

DETERMINATION AND QUANTIFICATION OF ALGAE IN A WASTEWATER TREATMENT SYSTEM (CONTINUOUS CLOSED PHOTOBIOREACTOR)

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ABSTRACT

Characterization of algae populations present in a closed photobioreactors system in continuous was carried out at genus level. This system belongs to the so-called Modified Natural Technologies (MNT) and it's used for urban wastewater treatment. Populations of three genres of planktonic microalgae in the majority in number were studied, comparing its behavior with various physical parameters in the study.

INTRODUCTION

In recent years, algae have begun to attach importance as active and positive elements in wastewater treatment processes.

Oxygen provided by algae as a result of their photosynthetic activity can be used, in high concentrations, for pathogen elimination in water. A closed photobioreactors system that studies this phenomenon has been tested (Gutiérrez Cotro, A. 2008). The study of phytoplankton and phytobenthos developed in the process has been necessary.

METHODS

Wastewater samples in a system of two closed glass photobioreactors, SDP (Debugger System) and SDF (System Disinfecter) were periodically taken, in continuous, to analyze the algae development during the debugging process. Urban wastewaters supplying the system were also analyzed. A Neubauer counting chamber and direct optical microscope (Standard Methods, 2005) were used for quantification and identification of genus of phytoplankton and phytobenthos. Continuously measuring of parameters pH, temperature, conductivity, dissolved oxygen (DO) and Oxidation-Reduction Potential (ORP) was carried out by sensors connected in continuous to a multiparametric equipment.

Results and discussion

Eight genus were found. The most widely represented is green algae or Chlorofytas, with five genus identified, which include *Scenedesmus*, *Chlorella* and *Selenastrum*, by importance in terms of variety and abundance of individuals. (see Table 1).

Table 1. Classification of taxa found in the photobioreactor system

Division	Family	Genus
Chlorofyta	Scenedesmaceae	<i>Scenedesmus</i>
	Oocystaceae	<i>Chlorella</i>
	Selenastraceae	<i>Selenastrum</i>
		<i>Ankistrodesmus</i>
	Chlamydomonadaceae	<i>Chlamydomonas</i>
Euglenophyta	Euglenaceae	<i>Euglena</i>
Chrysophyta	Nitzschiaceae	<i>Nitzschia</i>
Cyanophyta	Oscillatoriaceae	<i>Oscillatoria</i>

Due to its importance, the three genus concerned were studied quantitatively, considering their population trends in both reactors.

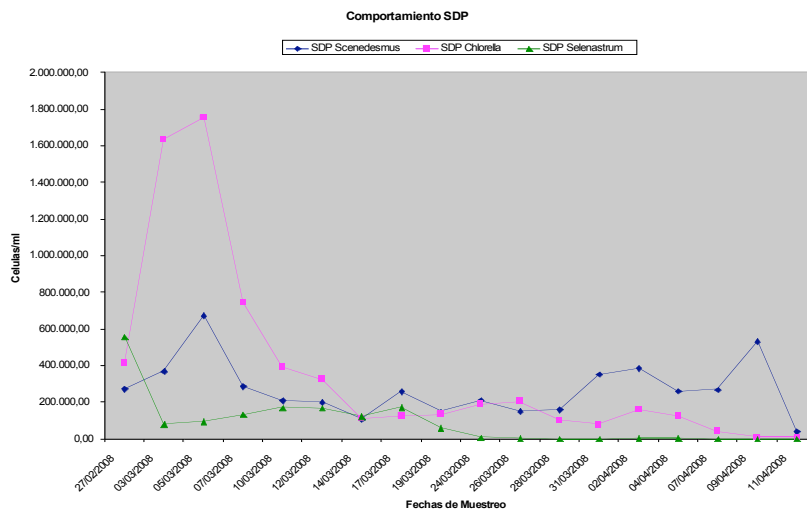


Figure 1. Population Change of *Scenedesmus*, *Chlorella* and *Selenastrum* in SDP.

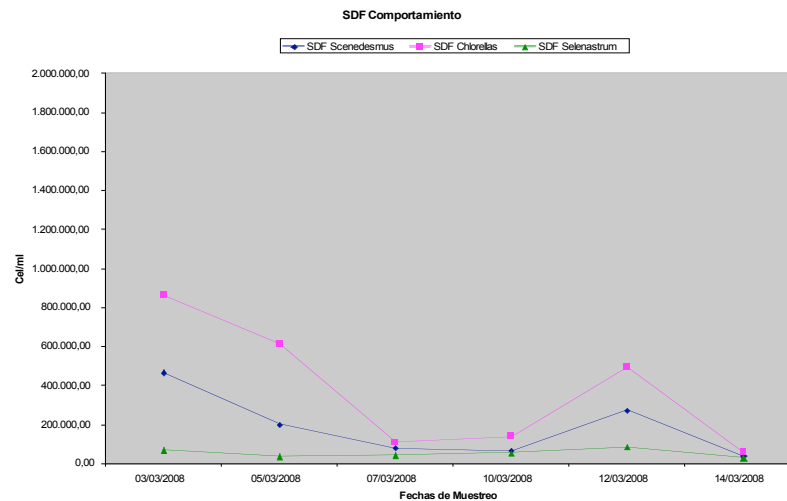


Figure 2. Population Change of *Scenedesmus*, *Chlorella* and *Selenastrum* in SDF.

The three populations show parallel developments, with dominance of the genus *Chlorella* as in the SDP (Fig. 2).

In both reactors, SDP y SDF, a decrease in the number of algae per mL over time can be observed. This situation is the result of the settling of algal biomass produced in the first photobioreactor, the SDP. This means that a smaller number of microalgae reach the second fotobioreactor. (see Fig. 1 and 2)

On the other hand, it can be assumed that the high organic matter contents in the SDP induce proliferation of bacteria that provides CO₂ to the populations of microalgae. These bacteria are favoured by the high concentration of dissolved oxygen, creating an atmosphere much more conducive to the development of phytoplankton and phytobenthos. This major development in the first reactor, means that the waters of the SDF are impoverished of nutrients and even bacteria, thus limiting algal development.

Microalgae in the system are developed into the photobioreactor from individuals arrived in the wastewater, so perhaps quiescent, and whose number is almost negligible, as it has been reported in other investigations (Cobelas, M.A, *et al.* 1989).

In the evolution of the different parameters studied during the period of experimentation, it can be emphasized that the redox potential is becoming positive as the number of algae tends to decrease in the SDP. In addition, the back-acidic pH goes over research time, which is logical since by reducing the number of algae photosynthesis decreased, increased CO₂ in the environment though it's not

consumed and therefore the water is acidified. Dissolved oxygen also decreases progressively towards the end of the experiment, when only gets rise coinciding with the small lift in the number of days before descending *Scenedesmus* strongly at the end.

Conclusions

The genus mainly developed are three, belonging to the Division Chlorohytas: *Scenedesmus*, *Chlorella* and *Selenastrum*, suffering all of them a population decline towards the end of the period of investigation. The photobioreactor Disinfector (SDF) always has fewer algal populations that SDP Debugger photobioreactor.

Some physico-chemical parameters studied (pH, ORP and DO) with a clear evolution over experimentation in line with the population development of the genera studied, being able to explain their behavior through the activity of the algae.

References

Cobelas, M.A., Gallardo, (1989). Dinámica Temporal de las microalgas de un tratamiento terciario de aguas residuales urbanas a escala de laboratorio. Botánica Complutensis, N°14, 65-74.

Gutierrez Cotro, A. (2008). Fotorreactor biológico en regimen continuo como sistema de depuración-desinfección de aguas residuales. Tesis Doctoral. Dept. de Cristalografía, Mineralogía y Química Agrícola. Universidad de Sevilla. España.

Standard Methods for the Examination of Water and Wastewater (2005). 21th ed, American Public Health Association/American Water Works Association/ Water Environment Federation, Washington DC, USA.