Assessment on the Performances of Biosand Filters Built with Untreated River Sand and Disinfected River Sand

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Abstract

Implemented in over 55 countries worldwide, biosand filters (BSFs) have proven to be effective small-scale drinking water treatment systems. Their inexpensive material cost, low maintenance requirements, and ease of use make BSFs appealing to communities in the developing countries where they typically operate. However, the difficulty of assembling materials for the implementation process can pose an obstacle, particularly in isolated areas. Currently, the use of on-site material for building BSFs is dissuaded, upon posited risk of contamination from pathogens and organic matter. Nonetheless, many BSFs are still filled with river sand because it is more readily available. An assessment of the effectiveness of BSFs built using river sand is being conducted on two full-scale concrete BSFs, two 5-gallon bucket BSFs, and two 2-gallon bucket BSFs. Half of the BSFs are filled with untreated river sand and the other half with disinfected river sand, and two additional full-scale concrete BSFs serve as controls, packed with commercial washed beach sand. The performances of the BSFs are compared by regularly spiking influent water with *Escherichia coli* and evaluating reduction capacity, as well as measuring daily turbidity removal. Additionally, weekly flow rates and water quality measurements (i.e. conductivity, phosphates, ammonia, pH) are monitored. Results of these analyses will suggest whether it is safe to use BSFs constructed with river sand, and if river sand sanitized by chlorination improves BSF performance. If such BSFs are found to meet drinking water standards, it would lower the cost and simplify the implementation of biosand filters in emergent nations.

Methods: Set-Up

Four full-scale concrete BSFs
- 2 control
- 1 untreated river sand
- 1 disinfected river sand

Two 5-gallon bucket BSFs
- -1 untreated river sand
- -1 disinfected river sand

Two 2-gallon bucket BSFs
- -1 untreated river sand
- -1 disinfected river sand

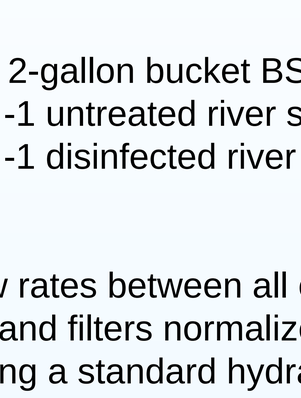
Flow rates between all eight biosand filters normalized by setting a standard hydraulic loading rate

Collect river sand and aggregates from a dry creek bed →

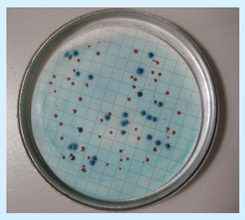
Crush river sand and aggregates until material can pass through number 20 sieve

Wash river sand with de-chlorinated water, then submerge half of the river sand in bleach →

Empty old sand from BSFs and refill with new material. Adjust flow rates as needed



Methods: Experimentation



Fill with unspiked creek water
Measure influent and effluent turbidity

Test flow rates
Test water quality parameters of influent and effluent 1
Measure influent and effluent turbidity

Test for residual *E. coli* in effluent 2
Measure influent and effluent turbidity

Spike BSFs with target of 10^5 CFU/ 100 mL *E. coli* and process influent (membrane filtration)
Measure influent and effluent (3) turbidity

Process effluent 4 for *E. coli* concentrations (membrane filtration)
Measure influent and effluent turbidity

Process effluent 5 for *E. coli* concentrations (membrane filtration)
Measure influent and effluent turbidity

Water quality measurements are taken on a weekly basis on influent and effluent levels of:
- -Phosphates
- -Ammonia
- -Total Nitrogen
- -pH
- -Conductivity

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