EFFECTIVENESS OF DIFFERENT WASTEWATER TREATMENTS FOR WATER RECLAMATION IN SMALL COMMUNITIES

I. Martín [1], C. Ariza [2] and J. Toja [3]

[1] Foundation Centre for New Water Technologies (CENTA). Avda. Américo Vespucio, 5-A, 2ª Planta, Módulo 9-10, 41092. Seville. Spain. imartin@centa.es

[2] Department of Microbiology and Parasitology, Faculty of Pharmacy, University of Seville. Prof. García González, s.n. 41012, Seville, Spain. cariza@us.es

[3] Department of Plant Biology and Ecology, Faculty of Biology, University of Seville. Avda. Reina Mercedes, Seville, Spain. jtoja@us.es

Abstract.

In countries or areas where water scarcity and water stress are increasingly pressing reality, reuse of water plays a significant role in mitigating the temporal and geographical gaps of water. In the case of rural and small urban areas for treating wastewater are required techniques with simple operation and low operating and maintenance costs, which are increasingly promoting the use of so-called extensive technologies, due principally to the advantages provided for debugging in these areas. However its use requires solving some problems inherent in this type of treatments that limit its application to many uses because they cannot meet the required quality limits for reclaimed water, mainly for more restrictive uses, especially in regard to the possibility of achieving reductions enough of pathogens, without using conventional disinfection systems later. The principal object of this study is to assess the ability wastewater treatment systems, both extensive (stabilisation ponds, peat filters, constructed wetlands) and intensive (extended aeration), existing in rural communities and small urban areas such as reclamation treatments based mainly in the biological parameters: *E. coli* and intestinal helminth eggs and physico-chemical: TSS and turbidity (set as control parameters in the Spanish regulation: RD 1620/2007), as well as propose sustainable improvements to expand end uses of treated wastewaters.

Keywords: water reclamation, small communities, extensive technologies, intensive technologies

Introduction

It is estimated that about 54 countries will present water scarcity and water stress for 2050. On the other hand, growth in demand for high quality water in urban and agricultural areas, mainly in arid, semi-arid and densely populated areas will increase pressure on this resource (WHO, 2006). In this context, the use of alternatives such as the reuse of treated wastewater, is a valuable option to alleviate the water demand, especially in applications that do not require drinking water quality, contributing to divert flow of the channels under natural helping to ensure the improvement of ecological state of the same.

However, when the reuse of treated urban wastewaters is considered we should start from the premise that these typically contains a range of parasitic and pathogenic microorganisms which, depending on the species and concentrations, pose a potential risk to human health and whose presence must therefore be reduced in the course of wastewater treatment (Singh & and McFeters, 1993; Ramirez *et al.,* 2005). However, in context of wastewater reuse there are uses which require more restrictive qualities than others, and to obtain these qualities implies the use of other reclamation treatments as conventional disinfection systems later.

In the case of rural and small urban areas for treating wastewater are required techniques with simple operation and low operating and maintenance costs, which are increasingly promoting the use of so-called extensive technologies, due principally to the advantages provided for debugging in these areas. Therefore, in the context of wastewater reuse in these areas are also necessary the use of low cost options for water reclamation.

In Spain the new Spanish Program on Water Quality (2007-2015) devotes special attention to the purification of wastewater in small urban areas. In fact, one of the new priorities of the mentioned Plan is to improve the treatment of the wastewater generated in small agglomerations (less than 2,000 population equivalent). Likewise, the future National Plan for Water Reuse (2010), aims to promote best practices for the use of reclaimed water and to estimate the potential for future reuse. In this sense, and with the application of Spanish regulation (RD 1620/2007), will be opened prospects for the treated wastewater reuse in the small agglomerations.

Methods

The study has been carried out at two types of wastewater: (1) urban and (2) urban with slaughterhouse discharge; in three wastewater treatment plants and one experimental wastewater treatment plant located in South of Spain. Fortnightly sampling of influent and final effluents from ten wastewater treatments was carried out from March 2007 to April 2009. The wastewater treatment technologies including: (1) two stabilisation ponds, (2) five constructed wetlands (subsurface vertical and horizontal flow, and free flow constructed wetlands), (3) one peat filter and (4) two extended aerations. Samples were analysed for a range of biological and physic-chemical parameters: *E. Coli*, helmints ova, turbidity, TSS, COD and BOD_5. The feasibility of the final effluents analyzed in this study has been made according the criteria established in Spanish RD 1620/2007. To do this, there has been a grouping of the 14 qualities listed in the RD in terms of its comprehensiveness regarding the quality of the biological and physical-chemical parameters (*E. coli*, intestinal nematode eggs, TSS and turbidity). Finally, have been established as 7 types (A-G) (Iglesias *et al.*, 2010).

Results

Acording to the information compiled in this study, in general, it appears that most of the technologies have produced reclaimed effluents suitable for less restrictive uses (types of quality D, E and F):

D: Irrigation without contact with fruit, products, cereals, etc.; process and cleaning except food industry.
E: Hold backs and run-off without public access.
F: Forestry, without public contact.

However, mainly for failure parameters: *E. coli*, TSS and turbidity, final effluents not have been suitable for more restrictive types (A, B and C):

A: Cooling tower and evaporative condensers, residential (irrigation, sanitation), aquifer recharge by direct injection.
B: Urban soils: irrigation, fountains, fire-preventions, etc.; agricultural irrigation without restrictions, irrigation of golf fields.
C: Irrigation for not fresh food with a posterior industrial treatment, pasture and aquiculture, process and cleaning in food industry, aquifer recharge by percolating.

Since the scope of the technologies under study are small communities, the solutions both in treatment and reclamation should be sustainable and economically viable. In this sense, different options are recommended:

To reduce concentrations of *E. coli,* TSS and turbidity in final effluents, the line of treatment can be completed with a reclamation treatment made by infiltration-percolation and final disinfection with hypochlorite.

In the event of breach parameters TSS and turbidity, the line of treatment can be completed with a sand filter or infiltration (0.8 m thick), which can be expanded to 2.5 - 3 m in the case of envisaging the *E. coli* removal.

If the parameter breached is *E. coli*, the line of treatment can be completed with a final disinfection using hypochlorite.

Conclusions

This study has revealed that according to the parameters of control in the Spanish RD 1620/2007 (*E. coli*, intestinal helminth eggs, TSS and turbidity), none of the tested wastewater treatment technologies generate reclaimed water to be used for more restrictive uses (quality types A, B and C).

For less restrictive applications (D, E and F), extended aeration and the combination horizontal gravel filter + horizontal flow constructed wetland, are suitable for applications included in these types of quality. The remaining effluent analyzed, except for the stabilisation ponds and peat filter, for non compliance with TSS and turbidity, are suitable for the uses established in the quality F.

In view of the results obtained there is the need to promote research, development and innovation in the field of water reclamation and reuse, especially with solutions applicable to small communities, based primarily on the use of extensive treatments or combinations of low cost technologies.

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