New England Water Treatment Technology Assistance Center
University of New Hampshire • Durham, New Hampshire
NE-WTTAC
PROJECT SUMMARY REPORT

Comparison of Riverbank Filtration to Slow Sand Filtration

Objectives

The main goal of this project was to compare riverbank filtration (RBF) to slow sand filtration (SSF) in terms of particulate, organic precursors and microbiological removal capabilities expressed in log removal credits. The removal mechanisms of RBF and SSF are similar in both systems and rely on biological filtration processes involving biodegradation and bioadsorption.

This project contained three primary tasks:

1. Identify and characterize RBF extraction wells in New Hampshire.

2. Characterize the treatment effectiveness of the slow sand filter systems.

3. Compare the treatment performance between the two biological filtration systems.

Methodology

RBF extracted water samples were collected from Pembroke, NH; Jackson, NH; the Milford State Fish Hatchery in New Hampshire; Louisville, KY; and Cedar Rapids, IA. Each of these sites has full-scale RBF, and the RBF extracted water is hydraulically connected to surface water coming from near-by streams. Pilot SSF systems were installed at Louisville, KY and Pembroke, NH for direct comparison to the existing RBF system. Samples were also taken from established full scale SSF systems located in Milo, ME; Springfield, MA; and West Springfield, MA.

In the case of RBF, water samples were taken from the river, an upgradient groundwater source, and the RBF extracted water and analyzed to assess RBF in terms of its particulate, organic precursors and microbial removal capabilities. SSF water samples were collected on the influent and effluent waters in order to compare their performance to that of RBF. An adequate quantity of samples was collected to allow comparison of both systems during typical seasonal variations in operating and water quality conditions.

Results

RBF samples were collected from 1) Pembroke, NH (19 samples) 2) Milford, NH (123 samples) 3) Louisville, KY (11 samples) and 4) Cedar Rapids, IA (5 samples). SSF samples were collected at 1) Milo, ME (3 samples) 2) Springfield, MA (3 samples) and 3) West Springfield, MA (2 samples). A summary of weighted average removals achieved by RBF and SSF are shown in Table 1.

Table 1. Summary of Weighted Removal Averages Achieved by RBF

Parameter	# of samples	RBF	# of samples	SSF	SSF (literature)
Total coliforms (CFU/100mL)	48	>1.9 log	8	2.2 log	0.92-2 log
Fecal coliforms (CFU/100mL)	48	>0.6 log	8	1.34 log	0.8-1.97 log
Aerobic spore Forming Bacteria (CFU/100mL)	48	>2.4 log	8	2.3 log	NA
Turbidity (NTU)	48	82.8%	8	82.9%	95%
Particle counts	21	84.8%	8	93.4%	NA
DOC (mg/L)	48	69.8%	8	17.9%	5-20%
UV254absorbance (nm)	48	71.5%	8	35%	17-40%

In RBF, typical river water total coliforms, E.coli and aerobic spore forming bacteria concentrations ranged between 10-24192 CFU/100mL, 5-1356 CFU/100mL and 84-145000 CFU/100mL, respectively. All three of these microbial concentrations were below detection limits (<1CFU/100mL) in the riverbank filtration extraction well water, even after eliminating the dilution effects with groundwater. The male specific coliphages (MS2) ranged between 328-491 PFU/25mL in the river water. The concentration of the male specific coliphages was reduced by 80% by the riverbank passage.

SSF has limited ability in removing color (<25% removal) and organic precursor materials, while effluent turbidities of less than 0.5 NTU are typical. The sampled SSFs as part of this study achieved microorganism removal toward the higher removals noted in the literature. The variability in removals may be due to the age or maturity of the biological filters and the influence of temperature variations.

Conclusions

This particular study demonstrated that RBF and SSF have similar capabilities in removing microbial pathogens as total and fecal coliform and aerobic spore forming bacteria removals were similar for the two systems (Table 1). Turbidity was equally removed by RBF and SSF, though RBF outperformed SSF during shock loads due to the slower filtration rate and larger filter area provided by RBF. Organic precursor material as quantified by DOC and UV254 absorbance were further decreased by RBF than SSF due again to slower filtration rates, longer filtration distances and possible dilutional affects from groundwater contribution.

Recommendations

The comparison of RBF and SSF should be performed through more side-by-side evaluations over longer periods of time, in order to account for variations in seasonal water quality. Additional microbial challenges should be performed where possible to both filtration systems.

Presentations

As a result of this research project several presentations have been given at conferences. A list of these presentations is below.

Partinoudi, V., Collins, M. R. an1d Brannaka, L. K. "Assessment of Riverbank Filtration as a viable treatment and pretreatment method" Oral presentation. NEWWA 121st Annual Conference, Hyannis, MA September 23-25th, 2002 (Groundwater: New Tools Session)

Partinoudi, V.; Collins, M. R., Margolin, A. B.; Brannaka, L. K. "Assessment of the microbial removal capabilities of riverbank filtration" Poster Presentation AGU, Nice, France. April 8th 2003 (Bank Filtration and Aquifer Storage and Recovery Session)

Partinoudi, V.; Collins, M. R.; Margolin, A. B.; Brannaka, L. K. "Assessment of the microbial removal capabilities of riverbank filtration" Oral Presentation. Second International Riverbank Filtration Conference. Cincinnati September 16-19th, 2003. (Microorganisms Session)

Disclaimer

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