

Efficiency of IFAS technology in biological treatment systems

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Abstract

Biological treatment systems constitute the most widely used technology in wastewater treatment, both suspended culture systems (activated sludge) and fixed film systems (biodiscs, bacterial beds, etc.).

Activated sludge processes include, among their many advantages, the high degree of treatment they can provide as well as the high degree of process flexibility in the majority of their variants. Adhered culture biological processes such as bacterial beds or biodiscs, on the other hand, are inherently stable and resistant to sporadic organic and hydraulic loads.

Accordingly, research has recently commenced in the field of biological treatment into the use of hybrid technologies which should, as a starting hypothesis, present the advantages of both fixed culture systems and activated sludge processes.

This research work presents the results obtained during the start-up of a pilot plant that combines activated sludge biological systems and fixed film systems, i.e. what might be termed fixed cultures, which presents extraordinary removal efficiencies, much higher than those required by current legislation. Likewise, the support employed in the study presents a suitable specific surface and size that favours the growth and fixing of the biofilm.

Introduction

The biological treatment of urban wastewater is currently carried out in a general manner via two distinct technologies: activated sludge systems and fixed film systems. One or the other technology is to be found at all wastewater treatment facilities.

The activated sludge process improves transformation velocities, maintaining a suitable concentration of microorganisms, facilitating the necessary oxygen by means of artificial aeration and ensuring optimum contact between the activated sludge, the wastewater

being treated and the oxygen via forced stirring. Under ideal conditions, the process is safe and flexible, obtaining very high removal efficiencies.

Depending on the quality objectives required of the effluent, activated sludge processes may be adapted to remove only carbonated organic matter or to also remove nutrients (nitrogen and/or phosphorous). The achievement of one or the other goal leads, for each type of treatment, to the adoption of different design parameters and setups.

The functioning of fixed film systems, on the other hand, is based on the use of a series of support structures on which the populations of microorganisms adhere and grow. The water is treated thanks to the assimilation of the dissolved substances that these adhered populations carry out.

There is a profusion of different setups among fixed film systems, depending on whether the support structure remains fixed (simply dipped or fully submerged in the water being treated), it is found in suspension within the water being treated or it forms part of a rotating element that alternates periods of immersion and aeration (as is the case of biodisc systems). Although the treatment efficiency of these systems focuses mainly on dissolved substances, their advantages include a greater tolerance to and faster recovery when dealing with toxic spills that result in an extreme alteration of the characteristics of the wastewater in which the biological treatment process usually takes place.

This communication presents the results obtained in the study carried out by the Environmental Technologies Research Group at the University of Cadiz and the firm Dytras S.A. using a mixed culture as a biological wastewater treatment. Systems of this kind combine the removal efficiency of activated sludge systems and the operational stability of fixed film systems, as well as decreasing the volumes of reagents necessary to treat a specific urban wastewater flow.

Methods



Figure 1. Image of the pilot plant used throughout the study

A semi-pilot scale plant was used to carry out this study which was designed and built by the firm Dytras S.A. at Conil de la Frontera (Cadiz) sewage treatment plant. The pilot plant was divided into three sections: an anoxic chamber, an aerobic reactor and a secondary settler. The biological reactor has a useful volume of 12 m³, which allows for data to be obtained that is very close to reality. The aerobic reactor houses the suspended support elements developed by Dytras S.A. such that the

activated sludge in suspension and the biomass adhered to the support elements work together in the treatment of the wastewater.

Table I. Dimensions of the pilot plant employed in the trials

Length of the anoxic chamber (m)	1.24
Length of the aerobic reactor (m)	3.24
Length of the secondary settler (m)	1.50
Width (m)	1.50
Total height (m)	3.00
Volume of the anoxic chamber (m ³)*	4.49
Volume of the aerobic reactor (m ³)*	12.48 ⁽¹⁾
Volume of the secondary settler (m ³)*	4.46
Total volume of the plant (m ³)*	21.43

Results and Discussion

The pilot plant employed in the study was operating in continuous mode at Conil de la Frontera (Cadiz) sewage treatment plant for a period of one year. During this time, the plant functioned in such a way as to adequately fulfil the goals set out in the study. Note should be taken of the great variability in the organic loads treated at the sewage plant during the study period. Nonetheless, the removal efficiencies obtained by the pilot plant were adequate and practically constant throughout the trials.

The great dispersion observed in the data of the variables determined in the influent of the plant, as well as the high average loads these reach are due to two basic factors: the major seasonal variation in population in the municipality of Conil and major variations in loads due to the disposal of the contents of septic tanks in the influent of the Conil de la Frontera sewage treatment plant.

Despite these abnormalities in the behaviour of the organic loads in the influent to the pilot plant, the major capacity of the mixed system under study to assimilate such variations is worth highlighting. Figure 2 shows the removal efficiencies obtained during the period under study as regards the variables of chemical oxygen demand, suspended solids and biological oxygen demand.

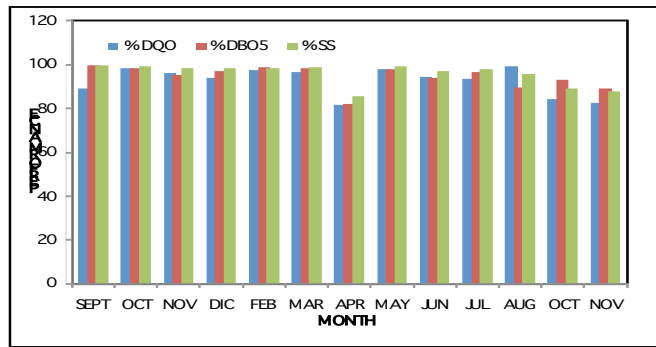


Figure 2. Removal efficiencies in the variables included in Directive 91/271

Conclusions

The main conclusions that may be drawn from the results obtained in the study period are:

- The removal efficiencies obtained in the system under study are very high, being higher than those required by current legislation, despite the problems arising from high influent loads
- This system presents a great capacity to adapt to and recover from the variations in flow and load to which it has been subjected
- The biological reactors have been able to admit volumetric flows much higher than those typically accepted by “exclusively” activated sludge processes
- The secondary settlers have been able to work at upflow velocities that are also higher than those normally admissible for activated sludge process settlers
- It has not been possible to reach the maximum volumetric load in either of the two plants because, due to the “special” characteristics of the raw wastewater, the plant’s admissible flow limit was reached before having reached the maximum admissible organic load
- The biological sludge produced by these systems has presented exceptional settleability, with SVI values that would even be considered high for an activated sludge process

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