SPECTRUM
LABS INC

LABORATORY ANALYSIS REPORT

DATE: March 9, 2000

CLIENT: Clearbrook
P.O. Box 191238
Mobile, AL 36619

CONTACT: Mr. Bruce Wagner

PROJECT NO.: 2233
COLLECTED BY: CK, GJ, JJ
PROJECT DESC.: High Performance Sports Bottle Water Filtration System

Enclosed, Please find our laboratory analysis report regarding the evaluation of "Clearbrook Generation 2 Drop-In Filter" for chlorine & high pH & alkalinity lead, & volatile organic compound (VOC) reduction. Each unit was evaluated for each parameter according to test protocol published by National Sanitation Foundation (NSF) International.

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 = Clearbrook Generation 2 Drop-In Filter

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

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 = Clearbrook Generation 2 Drop-In Filter

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).

Chlorine Reduction

Sample #, Desc.	Chlorine (SM 4500Cl F) 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

2233-5 = Clearbrook Generation 2 Drop-In Filter

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).

UNIVERSITY OF ARIZONA
Department of Soil, Water & Environmental Science

March 8, 2000

Evaluation of 3 Clearbrook Portable Water Purification Units for the Removal of Cryptosporidium parvum oocysts & Escherichia coli

SUMMARY

Three Clearbrook Portable (Mobile, AL) Water Purification Units (drinking bottle type) 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 >99.99%, whereas the removal of E. coli was >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 $1.4x10^7$ C. parvum oocysts/L, and $1x10^8$ 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 aliqouts 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 4 log (>99.993%) 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 characterisitics 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 Clearbrook portable water purification units

Organism	Influent	Effluent	% reduction	Log reduction
C. parvum	$1.4x10^7$	$<9.2x10^2$	>99.993	>4.2
E. Coli	$1.0x10^8$	<10	>99.99999	>7.0