BTO *Executive Summary*

Column set-ups give insight into removal of microorganisms during slow sand filtration

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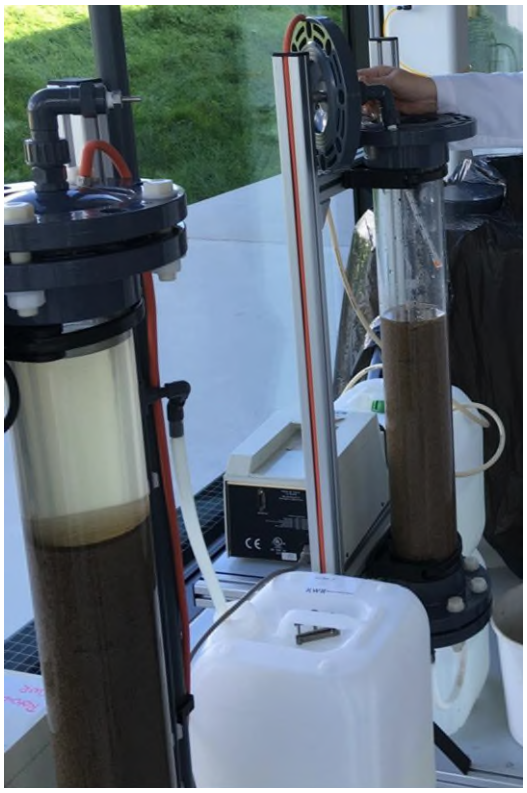
Slow sand filtration is a good option for sufficient removal of pathogenic microorganisms such as viruses, bacteria and protozoa in drinking water production. To determine the specific efficiency of slow sand filtration for different production locations and process conditions in practice, column experiments were carried out as was done previously in 2016. In addition to the removal of *Cryptosporidium* (a protozoan), the removal of *E. coli* bacteria and MS2 bacteriophages (viruses) was also investigated. The results confirmed the extensive removal of *Cryptosporidium*, by 3.9 to 4.9 log units. *E. coli* and MS2 bacteriophages were removed less effectively, with average removal of 2.4 and 1.7 log, respectively. The conduct of the experiments in duplicate demonstrated that results can be reproduced. Waterbedrijf Groningen can use the resulting validated process model to determine the removal for the legally required Quantitative Microbial Risk Assessment (QMRA, Dutch abbreviation: AMVD).



A column set-up for slow sand filtration is being prepared at the KWR test facility.

Interest: secured safe drinking water

Surface water is contaminated with pathogenic microorganisms that must be removed during drinking water production. Drinking water utilities are required to demonstrate, through a Quantitative Microbial Risk Assessment (QMRA, in Dutch: AMVD), that their water is sufficiently safe. They must therefore have a clear understanding of how effectively their production methods remove various types of pathogens, such as bacteria, viruses and protozoa.

Approach: column tests in duplicate

An experimental set-up with two filter columns was filled with sand from the De Punt production location. The filters were run under identical conditions with feed water from De Punt, in order to simulate the real operational conditions as much as possible. The filter column was run in precisely the same manner as it was in an earlier experiment, which only involved *Cryptosporidium*. This made it possible to compare the results of all the columns, and to translate them to practice. High concentrations of microorganisms were added to the feed water for the experiment. Then, over a period of 48 hours, all the filtered water was collected and studied in the laboratory to determine the microorganism concentrations. In this way, the removal of viruses, bacteria and protozoa in the column set-up could be established.

Result: determination of removal in De Punt slow sand filtration, and validation of calculation model

Cryptosporidium was removed by 3.9 to 4.9 log units, *E. coli* by an average of 2.4 log units and MS2 phages by 1.7 log units. The results were used to validate a calculation model for slow sand filtration.

Implementation: more secured safety of De Punt drinking water

Waterbedrijf Groningen can use the results of this research for the AMVD to demonstrate that the safety of the drinking water, under the current conditions, meets the legal requirements. The validation of the model means that it can also be used to secure the safety under other conditions, for example, under low temperatures or a higher load. Thus, with a relatively modest experimental set-up, a solid foundation was laid to secure the drinking water quality. The experiment set-up offers the possibility of even further validating the model, for example, for other conditions.

Report

This research is described in the report *Verwijdering MS2 bacteriofagen, E. coli en Cryptosporidium door langzame zandfiltratie, kolomexperimenten De Punt 2018* (BTO 2019.026).

Jaar van publicatie
2019

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Langzame zandfiltratie, microbiologische veiligheid, hygiëne, drinkwaterzuivering, Cryptosporidium, E. coli, MS2

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