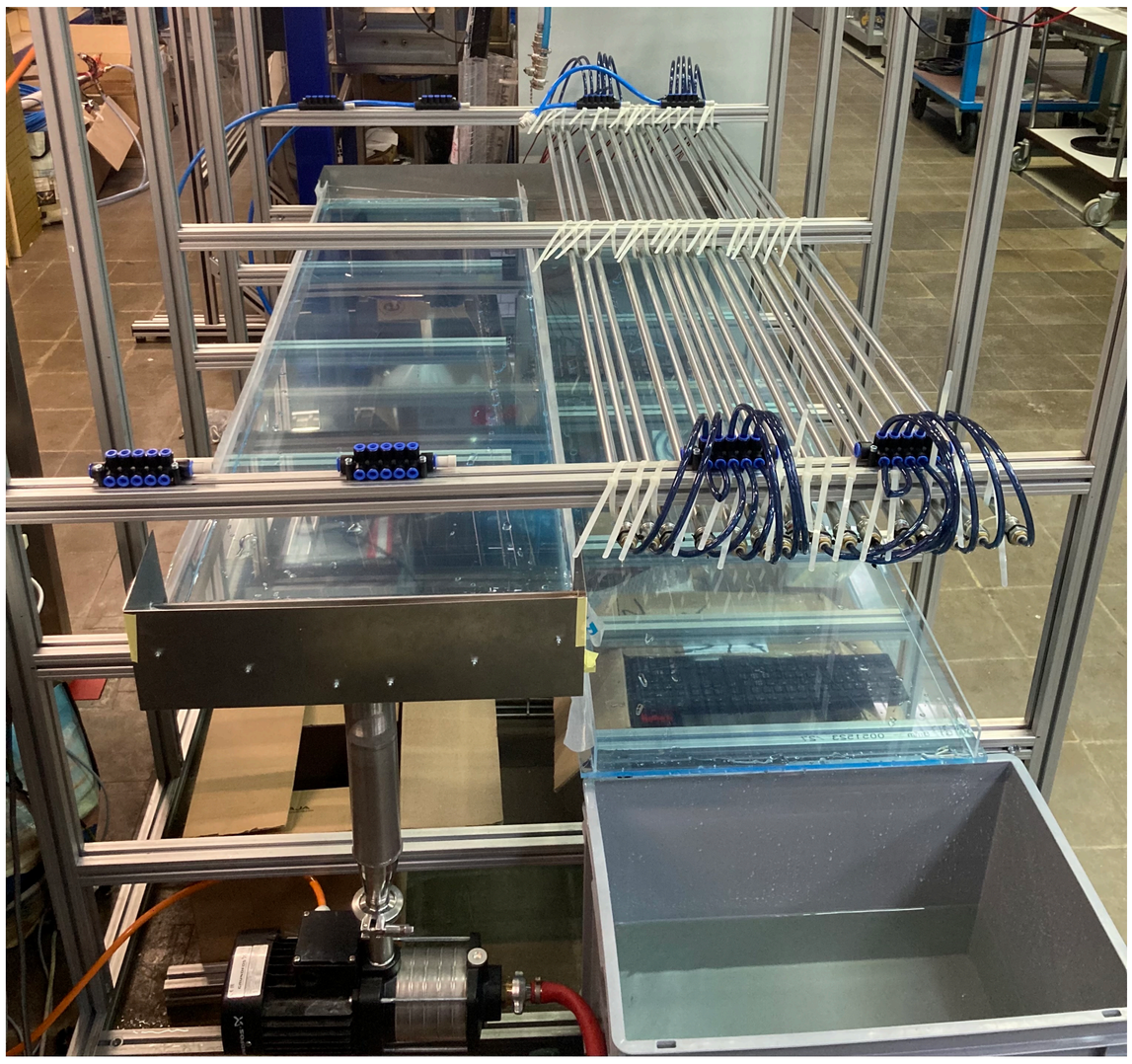
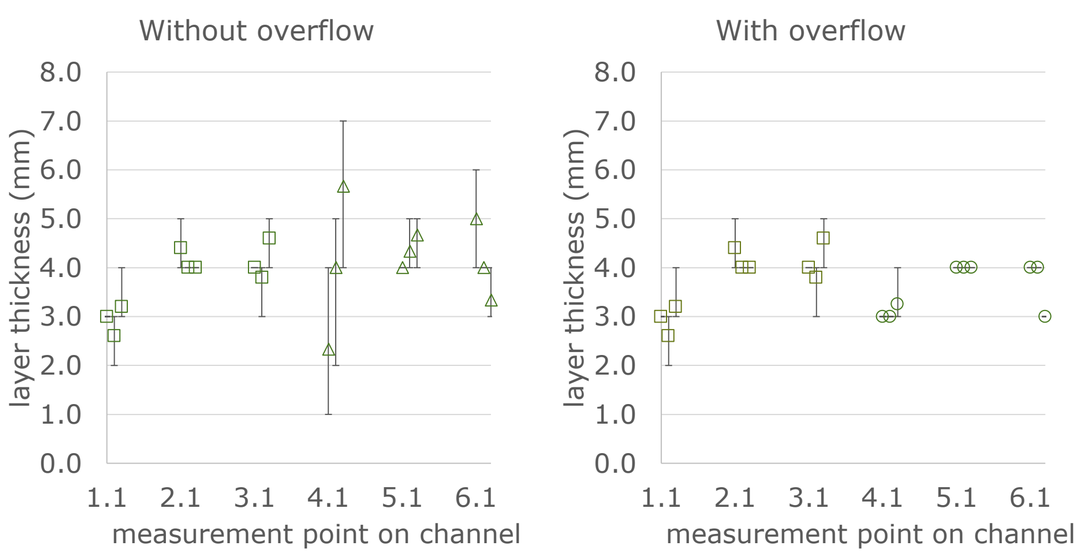
HSLU Hochschule Luzern

Technik & Architektur
Energy Systems Engineering
Environmental Systems Engineering

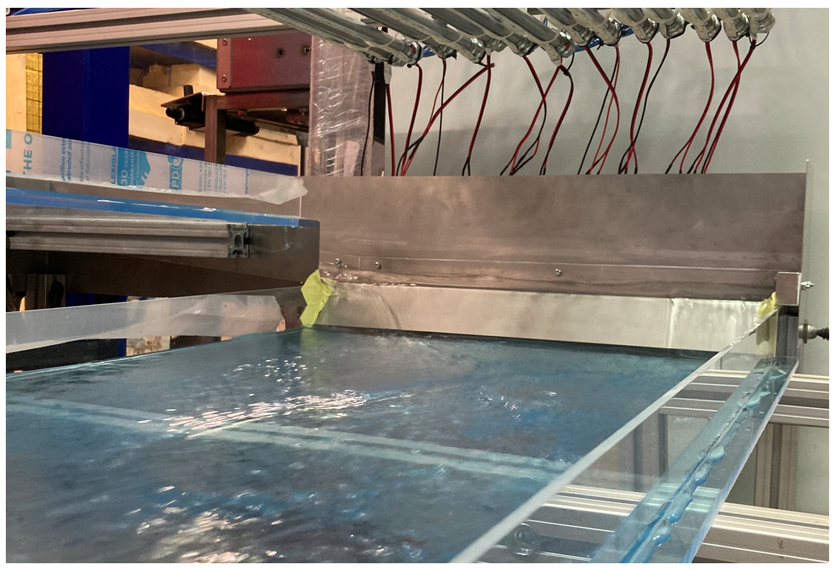
Bachelor Thesis in Energy and Environmental Systems Engineering

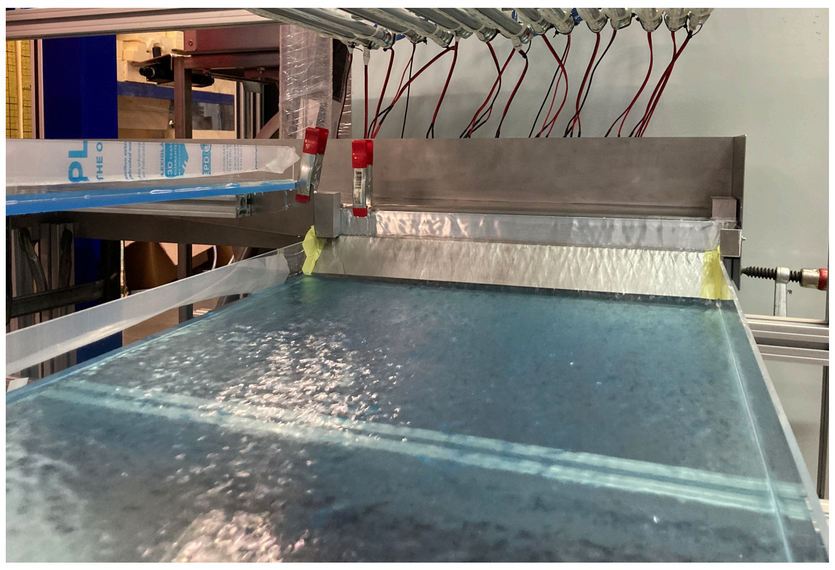
Development and commissioning of a demonstrator for a thin-layer photobioreactor





CO_2





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Abstract
To counteract anthropogenic climate change, not only anthropogenic CO_2 emissions must be reduced quickly and significantly, but also negative emission technologies must be employed on a large scale. Thin-layer photobioreactors are a promising negative emission technology. For experimental investigation on this reactor type a laboratory scale demonstrator was developed. A literature research on microalgae cultivation and related work regarding thin-layer photobioreactors set the background. Following the approach of systems engineering, requirements were defined, system architectures were established, and a solution concept was developed based on different variants for subsystems of the demonstrator as light supply, CO_2 supply, reactor skeleton and circulation. An experimental characterization showed that a more uniform layer thickness is achieved with an overflow in the flow reversal module. Layer thickness in the range from 2 to 5 mm were measured at a volume flow rate of 0.64 L/s.

Future experimental investigation with the demonstrator will allow to determine the values for identified scale-up factors as surface to volume ratio and lighting as well as to detail requirements for large scale algae cultivation with thin-layer photobioreactors. With this knowledge, thin-layer photobioreactors can be used to efficiently cultivate microalgae and sequester CO_2 to contribute to a reduction of climate change.

Aim and objectives

The project aim is to develop and realize a demonstrator of a thin-layer photobioreactor on a laboratory scale to be able to perform experiments with this reactor type throughout the year. This demonstrator and experimental investigations will serve as a basis for an upscaling.

To reach this aim the following objectives are to be accomplished:
- Information on thin-layer photobioreactors is collected.
- A conceptual design is established.
- The demonstrator is realized and commissioned.
- An experimental characterization is conducted.
- All work is scientifically documented in a comprehensible manner.

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