Assay III**
Flow (m^3/d)	28	22	11
BOD_5 (mg/l)	405	393	418
Peat Filters			
Organic load (kg $BOD_5/m^2.d$)	0.227	0.173	0.184
Hydraulic load ($m^3/m^2.d$)	0.560	0.440	0.440
Cycle's duration (d)	12	14	14
Trickling Filter			
Volumetric load (kg $DBO_5/m^3.d$)	0.33	0.19	0.10
Hydraulic load ($m^3/m^2.h$)	0.74	0.58	0.29

From the results obtained it can be concluded that if the existing Peat Filter units, operating under organic loads around 0.175 kg $BOD^5/m^2.d$, are complemented with Trickling filters, designed at a volumetric load ≤ 0.2 kg $BOD_5/m^3.d$, the final effluent quality shall achieved the limits imposed by the EU Directive 91/271. Table 2 shows both the average composition of the effluent obtained under operating conditions in Assay II and the performance of each of the treatment units (including the secondary clarifier).

Table 2. Results obtained in the Assay II

	Influent	**Peat Filter's effluent**	**Performance of Peat Filters (%)**	**Final Effluent**	**Global Performance (%)**
Suspended solids (mg/l)	377 ± 21.7	58 ± 6.1	85 ± 1.9	15 ± 4.0	96 ± 0.9
BOD_5 (mg/l)	393 ± 24.6	81 ± 7.0	79 ± 2.0	23 ± 5.5	94 ± 1.1
COD (mg/l)	702 ± 11.5	197 ± 8.0	72 ± 1.0	95 ± 6.5	87 ± 0.8
N-NH4 (mg N/l)	58.3 ± 3.2	34,5 ± 2.1	41 ± 0.6	30.2 ± 3.2	48 ± 2.6
TNK (mg N/l)	69.2 ± 3.1	39.1 ± 1.7	43 ± 0.3	33.2 ± 3.4	52 ± 2.7
Phosphates (mg P/l)	9.8 ± 0.7	8.5 ± 0.9	13 ± 8.9	7.6 ± 0.8	22 ± 7.8
TP (mg P/l)	11.3 ± 0.8	9.8 ± 0.5	13 ± 8.5	7.8 ± 0.8	31 ± 5.9

In addition, an assessment of treatment facilities where the combination Peat Filter – Trickling Filter is installed has been developed. It has been observed that the increase of surface required for the implementation of the new flow diagram is 7% and the investment costs associated achieve 12%.

Conclusions

The main conclusions of this study are:

- Trickling filters as a complementary treatment for existing Peat Filter units must be designed at a volumetric load ≤ 0,2 kg $BOD_5/m^3.d$
- The implementation of Trickling filters supposes an increase of 7% in the surface taken up by the Peat Filters.
- The application of the proposed combination requires an increase of 12% in the investment costs.

References

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