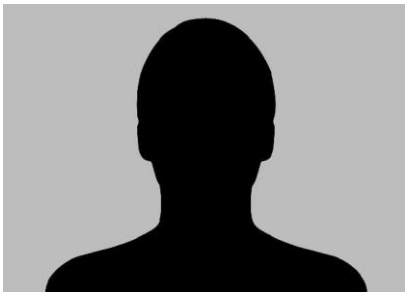
Zurich University
of Applied Sciences

School of
Engineering

ICP Institute of
Computational Physics

Concept study of UV-LED based water disinfection units using flow and radiation simulations



Diplomierende
David Dudli
Nino Schellenberg

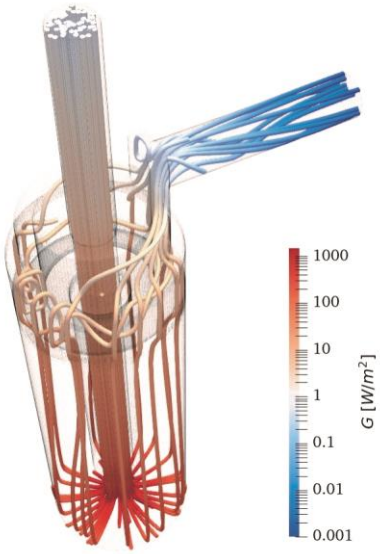
Dozierende
Kurt Pernstich
Viktor Lienhard

Conventional UV water disinfection systems are operated with mercury vapor lamps, but such systems are inefficient, especially at low flow rates and in interval operation. With the maturity of LEDs in the UV-C range, *Aqua Innovations Inc.* now has the opportunity to develop more sustainable products. In order to reduce the production of costly prototypes and test setups, the most promising variant of a reactor for water disinfection is to be found by means of simulations. Microbes flowing through the intensity region should receive the highest possible minimum dose of UV radiation in an economically feasible design.

The main objective of this work is to develop a useful process to calculate the minimum dose. In this process, five reactor concepts representing different development paradigms were compared. The simulations thus allow a targeted development of the reactor.

For the calculation of the reactor, the flow conditions were simulated in *OpenFOAM* with the solver 'simpleFoam' and the radiation with 'MultiRegionRadiationFoam' in a steady state. The two results were then merged and evaluated using *ParaView* and *MatLab*.

The developed process for calculating of the dose has proven itself in numerous simulations. As the process becomes more precise, it should be gradually automated in addition to reconsidering some of the model assumptions. The examination of the five concepts provided the first ideas for a prototype and simlutaneously demostrated optimization potentials. Finally, economic considerations provide a further decision factor as to which of the concepts is preferable for further development. In this respect, it must be clarified exactly which market needs the product is to cover before further development. In addition, validation with measured data is essential as soon as further decisions are to be made on the basis of the simulations.



Simulated particle paths through an irradiated reactor. When combined with the power density G, the UV dose of the particles can be calculated.