

Berkey Water Filter Lab Test Results

UNIVERSITY OF ARIZONA

Department of Soil, Water & Environmental Science

Evaluation of 3 Black Berkey Filter Formulation Purification Units for the Removal of *Cryptosporidium parvum* oocysts & *Escherichia coli*

SUMMARY

Three Black Berkey Filter Formulation Water Purification Units were evaluated for their ability to remove *Cryptosporidium parvum* (*C. parvum*) oocysts, and *Escherichia coli* (*E. coli*). The average oocysts removal by both units tested exceeded >99.99999

METHODOLOGY

Test Waters and Test Conditions

Typical chemical/physical parameters of the test water used in the study are shown in Table 1. This water was within the range recommended by the U.S. Environmental Protection Agency's Task Force Report on Guide Standard and Protocol for Testing Microbiological Water Purifiers (1990).

Waters for conditioning and testing were passed through the unit by negative pressure, with an Expert peristaltic pump (SciLog, Verona, WI), at an approximate flow rate of 200 ml/min. The test was conducted after conditioning the unit with approximately 4 liters of dechlorinated tap water. The challenge water (influent) contained approximately 1.4×10^7 *C. parvum* oocysts/L, and 1×10^8 colony forming units (CFU) of *E. coli*/L. Two influent samples (50 mL each) were collected at the beginning of the experiment, and two effluent samples (500 mL each) after passing approximately one and 1.8 liters of challenge water, respectively.

C. parvum Assay

C. parvum oocysts were obtained from feces of infected calves (Pleasant Hill Farm, Troy, ID). Oocysts were pelleted by centrifugation, and the supernatant was aspirated to approximately 1 mL above the pellet. After resuspension of the pellet in phosphate buffer saline, the oocysts were counted using a hemacytometer (Baxter Healthcare Corp. McGraw Park, IL). A total of 12 chamber aliquots were counted for each sample according to the procedure outlined in the Guidance Manual (USEPA, 1990). Influent and effluent samples were assayed in triplicate.

Bacterial Analysis

E. coli (ATCC-25922) was grown overnight in Trypticase Soy broth (Difco, Detroit, MI) at 37 degrees C to obtain the organisms in the stationary growth phase. The bacterial cells were pelleted by centrifugation and resuspended in phosphate buffered saline. This procedure was repeated three times to remove organic matter present in the broth. Bacterial assays were conducted by the membrane filtration method on m-Endo Agar LES (Becton Dickinson, Cookesville, MD). Appropriate dilutions of influent samples were made in sterile 0.025 M phosphate buffered saline (PBS) at pH 7.0. One, 10 and 100 mL volumes of effluent samples were assayed. All samples were assayed in triplicate.

RESULTS

The results of *C. parvum* oocysts and *E. coli* removal are shown in Table 2. These results show that the unit achieved an average removal of more than 7 log (>99.99999%) of *C. parvum* oocysts, and more than 7 log (>99.99999%) of *E. coli*.

REFERENCES

USEPA 1990. Guide Standard and Protocol for Testing Microbiological Water Purifiers. In: Guidance Manual for Compliance with the filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources.

Table 1. Typical characteristics of non-microbiological parameters of test water

Parameter	Test water
Chlorine residual (ppm)	<0.1
pH	7.7
Turbidity (NTU)	0.22
Temperature (C.)	24.5
Total dissolved solids (TDS) (mg/L)	221
Total organic carbon (TOC) (mg/L)	ND

Table 2. Removal of *C. parvum* oocysts and *E. coli* by three Black Berkey portable water purification units

Organism	Influent	Effluent	% reduction	Log reduction
<i>C. parvum</i>	1.4×10^7	$< 9.2 \times 10^2$	>99.99999	
<i>E. coli</i>	1.0×10^8	<10	>99.99999	

DATE: March 9, 2000

CLIENT: New Millennium Concepts LTD

CONTACT: Mr. Jim Shepherd

PROJECT NO.: 2233

COLLECTED BY: CK, GJ, JJ

PROJECT DESC.: New Millennium,
Black Berkey Filter
Formulation

Enclosed, Please find our laboratory analysis report regarding the evaluation of "the Black Berkey Filter Formulation" for chlorine & high pH & alkalinity lead, volatile organic compounds (VOC), and Trihalomethanes reduction. Each unit was evaluated for each parameter according to test protocol published by National Sanitation Foundation (NSF) International.

Chlorine Reduction

Sample #, Desc.	Chlorine (SM 4500ClF) Units = mg/L	Date Collected	Date Received	Date Analyzed
30461-1, initial influent	2.0	01/24/00	01/24/00	01/24/00
30461-3, initial 2233-5	<0.01	01/24/00	01/24/00	01/24/00
30461-4, 5 gallon influent	2.0	02/01/00	02/01/00	02/01/00
30461-6, 5 gallon 2233-5	<0.01	02/01/00	02/01/00	02/01/00
30461-7, 10 gallon influent	2.0	02/02/00	02/02/00	02/02/00
30461-9, 10 gallon 2233-5	<0.01	02/02/00	02/02/00	02/02/00
30461-10, 15 gallon influent	2.0	02/02/00	02/02/00	02/02/00
30461-12, 15 gallon 2233-5	<0.01	02/02/00	02/02/00	02/02/00
30461-13, 20 gallon influent	2.0	02/02/00	02/02/00	02/02/00
30461-15, 20 gallon 2233-5	<0.01	02/02/00	02/02/00	02/02/00
30461-16, 25 gallon influent	2.0	02/02/00	02/02/00	02/02/00
30461-18, 25 gallon 2233-5	<0.01	02/02/00	02/02/00	02/02/00
30461-19, 30 gallon influent	2.0	02/02/00	02/02/00	02/02/00
30461-21, 30 gallon 2233-5	<0.01	02/02/00	02/02/00	02/02/00
30461-22, 35 gallon influent	2.0	02/02/00	02/02/00	02/02/00
30461-24, 35 gallon 2233-5	<0.01	02/02/00	02/02/00	02/02/00
30461-25, 40 gallon influent	2.0	02/02/00	02/02/00	02/02/00
30461-27, 40 gallon 2233-5	<0.01	02/02/00	02/02/00	02/02/00
30461-28, 45 gallon influent	2.0	02/03/00	02/03/00	02/03/00
30461-30, 45 gallon 2233-5	<0.01	02/03/00	02/03/00	02/03/00
30461-31, 50 gallon influent	2.0	02/03/00	02/03/00	02/03/00
30461-33, 50 gallon 2233-5	<0.01	02/03/00	02/03/00	02/03/00
30461-34, 55 gallon influent	2.0	02/03/00	02/03/00	02/03/00
30461-36, 55 gallon 2233-5	<0.01	02/03/00	02/03/00	02/03/00
30461-37, 60 gallon influent	2.0	02/03/00	02/03/00	02/03/00
30461-39, 60 gallon 2233-5	<0.01	02/03/00	02/03/00	02/03/00
30461-40, 65 gallon influent	2.0	02/03/00	02/03/00	02/03/00
30461-42, 65 gallon 2233-5	<0.01	02/03/00	02/03/00	02/03/00
30461-43, 70 gallon influent	2.0	02/03/00	02/03/00	02/03/00
30461-45, 70 gallon 2233-5	<0.01	02/04/00	02/04/00	02/04/00
30461-46, 75 gallon influent	2.0	02/03/00	02/03/00	02/03/00
30461-48, 75 gallon 2233-5	<0.01	02/04/00	02/04/00	02/04/00
30461-49, 80 gallon influent	2.0	02/03/00	02/03/00	02/03/00
30461-51, 80 gallon 2233-5	<0.01	02/04/00	02/04/00	02/04/00
30461-52, 85 gallon influent	2.0	02/04/00	02/04/00	02/04/00
30461-54, 85 gallon 2233-5	<0.01	02/07/00	02/07/00	02/07/00
30461-57, 90 gallon influent	2.0	02/07/00	02/07/00	02/07/00
30461-58, 90 gallon 2233-5	<0.01	02/07/00	02/07/00	02/07/00
30461-61, 95 gallon influent	2.0	02/07/00	02/07/00	02/07/00
30461-62, 95 gallon 2233-5	<0.01	02/07/00	02/07/00	02/07/00
30461-65, 100 gallon influent	1.8	02/08/00	02/08/00	02/08/00
30461-66, 100 gallon 2233-5	<0.01	02/08/00	02/08/00	02/08/00

High pH & Alkalinity Lead Reduction

Sample #, Desc.	Lead (EPA 200.8) Units = mg/L	Date Collected	Date Received	Date Analyzed
30495-1, initial influent	0.14	01/25/00	01/26/00	01/26/00
30495-3, initial 2233-6	<0.001	01/25/00	01/26/00	01/26/00
30495-4, 5 gallon influent	0.17	02/02/00	02/03/00	02/04/00
30495-6, 5 gallon 2233-6	<0.001	02/02/00	02/03/00	02/04/00
30495-7, 10 gallon influent	0.17	02/02/00	02/03/00	02/04/00
30495-9, 10 gallon 2233-6	<0.001	02/02/00	02/03/00	02/04/00
30495-10, 15 gallon influent	0.16	02/02/00	02/03/00	02/04/00
30495-12, 15 gallon 2233-6	0.001	02/02/00	02/03/00	02/04/00
30495-15, 20 gallon influent	0.17	02/03/00	02/03/00	02/04/00
30495-17, 20 gallon 2233-6	0.001	02/03/00	02/04/00	02/15/00
30495-13, 25 gallon influent	0.17	02/03/00	02/03/00	02/04/00
30495-18, 25 gallon 2233-6	0.006	02/03/00	02/04/00	02/15/00

2233-6 = Black Berkey Filter Formulation

EPA means Environmental Protection Agency, which is the analytical method used in the evaluation. mg/L means Milligrams Per Liter, which is equivalent to Parts Per Million (ppm).

VOC Reduction by Chloroform Surrogate

Chloroform is the surrogate for all VOC's & Trihalomethanes

Sample #, Desc.	Chloroform (EPA 502.2) Units = mg/L	Date Collected	Date Received	Date Analyzed
30878-1, initial influent	0.17	02/09/00	02/10/00	02/20/00
30878-2, initial 2233-3	<0.0005	02/09/00	02/10/00	02/20/00
30878-5, 10 gallon influent	0.26	02/09/00	02/14/00	02/21/00
30878-6, 10 gallon 2233-3	<0.0005	02/09/00	02/14/00	02/21/00
30878-7, 15 gallon influent	0.21	02/09/00	02/14/00	02/21/00
30878-8, 15 gallon 2233-3	<0.0005	02/09/00	02/14/00	02/21/00
30878-9, 20 gallon influent	0.40	02/10/00	02/14/00	02/22/00
30878-10, 20 gallon 2233-3	0.0005	02/10/00	02/14/00	02/22/00
30878-11, 25 gallon influent	0.38	02/11/00	02/16/00	02/22/00
30878-12, 25 gallon 2233-3	0.0056	02/11/00	02/16/00	02/22/00

2233-3 = Black Berkey Filter Formulation

EPA means Environmental Protection Agency, which is the analytical method used in the evaluation. mg/L means Milligrams Per Liter, which is equivalent to Parts Per Million (ppm).

2233-5 = Black Berkey Filter formulation

SM means Standard Methods for the Examination of Water and Wastewater, which is the analytical method used in the evaluation. mg/L means Milligrams Per Liter, which is equivalent to Parts Per Million (ppm).

**Aquatic Toxicology Laboratory
Department of Environmental Studies
School of the Coast of Environment
Louisiana State University**

2-28-03

Jim Shepherd
New Millennium Concepts LTD

Challenge: Microbial Enumeration/Isolation Black Berkey™ Formula
Method: 9215, Standard Methods for the Evaluation of Water & Waste Water, 20th Edition
Approvals: EPA, American Public Health Assn., American Water Works Assn.
Date Tested: 2-18-03

Matrix: Water samples from two Black Berkey™ filters

The New Millennium Concepts unit containing two Black Berkey™ filters was rinsed with DI water and tested for microbial colonies according to Method 9215 (heterotrophic plate count).

Three Liters of feed water were prepared with Escherichia coli, Pseudomonas aeruginosa, and Klebsiella sp. The method was modified by the clients request to mix all the cultures rather than test for each, one at a time.

Cultures of >10Q5 for each colony formation are required. The actual colony formation was lawn growth >10Q9. Three liters of inoculated DI feed water were passed through the Black Berkey™ filters. The filtrate water sample was tested for residual cultures. The filtrate sample was then incubated overnight to propagate any isolated colonies and inspected under an electron microscope.

A second eight liter inoculated DI feed water challenge was prepared with lawn growth cultures and passed through the same Black Berkey™ filter units.

Analytical Result:

Test Sample Colony Formation CFU/L Comments
DI Rinse of Berkey Unit none none Initial Rinse
Influent, Inoculated DI Water Lawn growth >10Q9 Feed Water, 3 Liters
Effluent, 1st Filtrate Sample >10Q9 0 ND, >9 log reduction
Influent, Inoculated DI Water Lawn growth >10Q9 2nd Feed Water, 8 Liters
Effluent, 2nd Filtrate Sample >10Q9 0 ND, >9 log reduction

Additional analysis: Filtrates samples were inspected under electron microscope after a 24 hour incubation period. Filtrate samples were pure H₂O

All of above tests were performed as approved by client. Unless otherwise directed, the samples listed above with be disposed of by laboratory staff.

Certification Digitally signed by Dr. Ralph J. Portier
Louisiana State University, Dept. of Environ. Studies.

Date: 2003.02.28 12:40:19 -06' 00'