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Maximizing Nitrate Absorption of Agricultural Waste Water in a Tubular Microalgae Reactor by Adapting the Illumination Spectrum

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Abstract : Microalgae-based photobioreactors (PBR) for Life Support Systems (LSS) are currently being investigated for future space missions such as a crewed base on planets or moons. Biological components may help reducing resupply masses by closing material mass flows with the help of regenerative components. Via photosynthesis, the microalgae use CO₂, water, light and nutrients to provide oxygen and biomass for the astronauts. These capabilities could have synergies with Earth applications that tackle current problems and the developed technologies can be transferred. For example, a current worldwide discussed issue is the increased nitrate and phosphate pollution of ground water from agricultural waste waters. To investigate the potential use of a biological system based on the ability of the microalgae to extract and use nitrate and phosphate for the treatment of polluted ground water from agricultural applications, a scalable test stand is being developed. This test stand investigates the maximization of intake rates of nitrate and quantifies the produced biomass and oxygen. To minimize the required energy, for the uptake of nitrate from artificial waste water (AWW) the Flashing Light Effect (FLE) and the adaption of the illumination spectrum were realized. This paper describes the composition of the AWW, the development of the illumination unit and the possibility of non-invasive process optimization and control via the adaption of the illumination spectrum and illumination cycles. The findings were a doubling of the energy related growth rate by adapting the illumination setting.

Keywords : microalgae, illumination, nitrate uptake, flashing light effect
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