July 29, 2015

Village Water Filters
1258 Rainbow Drive #2839
Silverthrone, CO 80498

RE: Biological filtration efficacy testing of the filter provided by Village Water Filters; BCS 1506169.

To whom it may concern,

We have conducted the proposed biological filtration efficacy study on the filter received on June 17th, 2015. The experimental set up and challenge of the water filter was designed to evaluate the filter's microbiological contaminant removal efficacy. It is intended to demonstrate its efficacy on the removal of bacteria, cysts, and viruses from a heavily contaminated natural water source.

In the following pages, you will find a summary of the methodology used and the results of our analysis. Should you have any questions or concerns, please do not hesitate to contact me.

Best Regards,

George Lukasik, Ph.D.
Laboratory Director



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**Test Article:**

On June 17th, 2015 three filter cartridges from Village Water Filters were received and assigned BCS ID's 1506169, 1506170, and 1506171, respectively.

**Test Matrix; Challenge Test Water:**

Waste water sample "Raw Sewage" was obtained from an influent supply of a waste water reclamation facility (BCS 1506214). The temperature of the matrix was maintained between 22°C and 25°C during the challenge study. The sample was used as is to challenge the filter unit.

**Study Date:**

Study was initiated on July 03th, 2015 and completed on July 22nd, 2015.

**Test System / Challenge Species:**

**Bacteria:** Total Heterotrophic Bacteria (HPC) present in the raw wastewater sample were enumerated as per method Standard Method 9215 (APHA, 2012). Briefly, aliquots of the sample or sample dilutions were analyzed by spread plating onto plate count agar



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(PCA, Neogen, USA). Duplicate 0.1 and 1.0 ml samples of each of the collected filters' effluent and influent dilution were plated and incubated at 25-28°C for 4- days.

**Parasite analysis:** *Cryptosporidium* oocysts and *Giardia* cysts were enumerated as per method EPA 1623.1 Enumeration was performed by immunomagnetic separation followed by immunofluorescence microscopy using FITC filters.

**Enterovirus analysis:** Enterovirus analysis was conducted as per US EPA ICR Microbial Laboratory Manual; EPA/600/R-95/178. Infectious enteroviruses were enumerated onto mammalian cell culture using Buffalo Green Monkey Kidney Cells (BGMk). Infected cell monolayers were observed for cytopathic effect development over a 14 day period. Viruses were enumerated using a Most Probable Number (MPN) Assay.

**Challenge study Description / Methodology:**

The provided filter was fitted with appropriate connections to the water source. The filter was initially rinsed with 1.0 liter of laboratory reagent water (pH 7.0±0.5) at a flow of 550-650 ml/min. The line pressure was maintained at 1.5 PSI ±0.2 throughout the



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study. For challenge study, raw waste water was homogenized and a sample was removed for enumeration. Additionally, a sample was removed and preserved at the end of the challenge study. One liter of raw wastewater was passed through the filter at a flow rate of 500-600 ml/min. The filter effluent was collected in a sterile 1-liter bottle. Pressure and time elapsed for the volumes collected were recorded by a validated measuring device. Filters' influent and effluent samples were assayed as per Standard Methods and Lab Standard Operating Procedures (SOP F-1). All analysis was conducted, at minimum, in duplicates for each sample volume and dilution analyzed. The respective percent reductions were determined based on the concentration obtained in the filter influent and effluent at each specific challenge point.

**Performed by:** Kintin Ng/George Lukasik
July 03th, 2015

**Study Supervisor:** George Lukasik, Ph.D.
June 23-July 22, 2015

Study data are summarized in the provided table(s). The results presented pertain only to the study conducted on the test articles/samples provided by the client (or client representative). The study was authorized and commissioned by the client. The results presented pertain only to the samples analyzed and identifier number(s) indicated. The



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data provided is strictly representative of the study conducted using the material/samples/articles provided by the client (or client's representative) and it's (their) condition at the time of test. The study and data obtained under the laboratory conditions may not be representative or indicative of a real-life process and/or application. Positive, negative, and neutralization controls were performed as outlined in the method and as per Good Laboratory Practices. All analyses were performed in accordance with laboratory practices and procedures set-forth by our NELAP/TNI accreditation standards (ISO 17025) unless otherwise noted. BCS makes no express or implied warranty regarding the ownership, merchantability, safety or fitness for a particular purpose of any such property or product.



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**Study Sponsor:** Village Water Filters
**Test Articles:** Village Water Filter; BCS 1506169.
**Project:** Raw Waste water filtration*
**Study:** Filtration Efficacy / Pressure 1.5 PSI
**Test Parameter:** Heterotrophic Plate Count (HPC), enterovirus, and *Cryptosporidium* and *Giardia* (Oo)cysts.

| Test Unit | Challenge Species Concentration in the Filter's Effluent; Raw Waste Water (Sewage) Challenge | | |
|---|---|---|---|
| | **Bacterial HPC[1]** (Bacterial Species) Influent Concentration: 4.8 x $10^7$ cfu /ml | **Human Enteroviruses[2]** (Viral Contaminant) Influent Concentration: 2.4 x $10^4$ iu /L | **Parasitic (Oo)cyts[3]** Influent Concentration: 7.7 x $10^3$/L |
| Filter 1 BCS 1507169 | <0.5 cfu/ml** | 2.2 x $10^2$ iu/ml | <1.0%** |

[1] The bacteria were enumerated as colony forming units (cfu) following incubation at 25-28°C for 4-6 days as per Standard Method 9215C.
[2] Enterovirus were enumerated as infectious units (IU) as per EPA/600/R-95/178.
[3] *Cryptosporidium* oocysts and *Giardia* cysts were enumerated as per method EPA 1623.1
* Provided filter was subjected to the challenge study as described in the methods section. Filter's influent and effluent samples were assayed for the respective challenge species as per Standard Methods and Lab Standard Operating Procedures (SOP F-1). The respective percent reductions were determined based on the species' concentration obtained in the filter influent and effluent samples.
**No species were detected in the filter's effluent for the volume analyzed (<0.45 cfu /ml). Filter effluent samples were analyzed in duplicates at the minimum following collection.



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FL DOH #E82924, ISO/IEC 17025:2005 L2422 (L-A-B), EPA# FL01147

**Study Sponsor:** **Village Water Filters**
**Test Articles:** **Village Water Filter; BCS 1506169.**
**Project:** **Raw Waste water filtration***
**Study:** **Filtration Efficacy / Pressure 1.5 PSI**
**Test Parameter:** **Heterotrophic Plate Count (HPC), enterovirus, and *Cryptosporidium* and *Giardia* (Oo)cysts.**

| Test Unit | Percent Removal of Challenge Species from Raw Waste Water (Sewage) | | |
|---|---|---|---|
| | **HPC[1]** (Bacterial Species) Influent Concentration: 4.8 x $10^7$ cfu/ml | **Enteroviruses[2]** (Viral Contaminant) Influent Concentration: 2.4 x $10^4$ iu/L | **Parasitic (Oo)cyts[3]** Influent Concentration: 7.7 x x $10^3$/L |
| Filter 1 BCS 1507169 | >99.999998%** (>7.7 $\log_{10}$ reduction) | 99.1% (2 $\log_{10}$ reduction) | > 99.99%** (>4 $\log_{10}$ reduction) |

[1] The bacteria were enumerated as colony forming units (cfu) following incubation at 25-28°C for 4-6 days as per Standard Method 9215C.
[2] Enterovirus infectious units (IU) were enumerated as per EPA/600/R-95/178.
[3] *Cryptosporidium* oocysts and *Giardia* cysts were enumerated as per method EPA 1623.1
* Provided filter was subjected to the challenge study as described in the methods section. Filter's influent and effluent samples were assayed for the respective challenge species as per Standard Methods and Lab Standard Operating Procedures (SOP F-1). The respective percent reductions were determined based on the species' concentration obtained in the filter influent and effluent samples.
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