COMPARATIVE ANALISYS OF INDIVIDUAL SANITATION SYSTEMS

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Abstract

A number of European Standards were issued with the aim of regulating the technical solution for isolated buildings wastewater treatment facilities. In Spain, as in many other countries, most of isolated discharges still miss an appropriate treatment to fulfil the legislation requirements. In this paper, the different options for individual sanitation treatment are surveyed along with the subsequent final disposal-of by ground infiltration or discharge in superficial water bodies, according to the soil characteristics. Selection parameters are indicated and their optimal range of application. Specifically the calculated space requirements and the cost of the several alternatives are proposed for the discussion.

Introduction

Wastewater treatment can be grouped in 4 categories according to the size of the served population: big, medium and small nuclei plus individual sanitation for isolated buildings or small agglomerations. With reference to the latter, the Urban Wastewater Directive (91/271/EEC) state: "where the establishment of a collecting system is not justified either because it would produce no environmental benefit or because it would involve excessive cost, individual systems or other appropriate systems (...) shall be used". As a reference, for distances superior than 200 m from the sewerage system, it is more cost-efficient an individual sanitation system, taking into account the cost of the collecting pipe build-up. Technical reports and standards have been developed in Europe for individual sanitation and some countries, like France, are already implementing their own regulation system. Spain is still transposing the European Standards concerning non-collective sanitation EN/12566 "Small wastewater treatment systems for up to 50 p. e.".This paper reviews a variety of processes and technologies that can be applied to individual sanitation, making it possible to meet the regulations concerning urban wastewater treatment. It provides a survey on the existing systems, an evaluation of surface requirements and a summary of the investment costs.

Methods

A compilation was made of the standards, technical reports, guidelines and commercial data for the wastewater treatment design for non-collective sanitation systems related to small agglomerations up to 50 inhabitants (CSTB, 2001; USEPA, 2007; CENTA, 2007; Collado, 2008; Collado & Díez, 2010). The review was aimed at identifying the parameter to be evaluated in order to select the proper treatment method for the different environment conditions depending on soil permeability, slope, thickness and groundwater level. A comparative evaluation of the surface requirements for a 4 person's house-unit depending on the soil permeability (range: 15 to 500 mm/h) was performed by considering typical application rate case by case. The investment cost estimation was based on commercially available data, referred at the same house–unit.

Results and discussion: onsite treatment systems selection

The individual sanitation treatment include an anaerobic pretreatment (septic tank, Imhoff tank or similar), followed by an aerobic stage. The surveyed aerobic systems are: infiltration trenches, chambers and beds, non drained sand filters, drained sand filters, infiltration mounds, drained horizontal sand filters, constructed wetlands, and compact technologies such as zeolite filter beds and trickling filters. Table 1

summarizes the soil parameters and the disposal fate to be considered in the selection of the most appropriate system, while Figure 1 illustrates the trend of the surface requirement, depending on the soil permeability.

Table 1. Soil type and disposal fate for the treatment systems (Collado, 2005)

Treatment system	Soil type	Disposal fate
Infiltration trenches and chambers	High permeability; slope < 10%; existing soil	Ground
Infiltration bed	Sandy; flat; existing soil	Ground
Non drained sand filter	Cracked rock or high permeability; soil replaced by sand	Ground
Drained sand filter	Low permeability; drop between in and outlet > 1,5 m; soil replaced by sand	Superficial
Infiltration mound	High groundwater level; soil replaced by sand	Ground
Drained horizontal sand filter	Low permeability; high groundwater level; drop between in and outlet < 0,5 m; soil replaced by granular material	Superficial
Constructed wetland, Zeolite filter bed	Low permeability; soil replaced by gravel or zeolite	Superficial

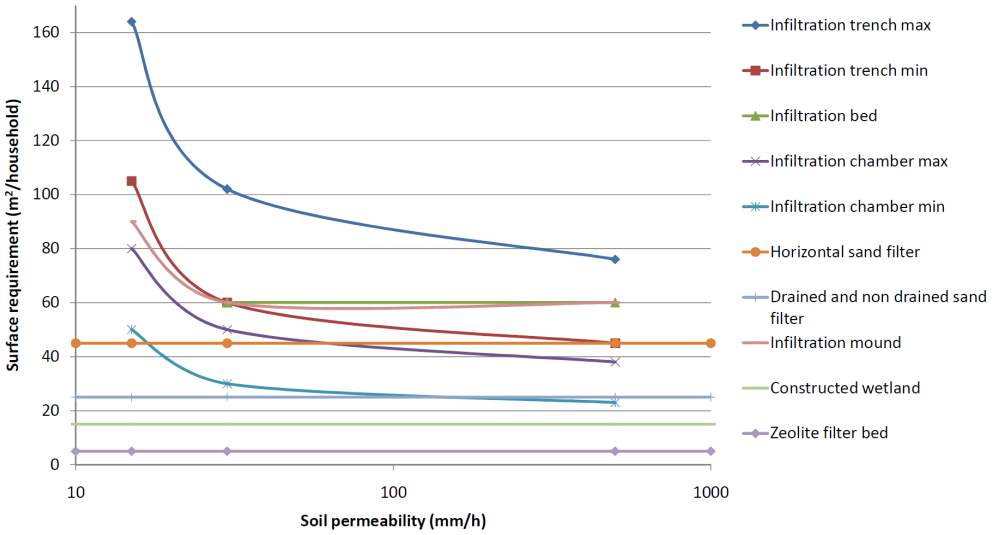

Figure 1. Surface requirement based on soil permeability and treatment system (Collado, 2005)

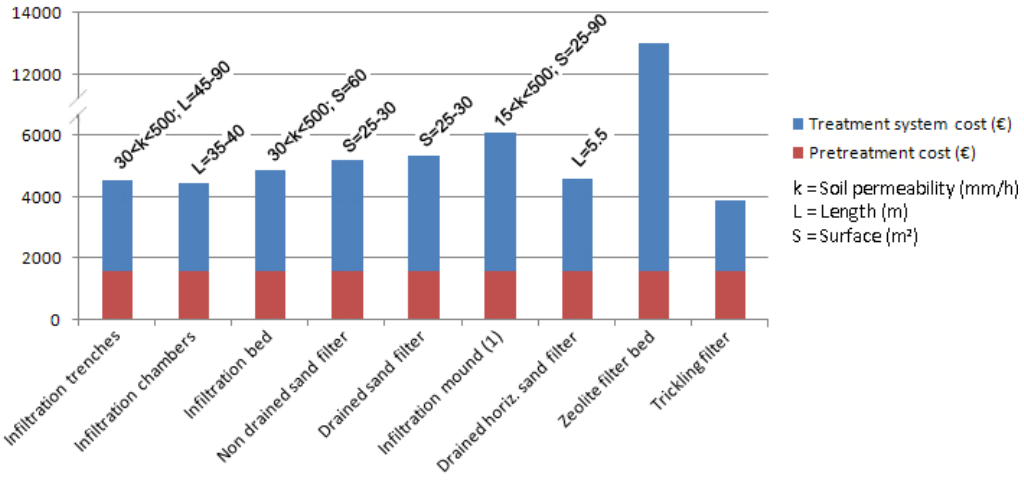

Figure 2. Treatment system costs for a 4 person household unit. (1) Including pumping station cost of 1,450 €

Figure 2 reports the estimation of the costs of the surveyed technologies for the non-collective sanitation system. An average value for all the costs excluding the zeolite filter bed give rise to an estimation of about 1,270 €/inhabitant to be compared with 165 €/p.e. for the collective sanitation system in big agglomerations (Llorente, 2008).

Conclusions

Individual on-site sanitation provides complete treatment system, able to meet the legislation requirements. The effluent of the individual treatment system can be discharged into the ground or to superficial water, depending on the case.

The soil type (slope, permeability, ground thickness, groundwater level, etc.) as well as the surface availability are the main factors to be considered in the selection of the most appropriate system, being the infiltration trenches the most space demanding while the replaced filtering material appear in a lower range space requirements. As for the isolated 4 person house-unit, space occupation of the treatment system is between 100 and 640 m^2 (25 - 160 m^2/inhabitant) in case the soil permeability allows for land infiltration. In case of using sand filters, constructed wetlands or zeolite filter beds the space requirement lowers to the range 20 - 360 m^2 (5 - 90 m^2/inhabitant).

The wastewater treatment investment cost for a 4 person household is within the range 3,900-13,000 €, being the average value (excluding the zeolite filter bed) 5,065 € per household.

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