Wastewater resource recovery with green microalgae – modelling the microalgal growth, nutrient uptake and storage using ASM-A

Wágner, Dorottya Sarolta; Valverde Pérez, Borja; Sæbø, M.; Bregua de la Sotilla, Marta; van Wagenen, Jonathan Myerson; Smets, Barth F.; Plösz, Benedek G.

Publication date:
2015

Document Version
Publisher's PDF, also known as Version of record

Citation (APA):
Wastewater resource recovery with green microalgae – modelling the microalgal growth, nutrient uptake and storage using ASM-A

1. INTRODUCTION
- Conventional wastewater treatment focuses on the destruction of organic chemicals and nutrients.
- Domestic wastewater should be considered as a resource of energy, nutrients and fresh water.
- Potential resource recovery using microalgae.
- Microalgal biomass can be used as a slow leaching fertilizer.

2. OBJECTIVES
- Development of a microalgal process model in the ASM framework → compatible with activated sludge models
- Identification of biokinetic processes for photosautotrophic and heterotrophic microalgal growth including nutrient uptake and storage

3. MATERIALS AND METHODS
- Mixed green microalgal culture: Chlorella sp. (Sorokiniana) and Scenedesmus sp.
- Targeted experiments in 3 scales:
  - 2 mL microbatch
  - 24 L open airlift PBR
  - 1-L batch

4. RESULTS
Model calibration using descending cycles (cycle 2):
- We calibrate the model for each descending cycle.
- We obtain an average parameter set from the 4 cycles.

Two-step model evaluation to test the following hypothesis:
- What is the influence of culture history and substrate availability on parameter estimates?
- Can we use a default parameter set?
- Can we explain the discrepancy as a result of parameter variability?

Step 1 – Janus coefficient
- J<1 calibrated model prediction is good
- J>1 calibrated model prediction fails

Step 2 – Monte Carlo simulations
- On the 4 ascending cycles
- Using average parameter values estimated from model calibration

The discrepancy between measured and simulated data is explained by parameter variability for algal biomass, ammonia and phosphate concentrations and the phosphorus storage.
- The prediction of internal nitrogen quota is influenced by the substrate availability.
- The prediction of soluble nitrate is compromised by the culture history.

5. CONCLUSION
- A novel process model in the ASM framework for predicting algal behavior in PBR has been identified, calibrated and critically evaluated
- Different scale lab experiments have been used to estimate different parameter sets
- The model can predict algal biomass, ammonia, phosphate and internal PP quota using a mean parameter set
- The prediction of internal nitrogen quota is influenced by the substrate availability and the soluble nitrate is compromised by the culture history

ACKNOWLEDGEMENT

Dorottya S. Wágner*, Borja Valverde-Pérez, Mariann Sæbø, Marta Bregua de la Sotilla, Jonathan Van Wagenen, Barth F. Smets and Benedek Gy. Píosz

*dosaw@env.dtu.dk, DTU Environment, Department of Environmental Engineering, Technical University of Denmark, Miljøvej, Building 113, 2800 Kgs. Lyngby, DENMARK

The European Commission is neither responsible nor liable for any written content in this poster.