Ceramic Testing Summary for AquaRain Water Filters

Challenge	EPA Purifier Requirements for Bacteria and Cysts	New[1] Cartridge	End-of-Cartridge Life[2]
Cryptosporidium parvum oocysts	>99.9% (3 log reduction)	>99.9%	>99.9%
Klebsiella terrigena	>99.9999% (6 log reduction)	>99.999999% (8.9 log)	>99.9999% (6.6 log)

[1] 0.250 inch wall thickness, tested at 60-90 psid

[2] 0.150 inch wall thickness, tested at 60-90 psid

Testing Sources:

Primrose Hutton, B.Sc., Hons., M.Sc. and Jerry Ongerth, Ph.D., P.E., University of South Wales, Sydney, Australia

Debra E. Friedman, Ph.D. and Joan Rose, Ph.D., University of South Florida, Dept. of Marine Sciences, St. Petersburg, Florida, USA

Summary:

"The ceramic cartridge does meet the USEPA Guide and Standard Protocol requirements for bacteria and protozoa removal thus providing a significantly reduced risk of diseases from these types of organisms." Friedman and Rose.

Challenge	Results with Cartidge at End-of-Life
MS-2 Bacteriophage (virus)	>99.99997 (7.7 log reduction)

Testing Source:

Biovir Labs, CA

Summary:

The ceramic cartridge in siphon-feed configuration was challenged with MS-2 Bacteriophage, a virus that attacks bacteria cells.

"No viruses were recovered from any of the permeate samples."

Challenge	Results
Toxicological Extraction Test	All analytes evaluated were within the guidelines set forth in NSF Standard Number 42

Testing Source:

Spectrum Labs, CA

Summary:

"All analytes evaluated were within the guidelines set forth in NSF Standard Number 42."

"The ceramic filter cartridge meets the requirements for compliance under NSF Standard Number 42-1997 for the toxicological extraction evaluation."

Challenge	Results
Escherichia coli	no organisms detected in effluent
Enterococcus faecalis	no organisms detected in effluent

Testing Source:

Stuart and Miller Inc., Canada

Summary:

"…Units satisfied criteria of "complete filtration" of contaminated water by bacterial growth of 100,000 orgs/mL with cultures yielding "NO GROWTH."

Challenge	Results at End-of-Cartridge Life
Turbidity (68.8 NTU water)	0.012 NTU [3]

[3] Average of 3 samples after 20 liters challenge water

Testing Source:

Tests conducted for the U.S. Marine Corps by Naval Facilities Engineering Service Center (NFESC), Port Hueneme, California, USA

Summary:

"All three filters tested treated 84 gallons of high turbidity feedwater without exceeding the 0.5 NTU products turbidity criteria."

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Klebsiella terrigena	>99.9999% (6 log reduction)	>99.999999% (8.9 log)	>99.9999% (6.6 log)

Testing Source:

Tests conducted for the U.S. Marine Corps by Jaime Naranjo, B.S., and Charles P. Gerba, Ph.D., University of Arizona, Dept of Soil, Water and Environmental Science, Tucson, Arizona, USA

Summary:

"The geometric average removal exceeded 99.9999% for the bacteria and 99.9% for the *Cryptosporidium* oocysts. These units would comply with the criteria guidelines for microbial removals under the U.S. Environmental Protection Agency's Guide Standard and Protocol for Testing Microbiological Water Purifiers"

Challenge	New[1] Cartridge	End-of-Cartridge Life[2]
Brevundimonas diminuta[4]	>99.9999% (6 log reduction)	99.99815% removal

Test conditions: Influent concentration of 10^5/ml at end-of-cartridge-life (minimum wall thickness) at 60-90 psid water pressure with laboratory test water.

Testing Source:

Primrose Hutton, B.Sc., Hons., M.Sc. and Jerry Ongerth, Ph.D., P.E., University of South Wales, Sydney, Australia

Summary:

"The ceramic filter consistently removed 99.998% (approx. 5-logs) of potentially pathogenic bacteria when subjected to a rigorous test under realistic operating conditions."

Significance of Test Organisms:

Klebsiella terrigena & Cryptosporidium are the assigned test organisms by the USEPA Guide Standard and Protocol for Testing Microbiological Water Purifiers. These organisms represent a filter's effectiveness in removing bacteria and protozoa, including *Giardia lamblia* and other organisms.

[4] *Brevundimonas diminuta* is the test organism for HIMA (Health Industries Manufacturing Association) test protocol for pharmaceutical grade filters used for the filtration of injectable fluids and is one-third the size of the USEPA bacteria test organism.

Test Comparability to Other Filter Manufacturers:

In comparing test data from other manufacturers, one should be alert to data that may not represent how the competitor's product will actually be used by the consumer throughout the entire life of the product, up to and including diminished performance of their filter at the end-of-life. Our filters have been challenged with a much more rigorous and demanding method than other manufacturers use.

The following four criteria will impact test results when comparing filter systems from different manufacturers:

1) Volume of challenge water tested (ie. a filter challenged with only 5 liters vs. our 50 liters)
2) Pressure and/or flow rate of test (ie. Only 15 psi vs. our 90 psi) (ie. Only 0.25 GPM vs. our 1.0 GPM)
3) Wall thickness (ie. new ceramic or filter product vs. our ceramic product abraded or cleaned to a thin wall)
4) Exposure history (ie. distilled water aging vs. our realistic field water exposure for aging)