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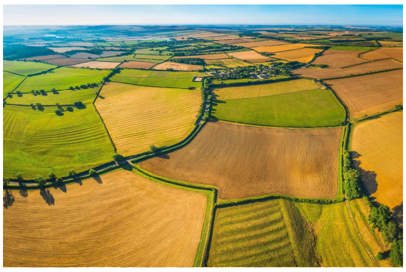
10th IWA International Symposium on Waste Management Problems in Agro-Industries



AGRO'2019

BOOK OF ABSTRACTS

SKATMK TURKISH NATIONAL COMMITTEE ON WATER POLLUTION RESEARCH AND CONTROL

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BOOK OF ABSTRACTS

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Development of microalgae-bacteria granular sludge for the treatment of aquaculture wastewater

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Abstract
The use of microalgae–bacteria systems is particularly attractive for wastewater treatment as combining microorganisms with different metabolic machineries could allow the development of a robust biological system. The aim of this study was to evaluate the feasibility to develop microalgae-bacterial granular sludge through the self-immobilization of microorganisms under SBR mode. After the addition of the suspended microalgae consortia containing several strains isolated from an aquaculture facility, adhesion of microalgae to the bacterial granules was observed. Reactor removal performance for carbon and nutrients was followed to assess the effect of the microalgae bioaugmentation process.

Keywords
Granular sludge; bacteria; microalgae; aquaculture wastewater.

INTRODUCTION

Biofilm systems are promising for wastewater treatment and the recent developments in aerobic microbial granulation technology have brought substantial improvements in biofilm-based processes (Lewandowski and Boltz, 2011). The high microbial biomass and the layered structure of the granular sludge offer protection to the microbial community against the adverse conditions in wastewater. Although belonging to different trophic levels, both microalgae and bacteria have demonstrated ability to deal with recalcitrant wastewaters (Delrue et al., 2016; Amorim et al., 2017). The combination of microalgae and bacteria within the same structure could be beneficial for wastewater treatment as a more diverse metabolic machinery is present and could turn the process more efficient. Thereby, this study aims to investigate if microalgae and bacteria can form through self-immobilization a granular biomass to be applied for the treatment of aquaculture wastewater.

MATERIALS & METHODS

The reactor was operated as sequencing batch reactor (SBRs), which typically has an anaerobic feeding phase, followed by aeration phase, settling phase and a decanting phase. Synthetic wastewater was used as the feed. Aerobic granular sludge from a full-scale wastewater treatment plant was used as the initial seed bacterial granules. Later, a mixed microalgal consortium containing strains isolated from an aquaculture facility was added to the reactor. The self-aggregation and persistence of microalgae within the reactor were followed. The reactor performance concerning C, N and P-removal was assessed throughout reactor operation.

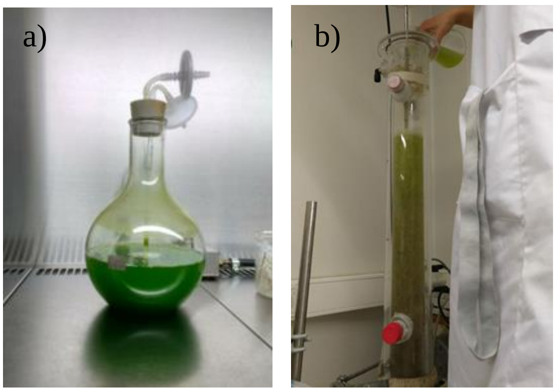

Figure 1. - Microalgae consortia containing strains isolated from an aquaculture facility (a) an its addition to the reactor (b).

RESULTS & DISCUSSION

Several microalgae were isolated from the sludge collected at a freshwater aquaculture facility. A suspended stock solution of microalgae strains was added to the bacterial granular sludge growing in the SBR during the aeration phase. Initially cycle time was of 6 h up to 72 days, after which it was reduced to 4 h. The process of self-immobilization of microalgae into the bacterial granules was followed after the bioaugmentation of the reactor. Samples of the aggregates were taken and carefully washed, crushed and then observed at the optical microscope revealing the presence of microalgae in the bacterial granules. In addition, some of those aggregates were plated on BG-11 medium and microalgae growth was observed. These results showed that the microalgae added to the bioreactor were able to self-immobilize into the bacterial granules. As suspended microorganisms, many microalgae hardly settle; therefore its ability to adhere to bacterial granules can be a great advantage to the treatment process. EPS excreted by the cells could have promoted the adhesion of the microorganisms (González-Fernández and Ballesteros, 2013). Concerning reactor removal performance, the chemical oxygen demand (COD) was mainly removed during anaerobic feeding period. The ammonium present in the feeding wastewater was completely removed and converted into nitrate, without nitrite accumulation. The reactor operation is ongoing to investigate the aggregation and persistence of microalgae and the cell viability of the involved microorganisms. Key operational parameters that affect the carbon and nutrient removal and thus the effluent quality should be further explored.

CONCLUSION

In this study, microalgae-bacterial granules were developed under SBR process conditions. The success of the aggregation of microalgae to the existent granules could be related with the EPS production capability. The reactor operation is ongoing to better understand how the interaction of both microorganisms affect the removal processes. Further application of the microalgae-bacterial granules for the treatment of aquaculture wastewater is envisaged.

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