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NEW BIOTECHNOLOGICAL MODEL OF BACTERIA MICRO-ALGAE WASTEWATER TREATMENT

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Introduction

Conservation of water resources represents one of the socio-ecologic sustainable development priority strategies, wastewater treatment plants ensuring water resources reintegration within the hydrologic circuit. The activated sludge system needs to undergo frequent switch between anaerobic, anoxic and aerobic conditions for biological nutrient removal, thus requiring extra energy and chemicals to fulfil the task, leading to the need for evaluating alternative solutions with reduced operational costs and high efficiencies. The study focuses on assessing the efficiency of microalgae-bacteria granules for wastewater treatment and possibility to use the microalgae-bacteria system as a single step for wastewater treatment.

Materials and methods

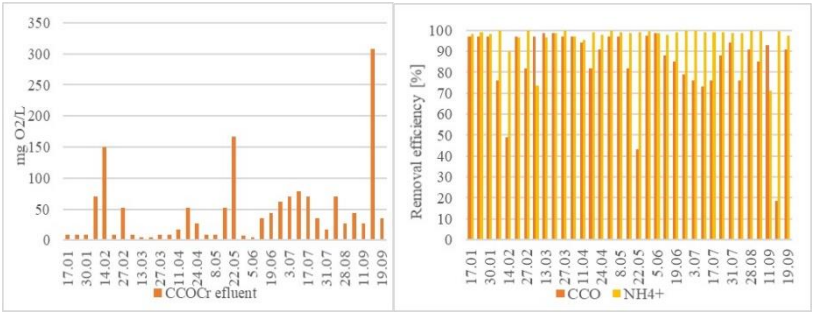
The experiments were designed to evaluate the influence of operational parameters on the balance between microalgae and bacterial species in granules. Thus, it was possible to determine the optimal operational parameters and the limiting factors of the process. Several key parameters were varied while monitoring population diversity and dynamics in algae-bacterial granules, including: biomass concentration, pH, light intensity, light-dark sequence. In addition, different wastewater loads have been considered and tested to determine the versatility and adaptability of the technology.

The experiments were carried out in a Biostat®Aplus bioreactor with a useful volume of 1.5 L with stirring system, influent feed pump, effluent discharge pump, influent and effluent tanks, external photosynthetic light source, continuous monitoring for temperature, pH, dissolved oxygen concentration and pH control. The photobioreactor was operated in a sequential regime (feed-reaction-settling-evacuation) in successive 24 hours cycles. No external air source was added to the system, the oxygen required for the aerobic metabolic processes being supplied exclusively through the photosynthesis process performed by the photoautotrophic microalgae in the light phase.

Results and conclusions

During 9 months of operation, different influent organic and nutrients loads were tested to assess the efficiency, performance and limits of the system. The mixer used in the experiments is designed to homogenize mixtures containing microbiological cultures at speeds between 160 and 300 rpm. The gradual increase of the stirring speed was imposed by the increase of the biomass concentration in the reactor, in

conjunction with the increase in diameter of the granules and the need for uniform mixing. The use of this homogenization system at the speed of 300 rpm led to higher biomass concentrations in the upper part of the bioreactor than those near the tank bottom.



A B

Figure 1. Effluent COD (A) and removal efficiency for COD and NH_4^+ (B)

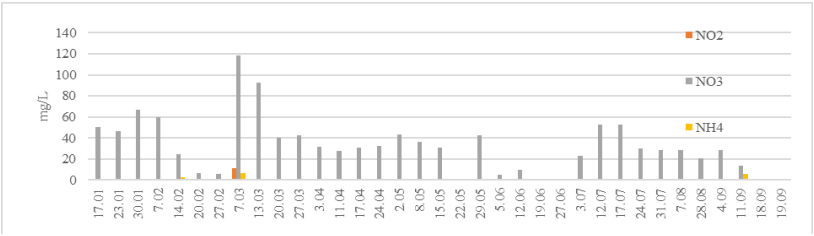


Figure 2. Effluent nitrogen compounds concentrations

The results) showed a good microbial populations adaptability to influent load variations of ± 30%. The laboratory setup ensures high treatment efficiencies under sequential operation conditions with a 24-hour cycle and a photoperiodicity of 15 h light, 9 h dark leading to an effluent that on average meets the legislation discharge requirements.