

Title:

Self-sedimenting algal-bacterial communities for municipal wastewater treatment

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In recent years, the scientific and industrial interest in microalgae as an alternative biological nutrient removal in wastewater treatment increased. The potential of microalgae to make wastewater treatment energy efficient and carbon neutral stimulates the research in this field. A bottleneck in the application of microalgae technology is the energy-intensive separation step of biomass and treated liquid. Our study suggests a photo-bioreactor (PBR) using a self-sedimenting algal-bacterial community, in the form of granules for the treatment of municipal wastewater.

Three lab-scale PBRs were inoculated with field samples of microalgae and bacteria from various locations in the Netherlands. Subsequently the effect of hydraulic retention time (HRT) on the functions (sedimentation, nutrient removal) and assembly of the microbial community were assessed for a period of 120 days. The reactors were operated at three different HRT (2.00, 1.00, 0.67 days), while retaining the same solid retention time of 7 days. Creating this selective environment, a microbial community with excellent settling characteristics (95-99% separation efficiency) established within 3-5 weeks. The observed nutrient uptake rates ranged from 24-55 mg_N/L/day and 3.1-5.4 mg_P/L/day depending on the applied HRT. The changes in morphology of the community were followed by microscopy and gave valuable insight in the assembly of algae and bacteria to flocs and granules. Two important parameters could be identified for the structural integrity of the algal-bacterial aggregates: 1. Extracellular polymeric substances (EPS) and 2. filamentous microalgae.