Algae-bacteria systems for nitrogen recovery: promises and challenges through a modelling approach

ABSTRACT

Algae-bacteria processes in wastewater are promising for reducing the energetic demand due to oxygenation, since microalgae produce the oxygen supporting the growth of bacteria. High Rate Algal/Bacterial Ponds (HRABP) are also an emerging technology for nitrogen and phosphorus recovering in the algal biomass. However, HRABPs are complex ecosystems involving a wide biodiversity and being highly climate dependent, therefore still requiring optimization and managing studies. The objective of this work is to develop a computer assisted optimization strategy to optimize the process. We present a full predictive model that was validated under realistic conditions, with two outdoor case studies, and for more than 600 days. The ALBA model has been shown to accurately predict the four tested seasons in two different climatic conditions. The model also highlighted a risk of N_2O emission resulting from a strong competition for inorganic carbon following a shortage in alkalinity, due to a strong nitrification activity, as experimentally observed when the growth medium was the digestate. We show that to meet the process promise, the complex interplay between SRT, HRT, liquid depth and alkalinity must be understood and lead to a trade-off between algal productivity and nitrogen recycling, by considering only operating conditions that are not susceptible of leading to N_2O emissions.

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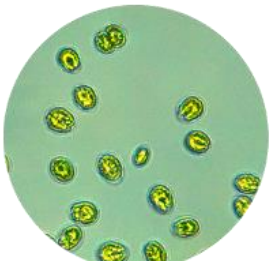

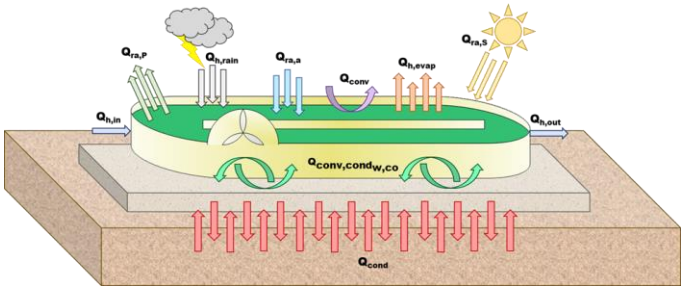
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$Q_{h,rain}$
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Q_{conv}
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$Q_{h,in}$
$Q_{h,out}$
$Q_{conv,cond_{w,co}}$
Q_{cond}