SUSTAINABLE REUSE AND TREATMENT OF WASTEWATERS IN SMALL TOWNS OF CASTILLA & LEÓN (VILLAVIEJA DE YELTES, MONLERAS AND SAUCELLE, SALAMANCA, SPAIN)

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Abstract

Recently, at request of provincial institutions, the Center for R & D of Water from the University of Salamanca has carried out a study assessing the status of treatment systems installed in various municipalities in the province of Salamanca, analyzing their performance and the quality of their wastewaters. The study highlights the following weaknesses in the municipalities in relation to sanitation and treatment infrastructures: 1) Lack of facilities for wastewater treatment. 2) Deficit in sewage. 3) High levels of odours in some municipalities. 4) Undersized and poor management of existing treatment systems. 5) High operating costs, and consequently many of them did not work.

Given this situation, it was necessary to develop a methodology for the design and dimensioning of the wastewater treatment systems in small towns, that are effective and efficient and brings the minimum social and environmental costs. The chosen systems must meet a number of objectives for the planning, costs and human resources and guarantee not to contaminate water resources. These facilities are called low-cost systems, their philosophy is to copy the natural phenomena and processes, but in less time and space, minimizing human action and avoiding unnatural energy consumption.

1. Introduction

The economic factor is the main cause to justify the abandonment of 90% of the outlined treatment systems. In this regard, include: The high costs of construction, maintenance and operation, do not establish appropriate penalties to ensure the smooth running of the service and the strong impact of the amortization for small populations.

Given this situation, it is necessary to develop a methodology for the design and dimensioning of wastewater treatment systems in small towns, that are effective and efficient and bringing the minimum social and environmental costs. The system must meet a number of objectives for the planning, costs and personnel and guarantee no pollution of water resources. The main requirements are: 1) The equipment operation will be as natural as possible, seeking maximum integration in the environment. 2) The system should be as simple as possible, eliminating all those unnecessary processing units, but must take into account the conditions of discharge and that yields should be necessary, but no more. 3) Equipments must have low power consumption and

maximum independence from foreign energy sources. Avoid automation or sophistications, which may require more skilled labor, or heavy reliance on foreign companies, reducing the cost of breakdowns and downtime of the plant. 4) Equipments must require minimal maintenance and facilities such that their breakdowns cause the least possible damage to the quality of effluent

For all the above, these facilities are called low-cost systems, their philosophy is to copy the natural phenomena and processes, but in less time and space, minimizing human action and avoiding unnatural energy consumption.

2. Methods

Selection Criteria

Various treatment systems are low cost, such as lagoons, soil application systems or geodepuration systems, biological filters, green filters, etc. The screening system adopted by the CIDTA is to obtain and optimize the best choice of treatment system to be implemented by computer simulation of the design and dimensioning of different combinations of primary treatments (septic tanks, decantation, decantation-digestion, etc) with different secondary treatments (lagoons, geodepuration systems, green filter, biological filters, etc), as well as its potential performance and economic impact.

As a result, rating matrices were developed according to different preset criteria and choosing the best option of treatment.

In depurification systems for small towns, as primary systems stands out the settling-digestion tanks, since they are systems that support well the seasonal variations of loadings that occur in such municipalities. Green filters stands out as secondary treatment and have been implemented in the towns of Monleras and Villavieja de Yeltes.

3. Results and discussion

The system implemented in Villavieja de Yeltes (Figure 1) has the main objective of water depuration by means of a system integrated within the environment, taking advantage of the differences of levels of grounds which facilitates the draining downhill of waters and sludges. This fact implies the total absence of mechanical or electrical devices, a low maintenance requirement and no need of maintenance qualified personnel. After computer simulation of the different alternatives, it was chosen a system consisting of: a) pretreatment units for grinding and sand and grease removal, b) a primary treatment such as a decanter-digester and drying beds and c) a secondary treatment of green filters with subsurface flow plus an innovative process as a cascade of photocatalytic aeration of water falling downhill.

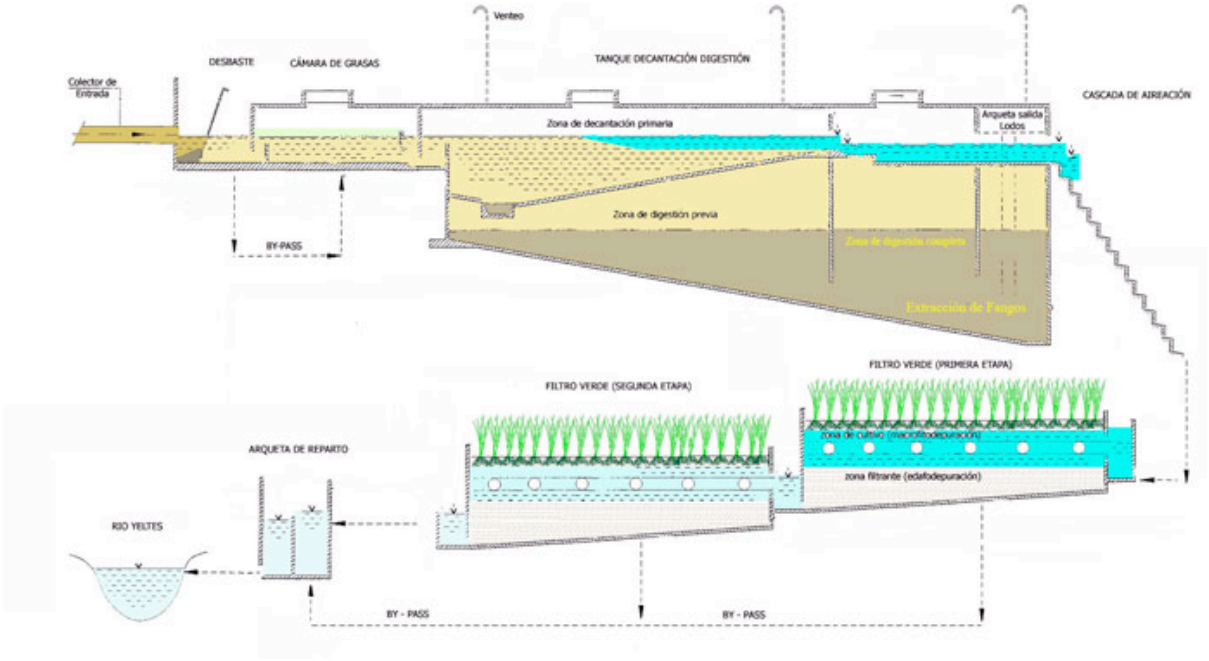

Figure 1. Wastewater low-cost treatment system to be implemented in the town of Villavieja de Yeltes (Salamanca province, Spain)

The town of Monteras already had a primary wastewater treatment consisting of a septic tank and a secondary system was designed as a green filter of subsurface vertical flow followed of a surface wetland. The aim of this county is to obtain economic benefit of its wastewater through the use of the biomass generated, in particular by using plants of high economic performance, which in turn attract aquatic fauna of interest, allowing educational activities for students and actions of rural tourism, promoting the establishment and support of the population of low-income areas. This project has been chosen by the Hydrographic Confederation of Duero River in Castilla y León (Spain) as a pilot project of low-cost ecological water use.

Green filters are secondary wastewaters treatment systems with the highest profitability for irrigation of crops. The wastewater applied to irrigation is one of the options considered by the Spanish Royal Decree 1620/2007 laying down the legal framework for the reuse of treated waters. Wastewater must have special characteristics, and the crops must be fitted properly to the characteristics (organic load) and water consumption. Therefore, in the town of Saucelle this system was, also, designed to reuse treated water for irrigation.

References

Bragato, C., Brix, H. Malagoli, M.(2006) *Accumulation of nutrients and heavy metals in Phragmites australis (Cav.) Trin. ex Steudel and Bolboschoenus maritimus (L.) Palla in a constructed wetland of the Venice lagoon watershed*. Environmental Pollution 144 (3), 967-975.

Related CIDTA projects

García Prieto J. C., Cachaza Silverio, J.M. (2007) *"Proyecto para la implantación de un humedal como tratamiento secundario de las aguas residuales urbanas de la localidad de Monleras (Salamanca)"*. Convenio Ayto Monleras–CIDTA (Univ. de Salamanca) España

García Prieto J. C., Febrero, R., Cachaza Silverio (2005) *"Proyecto para la reutilización de las aguas residuales urbanas en cultivos aprovechados como filtro verde en la localidad de Villavieja de Yeltes (Salamanca)"* Convenio Ayto Villavieja de Yeltes–CIDTA (Univ. de Salamanca) España

García Prieto J. C., Febrero, R., Hernández Sánchez, L.M, Sangrador Fontecha, R., Diez, A., Cachaza Silverio, J.M (2003–2007). *Ensayos de Eficacia y Eficiencia de un reactor Fotocatalítico a escala de Planta Piloto en la degradación de contaminantes tóxicos (detoxificación) y en la inactivación de microorganismos (bacterias y virus) presentes en aguas de diferente procedencia.* Convenio U.CH.E .Chemical Europa S.A. – CECA SISTEMAS S.A. - CIDTA (Universidad de Salamanca) España

García Prieto J. C., Hernández Sánchez, L.M, Sangrador Fontecha, R., Diez, A., Cachaza Silverio, J.M (2000) *"Proyecto de intervención para el saneamiento de los ríos Tormes y Agueda como afluentes del río Duero"* Exma Diputación de Salamanca- CIDTA (Univ. de Salamanca) España

García Prieto J. C., Hernández Sánchez, L.M, Sangrador Fontecha, R., Diez, A., Cachaza Silverio, J.M (1999) *"Evaluación del rendimiento de estaciones depuradoras de la provincia de Salamanca (España)"* Exma Diputación de Salamanca- CIDTA (Univ. de Salamanca) España