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Revitalization of Abandoned Biosand Filters

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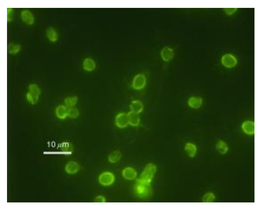
Abstract

Although biosand filters (BSFs) have been implemented in over 55 countries to provide safe drinking water, the necessity of operating filters on a daily basis has raised questions about filter efficacy after a period of abandonment (e.g., due to travels away from home or school vacations when students/faculty are not present to use institutional filters every day). Presently, the safe recommendation for abandoned filters is to deconstruct and rebuild. An assessment of the effectiveness of revitalized BSFs was conducted on two full-scale concrete BSFs (C1, C4), two 5-gallon bucket BSFs (B1, B4), and two 2-gallon bucket BSFs (A1, A4) that were abandoned for two years. The filters were revitalized by rehydration (as needed), swirl-and-dump sand cleaning, tubing disinfection, and flushing. The performance of the revitalized filters was compared to that of two newly built concrete filters by measuring influent and effluent levels of *Escherichia coli*, *Cryptosporidium parvum* oocysts, and turbidity. Influent water was collected from a local creek to provide adequate nutrients to support biolayer development and to emulate field use. The log removal of *E. coli* and *C. parvum* by each filter was calculated by testing the two subsequent effluents following each spike. In addition, turbidity of each influent and effluent was measured to determine percent reduction. Flow rates of the filters, as well as water quality measurements of influent and effluent water (i.e., conductivity, phosphates, ammonia, total nitrogen), were evaluated weekly. The data show that revitalized BSFs are comparable to newly built filters, simplifying the continued use of drinking water treatment systems in developing nations.

Methods

Rebuild two full size control BSFs (C2, C3) according to CAWST guidelines

Revitalize test BSFs
- Rehydrate (C1, C4, A1, A4)
- Disinfect tubing (all)
- Swirl and dump (all)

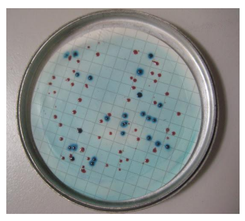


Spike BSFs with *C. parvum* and process influent (IMS-IFA)
Test flow rates
Test water quality parameters of influent and effluent 1
Measure influent and effluent turbidity

Process effluent 2 for *C. parvum* oocysts (IFA)
Measure influent and effluent turbidity

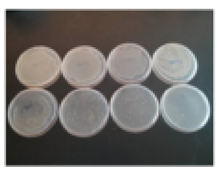
Fill twice with unspiked creek water
Measure influent and effluent turbidity

Spike BSFs with target of 10^6 CFU/ 100 mL *E. coli* and process influent (membrane filtration)
Process effluent 3 for *C. parvum* oocysts (IFA)
Measure influent and effluent turbidity

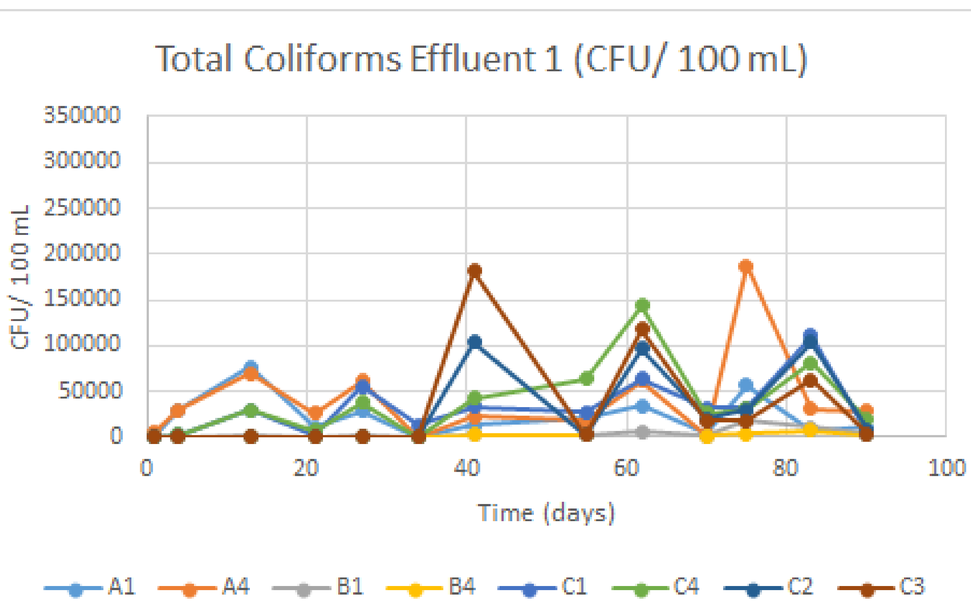


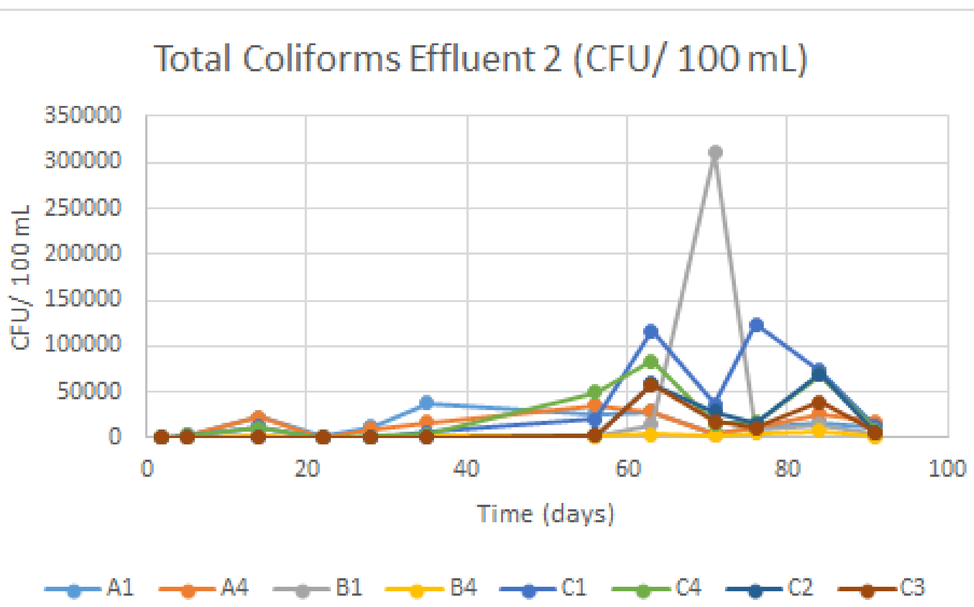
Process effluent 4 for *E. coli* concentrations (membrane filtration)
Measure influent and effluent turbidity

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



Results





Conclusions

Total Coliforms:
For environmental concentrations, removal by revitalized BSFs is comparable to that of newly rebuilt ones
Cryptosporidium parvum:
No oocysts detected in effluent samples; ≥ 3.70 log removal
Turbidity:
Effluent turbidity is as low in revitalized BSFs as in new ones, if not better

Future Work

-Compare results with that from Honduras and Haiti
-Determine when *E. coli* buildup occurs
-Continue examining the effects of organic contamination by rebuilding BSFs using river sand

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