

COMPARISON BETWEEN MBR AND ACTIVATED SLUDGE TECHNOLOGIES FOR WASTEWATER RECLAMATION AND REUSE.

Caro Estrada, R.; Coello Oviedo, M^a. D.; *Barragán Sanchez, J., **Boehme, T.; López-Ramírez, J. A.

Department of Environmental Engineering, University of Cadiz.

*Chiclana Natural, S. A.

**MP Medio Ambiente, S. L.

Poligono Rio San Pedro, s/n. Puerto Real, Cadiz, 11510, Spain.

e-mail: juanantonio.lopez@uca.es, dolores.coello@uca.es, raul.caro@uca.es, JBARRAGA@chiclananatural.com, TB@mpcorporacion.com

Abstract

This research is based on the comparison between reclaimed wastewater quality from a MBR pilot plant and a Municipal Wastewater Treatment Plant, WTP (10.000 cubic meters/day). The pilot plant is an aerobic reactor with an immersed hollow fibre membrane and the WTP is a full-scale plant (Activated Sludge + Biostyr[®]) with tertiary treatment consisting of sand filters and UV light. The interest in comparing both reclaimed waters from these two technologies is largely due to reduce operating and maintenance costs and to obtain a high quality effluent for reuse in a near golf course.

Keywords: water reuse, quality effluent, microfiltration,

INTRODUCTION.

The scarcity of water resources, the interest in environmental protection and the need to reduce quantity of pollutants discharged to the environment, coupled with the increasing new standards for wastewater reuse, have caused some changes in the concept of treated water. In European countries, in terms of effluent quality, Directive 91/271 EEC, establishes the discharge requirements for wastewater treatment plants. These requirements have been met so far by applying conventional technologies based on activated sludges. The pattern of increasingly more stringent regulations focusing the efforts towards more and more efficient processes and more effective pollutant removals requires new and more effective technologies. The application of these new technologies for efficient wastewater treatment is a challenge for the scientific community.

In Spain, Royal Decree 1620/2007 establishes the legal framework for wastewater reuse. The standards define the concept of reuse, define reclaimed wastewater and determine the requirements for reclaimed water uses. It also establishes the legal procedure and quality requirements in each case. This law lets to promote recycling

initiatives from government and private companies. The intended uses of reclaimed wastewater are: urban, agricultural, industrial, recreational and environmental. Depending on application requirements the effluent characteristics are more or less demanding.

The MBR technology

Membrane bioreactors (MBR) offer an alternative to conventional activated sludge processes. In these systems membrane filtration units are used instead of the secondary clarifiers. MBR are very compact wastewater treatment systems in which a high effluent quality is produced.

In MBR systems it is possible to maintain a better control of solids concentration due to the membranes that retain the suspended solid fraction that is usually washed out in biological systems with secondary clarifiers. However, inherent limitations to the application of MBR systems are related with the costs of plant investment, aeration and membranes; which are higher than those typically associated with more traditional activated sludge systems.

MBR technology is widely accepted today as the key technology for wastewater treatment. Almost globally, the MBR approach is used for wastewater reuse or to provide superior effluent quality. As a result of this the MBR potential market is enormous and larger companies try to take over the technology ownership.

1. OBJECTIVES

The main objective of this research is to compare the effluent qualities from a MBR pilot plant and from a municipal Wastewater Treatment Plant for wastewater reuse.

Effluent quality parameters are analyzed in according to Spanish reuse criteria, and taking into account the conditions of operation and maintenance carried out in the pilot plant in order to extrapolate the results to a real plant operating with MBR and so to compare the results showed by the two plants.

This study aims to provide a reference on the application of MBR to urban wastewater treatment, and demonstrate that the benefits associated with this process should be taken into account in the decision to install new plants or expanding or upgrading existing plants.

2. MATERIALS AND METHODS

The full-scale WTP "La Barrosa" is located in Chiclana de la Frontera (Cádiz). It consists of a conventional activated sludge system supported by a Biostyr[®], it also operates with a tertiary treatment consisting of sand filters and UV light. The MBR pilot plant consists of an immersed hollow fiber membrane and it is located inside the WTP. Pretreated wastewater is the same for both.

2.1. Description of the pilot plant

The pilot plant (ZW10, Zenon Inc. Canada) consists of three main parts: a 500 L feed tank, an aerobic tank with a working volume of 225 litres and the permeate tank with 22 litres. A ZeeWeed® membrane module is inserted into the aerobic tank. Filtration module consists of hollow fibre membranes with 0.04 µm pore size, a diameter of 2 mm and a length 69.2 cm with a total filtering surface of 0.93 m². Membranes are operated in an outside–inside filtration mode under small negative pressures created by a piston pump.

Aeration is carried out from the bottom of the filtration module using a coarse diffuser in order to reduce fouling. Membranes are continuously aerated with tangential air currents maintaining the biomass in suspension with the turbulent flow. A flow meter is used to measure and regulate the aeration rate. A peristaltic pump is responsible for carrying out the sludge purges to maintain adequate MLVSS in the reactor.



2.2. Operating conditions

The feed water for the pilot plant is the outlet of the pre-treatment of "La Barrosa" WTP, which consists of a mechanically cleaned bar screen, a fine screen, and an aerated grit chamber. Due to previous problems related with braids, the pilot plant pretreatment has been intensified with three sieves of 2,0 mm, 1,0 mm and 0,2 mm in order to avoid hairs and fibres. The level into the 500 litres tank is kept constant by a level sensor commanding the submerged pump. The aerobic tank is commanded by a level sensor which acts on a pump connected to the 500 litres feed water tank. So when membrane extracts permeate from the aerobic tank the level is automatically readjusted by the pump. A panel provides control on the different devices, flows and durations of filtration and backwash cycles. A pressure gauge allows measuring the transmembrane pressure occurring along the cycles.

The fouling control is carried out by reversing the flow through the membranes during 1 min of 10 minutes filtration time. The reverse flow rate is set 1.2 times the filtration one.

2.3. Measurements

Periodic sampling is established to assess the developed experiments. Standard methods (APHA–AWWA–WPCF 1992) are used for the analysis of samples in the laboratories of the Department of Environmental Engineering at the University of Cadiz (Puerto Real, Cadiz). These analytical results are compared with regulation criteria used in Spain

Different analytical parameters are measured both in WTP effluent and pilot plant permeate: COD, BOD₅, TSS, VSS, turbidity, pH, dissolved oxygen, temperature, total nitrogen, total phosphorus, respiration rates, Faecal coliforms, E. coli and nematodes.

It will also be necessary to control the transmembrane pressure to establish a schedule for periodic cleaning of the membranes. It is known that membrane fouling is caused by a number of factors that relate to each other, such as viscosity, pretreatment efficacy, water temperature, floc size, aeration, filtration flow and backwash cycles.

3. CONCLUSIONS

Experiments are in progress right now and so no conclusion can be drawn by the time. However it is expected to be able to compare very soon both technologies. Preliminary results (two months) for both effluent water qualities show a better performance for MBR than for the full combined treatment of the WTP (pre-treatment, primary treatment, secondary treatment and tertiary treatment).