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Propose of a wastewater treatment and management for small comunities

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Highlights:

- Innovative both screening and grit removal system in a manhole.
- Essential propuse of a wastewater treatment operation and management for a small system.

Keywords: Small system; Screening and grit removal manhole; Constructed treatment wetland.

INTRODUCTION

One of the biggest obstacles to the universalization of sanitation in Brazil (Brazil 2020) is the provision of sewage collection and treatment in rural, remote areas or in consolidated informal urban centers, which, according to legislation, is provided to the service provider use alternative and decentralized methods. This obstacles is aligned with the porpuse of the presente event: to develop technologies in small scale and decentralized wastewater treatment and management systems.

This post presents a presizing of wastewater treatment and management systems that is easy to implement, maintain and operate, to be implemented.

The proposed system consists of a screening and grit removal manhole, septic tank followed by constructed wetland, land disposal and release into a water body.

METHODOLOGY

A treatment system was presized to serve a population of 100 people, with 100 l/inhab.d of a wastewater contribution (ABNT 2024). A per capita load BOD of 30.0g/(inhab.d) was assumed (Imhoff & Imhoff 2000). And a hydraulic simulation was carried out using SewerCad® software.

For preliminary treatment the coarse screening consists of a basket grid fixed at a manhole wall. Grit settles by gravity into the conic bottom of the same manhole. Then the efluente goes to a septic tank and is directed to a constructed wetland whit land infiltration disposal until the meeting with the receiving body. Flow measured isn't predicted.

Basket grid fixed at a manhole wall has been used at the entrance to pumping stations for Sanepar – Companhia de Saneamento do Paraná. And a desanding manhole with a conical bottom has been used in the collection networks of the company. The both functions have not be used at company.

The septic tank was presized accordance with brazilian´s standard (ABNT 2024) and be made of field-made reinforced concrete or prefabricated reinforced concrete or polyethylene.

Kadlec and Wallace (2009) present three main types of wetlands: free water surface; horizontal subsurface and vertical flow wetlands. For the secondary treatment, a subsurface horizontal flow treatment wetland (WCH) with vegetated submersed bed systems was pre-dimensioned, in accordance with the prescriptions of Von Sperling and Sezerino (2018) and also observed the prescriptions of IWA (2017).

The land disposal depends of available topography and can occor by slow-rate systems, rapid infiltration, subsurface infiltration or overland flow (Von Sperling 2007).

The construction, operation and management was planed to be implemented in partnership with the sanitation company, the granting authority and the local population.

RESULTS AND CONCLUSIONS

A treatment system propused for a population of 100 people flowsheet is showing in Figure 1.

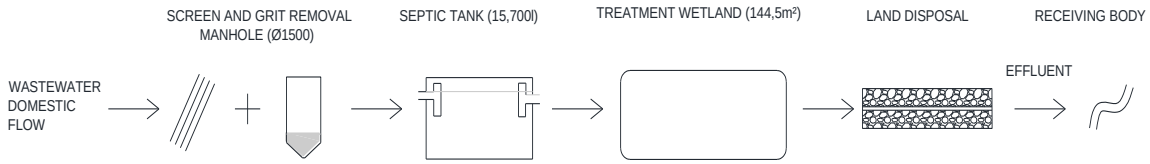

Figure 1 – Propused system flowsheet

The presized results in preliminar treatment with a 1.5m diameter manhole with the both function of grating using a solids retention basket (grid spacing 20mm) and sand removal with a conical bottom (Figure 2). Followed by a reinforced concrete tank with 15,700 liters of capacity. An BOD efficiency of 30% was predicted for this primary treatment.

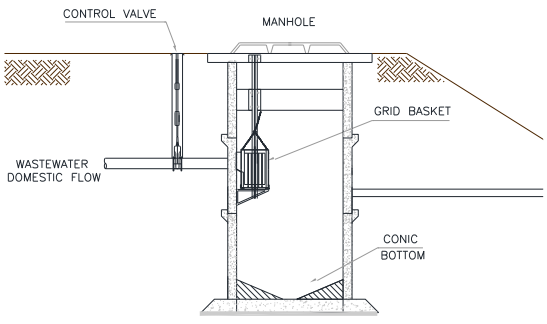

Figure 2 - Screening and grit removal system in a manhole

The required area for horizontal treatment wetland according to the criteria of Von Sperling and Sezerino (2018) resulted in 142.86m² by surface hydraulic application rate methods results in 0.07

$m^3/m^2.d$ (14.7$gDBO/m^2$ surface organic application rate). For well construction an area of 144.50m² (width of 8.5m and lenght of 17m) was adopted resulting in a 1.45m²/inhab relation and a length/width ratio of 2. A 1.0m deep bed will be composed by 0.90m of small stones that gives support to the growth of plants and gives conditions for a bacterial biofilm to grow up filled by 0.80m effluent layer. It is suggested to cultivate *Typhas spp.*, native plants of the region and ornamental species such as *Zantedeschia aethiopica* and *Canna indica* that was adapt to the local soil and climate and in addition improving the visual appearance and olfactory. An BOD efficiency of 85% was predicted for this effluent.

The both screening and grit removal system in a manhole speeds flow obtained by SewerCad® software meet below those recommended by literature (Netto & Fernandez 2015; ABNT 2011) due to the low contribution of sanitary sewage inherent to small systems. These low speeds can cause undesirable odors in the system.

According Von Sperling *et al.* (2017) the land requirements for effluents from septic tanks are around 5.0 to 6.0 m²/inhab above the 1.45 m²/inhab like propused in this paper.

The required área with suitable topography requirements can be made available by the municipality. Operation and management may initially follow the rules set out as in Table 1.

Objetc	Periodicity
Grid basket cleaning	Once a week
Solid waste	Once a week
Sand at the manhole bottom	Every two months
Septic Tank cleaning	Once a year
Plants cultivation	Once a week
Wetland support layers	Every ten years

Table 1 – Rules for operation and management

The cleaning of the grating can be carried out once a week and dispose at a bucket in the plant system. For cleaning the bottom material retained by the desander manhole can be used a pumping with a truck every two months, and the materials disposed at a bucket. The septic tank must be cleaned annually using a septic tank truck with disposall following the local rules. The solid waste retained at a bucket must be sent to a landfill.

Wetland planting must be maintained using agricultural techniques. Inlet pipes must be washed by hydrojetting in case of blockages. The filling material of the wetland as well as the filtering ditches must be cleaned and washed by hydrojetting in the case of blockages and must undergo preventive maintenance every 10 years and replaced every 30 years.

This system may be constructed and have your eficience monitoring. The initial rules adopted need to be adjusted. The autors suggest checking total solids effluents after and before the process units and BOD influent and effluent system monitoring.

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