Technische Auslegung zum DIY-Bau einer UVC-LED-Trinkwasseraufbereitung

Student

Marc Werro

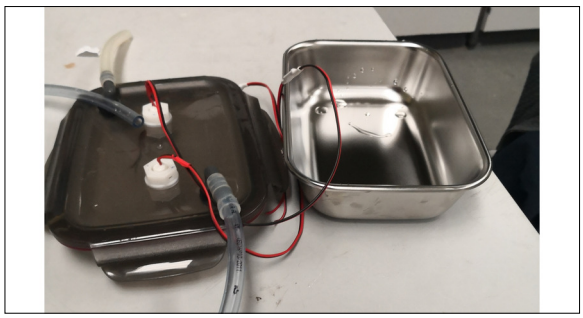
Introduction: In this thesis, different concepts for a water disinfection reactor using UVC LEDs were investigated.
The use of such a device could guarantee families drinking water free of bacteria
and viruses.
The goal is to create a device, which is reasonably priced and easy to assemble
in any part of the world.

Approach / Technology: This simplicity was achieved by using waterproofed LEDs and products
that required minimal modifications.
To evaluate the inactivation capabilities, the reactors were tested with E. coli bacteria.
The LEDs which were used were low power, waterproof, and in an acceptable price range. One LED can emit an optical power of 2.3 mW with a beam angle of 140° and costs of 10 USD.
The final design based on a lunchbox consisting of a stainless-steel box with a polypropylene lid.
Multiple setups and tests were conducted, which showed the capabilities of such a device and which parameters are especially important when designing a reactor.

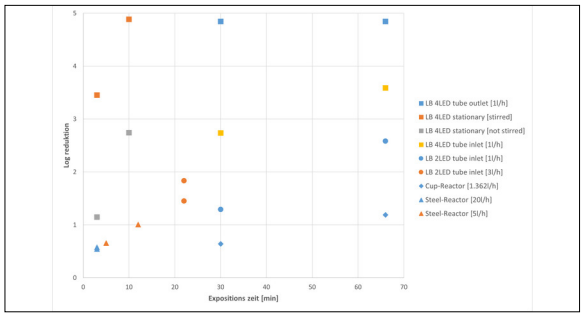
Result: The largest difference in log reduction was achieved when a small tube, which was previously installed at the inlet, was moved to the outlet. This caused the water to flow downwards before it could exit the reactor and thus it had to traverse the light of the LEDs. This change alone inactivated all bacteria compared to the previous setup, which only achieved a 3.5 log reduction at very long exposure times.
Other factors, such as increasing the optical power output, seem to have a linear correlation
with the amount of inactivation achieved.
In this thesis, the reflecting capabilities of the reactor material were explored with a simple mathematical model. This model predicts an approximate 2.5 decrease in necessary exposure time for a reactor with reflecting materials.
It also shows that there is an optimum to be found between the length of the reactor and
the amount of exposure time needed for the water which is passing through.

Lunchbox-Reactor with 4 UVC-LEDs in experiment setup.
Own presentment

Lunchbox-Reactor with 2 UVC-LEDs installed.
Own presentment



Log reduction with E. coli of different reactor designs.
Own presentment



Examiner
Prof. Dr. Michael Burkhardt

Subject Area
Water treatment, Waste processing and recycling