

Hydraulic properties and reduction of COD, phosphorus and nitrogen in sand filter used for greywater treatment – simulation and verification

Susanna Ciuk Karlsson

Research project:

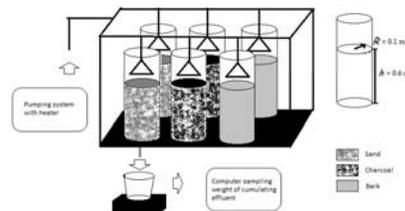
Onsite treatment of greywater

- Smallscale treatment for single households generating greywater, such as remote swedish summerhouses or households in low-income, water-scarce countries

- Simple, robust, lowcost

-> Vertical flow filters

Experimental set-up



Assessment of pollutant concentrations in filter influent and effluent

Biochemical oxygen demand, **BOD**

Chemical oxygen demand, **COD**

Total organic carbon, **TOC**

Methylane blue activity substances, **MBAS**

Inorganic phosphorus, **IP**

Total phosphorus, **TOT-P**

Nitrogen species, **NO₂, NO₃, NH₄**

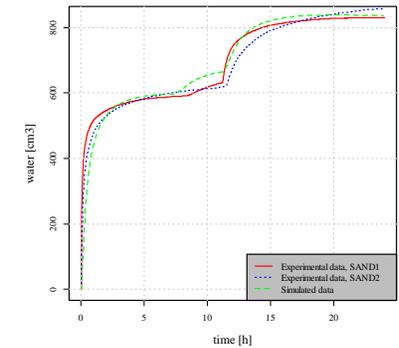
Total nitrogen, **TOT-N**

HYDRUS-CW2D

Get a better quantitative understanding of the treatment processes inside the filter by:
 setting up the vertical flow sand filter in the HYDRUS2D-CW2D interface

Hydraulic model (van Genuchten)

Cumulative flow,
 simulated data compared to experimental data from the main sand filter (SAND1) and its duplicate (SAND2)

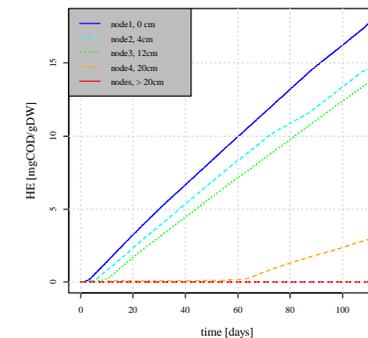


Reactive transport results:

Simulated and measured mean values of the filter effluent concentrations of pollutants (from simulation timespan 56-113 days).

Parameter	Measured filter effluent concentrations [mgL ⁻¹]	Simulated filter effluent concentrations [mgL ⁻¹]
Readily biodegradable COD, CR	108	0
Slowly biodegradable COD, CS	46	0
Inert COD, CI	91	308
Total COD (CR+CS+CI)	245	308
Inorganic phosphorus, IP	0.4	0.5
Total phosphorus, TP	0.9	1.2
Nitrate, NO3N	57	47
Ammonia, NH4N	4	0.1
Nitrogen dioxide, NO2N	-	0
Total nitrogen, TN	72	-

Simulated heterotrophic microorganisms





Plans for improvement

Characterisation of the microbial biomass in our physical filters -> use experimental observations to calibrate parameters of CW2D



Applications after calibration

Predict outcome of different loading regimes

Gain insights on optimal filter design



Future plans on simulation

HYDRUS-CW2D simulations of vertical flow filters with bark or charcoal as filter media



Thank you for your attention!

susanna.ciuk.karlsson@slu.se