

AQUARAIN™ CAMPING & EMERGENCY GRAVITY WATER FILTERS

INTRODUCTION

The AquaRain™ Water Filtration System has been engineered to provide safe drinking water from raw water sources such as rivers, lakes, streams, creeks, ponds, wells, and cisterns. At the heart of the AquaRain™ Water Filtration System are Marathon® State-of-the-art ceramic elements utilizing a long-proven filtration process that is over 100 years old which will safely remove dangerous waterborne pathogens such as cysts (*Cryptosporidium*, *Giardia lamblia*) and bacteria (*E. coli*, *Salmonella typhus*, etc...). These innovative Marathon® ceramic elements are also filled with a high grade silvered granulated activated carbon (GAC). The GAC reduces pesticides, chemicals, chlorine, tastes & odors, while leaving the naturally occurring minerals found in the water unaffected.

The Marathon® ceramic elements are carefully manufactured through a patented extrusion process that results in a very consistent, close tolerance wall thickness. This allows for accurate measurement of their remaining life and thereby maintenance of the highest level of reliability and security. Additionally, Marathon® kilns are compact and operate within very close tolerance temperature ranges. This provides extremely tight control of the ceramic's final porosity. Every batch of ceramic elements out of the kilns is tested with mercury porosimetry equipment to confirm proper pore size distribution. Each finished element is fully flushed at the factory and is tested twice in the production process to insure complete product integrity.

Traditional ceramics are produced through a slip-cast method in bulk quantities, utilizing a crude plaster of paris-style mold process. Typically, they are then fired in large room-sized kilns with a wide variance in temperatures. The result is inconsistent product quality. Traditional ceramics therefore cannot achieve the consistency and reliability of our new patented process extruded ceramics.

One of the most important benefits of the use of a ceramic produced by the patented Marathon® extrusion process, is the consistent, symmetrical, and measurable wall thickness. This symmetry allows us to externally measure the remaining wall thickness to determine when the element has reached the end of its usable life (minimum wall thickness). Determining the minimum safe wall thickness by independent lab testing and being able to measure that safe minimum on an element in service, are absolutely critical to having a Filtration system you can trust.

Unlike other filters found in the market, our patented deep drawn stainless containers are formed from a single piece of heavy #304 (18-8) stainless steel and have no welded seams to trap bacteria. The large 3-gallon vessel allows for more convenient operation with fewer fillings for usable quantities of water. A new splash guard (patent pending) has been added between the upper "raw water" vessel and the lower filtered drinking water vessel that will deflect spilled water if the upper container should be overfilled or water splashed over the side. The addition of handles

to the upper vessel facilitates its easy removal, leaving the lower filtered drinking water container as a more compact, convenient water dispenser.

HOW CERAMICS WORK

Ceramic water filters work in three ways. First, surface sieving, much like a screen door, does not allow larger particles to pass through the outer surface of the filter. Second, ceramic filters operate as a depth media, providing a twisting, tortuous path like a maze, trapping contaminants within the walls (usually in the top .005” below the surface). Third is surface charge or adhesion, whereby contaminants that are small enough to penetrate the walls of the ceramic may cling to the walls like opposite polarity magnets attract each other. This surface charge is often greater than the force of the water flow that might otherwise dislodge the contaminant. This is particularly true with gravity or siphon-fed ceramic applications.

Wall thickness is particularly important with regard to a ceramic’s performance as a depth media. The maze-like, tortuous path allows for filtration performance at an effective pore size that is much less than the actual median pore diameter of the diatoms from which the filter is made. As clogged filters are cleaned to restore flow, contaminants in the top .005” of surface material are removed. Gentle abrasive cleaning will gradually reduce wall thickness. Filtration performance will gradually diminish as wall thickness diminishes. Eventually, filtration performance will fall below acceptable, safe levels if the filter is used with walls that have become too thin. This will occur before the filter physically cracks or breaks, making a reliable end-of-life indicator or gauge absolutely essential for the health and safety of the user.

OPERATION

The operation of the AquaRain™ Gravity Water Filter is simplicity itself. Questionable water is poured into the upper container where it trickles down through the highly specialized ceramic filter elements, leaving cysts, bacteria, viruses and sediment in the outer layer of the ceramic. After passing through the thick ceramic wall, the water flows through a bed of silvered coconut shell carbon which reduces pesticides, various chemicals, and chlorine (if present), along with objectionable tastes & odors. The filtered water then drips into the lower storage container where it accumulates for easy dispensing with our handy lever-action faucet.

Our published water production rates, as well as with all other gravity water filters on the market, have been established under controlled and optimum conditions with fully wetted elements. New, dry elements will need several loads of water run through them before they are fully wetted and reach their maximum flow rate. In normal everyday use, water for filtration may be placed in the upper vessel in the evening and allowed to filter through overnight. In the morning, most of the water will have filtered through into the lower dispensing container. Additional water may then be added to the upper container so that a continuous process of filtration and subsequent use may be established. Keeping the upper vessel as full as possible, perhaps refilling every fifteen minutes, is essential to reach the maximum production potential. To halt the production of filtered water, simply lift the upper container and empty it. The stainless steel lid can then be placed on the bottom container which may be used as a convenient and compact counter-top water dispenser.

Over time, small particulates and bacteria will eventually clog the walls of the element and slow the production of water through the filter. When this occurs, simply remove the filter element(s) and while holding the threaded end, lightly clean the hard surface of the ceramic with a brush or the scrub pad provided. The element is

then reinstalled in the upper filter vessel, taking care to not contaminate the clean water side of the elements or the bottom of the upper vessel.

TESTING

Extensive independent testing is the key to proving the performance of any water filter product. The Marathon® ceramic filter elements used in the AquaRain™ Gravity Water Filter have been thoroughly tested by independent laboratories, government agencies and are currently under testing for NSF listing. We can safely say that no other ceramic element has undergone the unique testing program that Marathon® has specified for their ceramic elements. Not only have the elements been tested new, as all other manufacturers test, but Marathon® has included ceramics for testing that have been abraded to their end-of-life tolerance and flushed with contaminated field water so that these special test elements approximate true expended parts ready for disposal, as well as testing elements actually used in a variety field conditions over their entire life. Testing of these end-of-life elements has demonstrated that the patented Marathon® ceramic gravity filter elements will remain effective and meet all mandated performance levels throughout their entire usable life.

Marathon® ceramic elements have been successfully tested in independent laboratories with *Cryptosporidium parvum* (kryp-toh-spor-id-dee-um parr-vum) for cyst removal, with the EPA mandated *Klebsiella terrigena* (kleb-see-ell-a terra-gee-na) for bacterial removal. The Marathon® filter elements have also been successfully tested against the Health Industry Manufacturing Association's test organism, *Brevundimonas diminuta* (Bra-vun-daa-moan-us da-min-u-taa), which is approximately one-third the size of the EPA bacteria test organism. What is particularly noteworthy, is that all of the above tests have been passed with *fully expended elements*, ready for disposal. Marathon® has gone the extra mile to insure that our product will perform *as promised* and remain effective in producing safe drinking water throughout its *entire life*. To the best of our knowledge, *no other manufacturer* has dared to test in this way and publish the results of this type of end-of-life testing.

Marathon® ceramic elements are currently in the midst of testing at a renowned laboratory in California, in an attempt to achieve virus removal to the fullest extent of the EPA testing guidelines. We have already demonstrated a 7.7-log (99.999997%) reduction of MS2 colophage virus with no detectable break-through. EPA standards only require a 4-log (99.99%) viral reduction with Polio virus and Rota virus. No other ceramic in the world has demonstrated these levels of performance.

The Marathon® filter elements are filled with the highest grade of silvered coconut shell granulated carbon. The coconut shell carbon has been acid-washed and de-dusted, making it the cleanest ash-free carbon available. The silver-carbon is manufactured to meet NSF 42 requirements, is in the final paperwork filing process of becoming listed with NSF, and it is EPA registered.

INNOVATIONS

AquaRain™ Gravity Water Filters offer several unique innovations that set them far ahead of all other gravity water filters:

PATENTED EXTRUSION PROCESS: Marathon's patented extrusion process produces a perfectly formed ceramic "tube" that has exacting characteristics. The wall dimensions and concentricity are tightly controlled, allowing an exact external measurement of the remaining wall thickness.

ACCURATE KILNS: The Marathon® elements are fired in small computer-controlled kilns which allow complete and accurate control of the porosity of the finished product. The firing of the ceramic is the critical step in the process that determines the final performance. Bulk firing in large room-size kilns cannot provide the consistency that equals highly reliable performance in the finished product. Our ceramic elements are by far the most consistent, high performance ceramic available. Extensive testing proves it.

WEAR GAUGE FOR SAFETY: Our Marathon® filter elements incorporate an end-of-life caliper gauge snapped onto each element. When this highly accurate gauge can easily slip over the outside diameter of the ceramic, the thickness of the ceramic wall has been reduced through cleaning to the point that we recommend replacing the element. The end-of-life measurement is possible only because of Marathon's unique patented extrusion process, which produces a consistent and measurable finished product. Laboratory testing has proven that the Marathon® ceramic element will be safe to use, all the way to the element's measured end-of-life..

SPLASH GUARD: The AquaRain™ Gravity Water Filter incorporates a patent pending feature not found on any other stainless gravity water system. The upper vessel that holds the questionable water has a stainless steel splash guard formed on the bottom of the housing that will deflect splashed or overflowed water away from the lower storage area holding the filtered water. Since frequent filling of the upper vessel aids in maximum production, the splash guard adds extra insurance to the daily operation of the AquaRain™ Gravity Water Filter.

EASYLIFT HANDLES: Two solid stainless steel handles have been added to the upper housing to allow easy removal for cleaning. The handles have been spot welded to the container with a special computer operated system that controls the process precisely, forming a perfect bond. No other gravity water filter offers this convenient feature.

SIMPLE & RELIABLE FAUCET: The lever-action faucet used on the AquaRain™ Gravity Water Filter is very easy to use with a simple push of the lever to draw a cup of clean water. The lever may also be flipped up to lock it in the open position for high flow dispensing of larger quantities of water. The simple yet functional design of this American made, NSF listed faucet, makes it a very reliable part of the AquaRain™ Gravity Water Filter. You can depend on it.

ENDORSEMENTS

AMERICAN CERAMIC SOCIETY: Marathon® has been awarded special recognition by the American Ceramic Society as achieving “one of the most innovative advances in ceramics in the last 100 years”.

The U.S. MARINE CORPS, Raids & Reconnaissance Group, has selected Marathon's ceramics for their use in the field.

COL BO GRITZ, U.S. Army (Ret.) Delta Force, Special Forces, most decorated Green Beret Commander in Viet Nam recommends the AquaRain™ system in his radio programs and in his newsletters.

MICHAEL S. HYATT, author of best-selling books, The Millenium Bug and Y2K, A Personal Preparedness Guide has endorsed the AquaRain Water Filter.

AIR, LAND, EMERGENCY RELIEF TEAM (ALERT) use the AquaRain™ and Marathon® Ceramic filter products in worldwide relief programs, and recommend our gravity water filter system for emergency preparedness in the USA.

QUESTIONS AND ANSWERS:

Q: What is the difference between the British Berkefeld and the AquaRain™?

A: There are several notable differences, but the most important one is our ability to reliably remove virus from water. The British Berkefeld water filter is a well-designed system that relies on ceramic technology they introduced over 100 years ago. The slip-cast method of production used by British Berkefeld has changed very little since then. Their large, room-sized kilns have a tremendous volume capacity, and for sheer quantity and low cost, they cannot be beat. Our American made Marathon® ceramics are produced in very small batches and are individually tested twice before leaving the factory. The patented extrusion process, the small computerized kilns, use of the highest quality components available, and extreme quality control make the Marathon® ceramic element singularly the closest tolerance and most reliable water filtration element available in the WORLD. Who else can claim virus removal without the use of chemicals or pressure?

Another important difference is our ability to accurately measure the filter's remaining wall thickness and thereby safely determine when the filter has reached the end of its useful life. British Berkefeld salespeople tell their customers that they can use their elements until they crack. This can be very dangerous. Since the wall thickness has a great effect on the performance of the filter, elements thin enough to crack are simply unsafe.

Our stainless steel housing is seamless and smooth edged, being formed from single sections of #304 (18-8) heavy stainless steel sheet. The British Berkefeld is welded and may have voids where bacteria can be trapped. Our system also holds three gallons of water, allowing for fewer fillings for maximum production, and has a simple and reliable lever-action faucet.

Q: What is the difference between the Katadyn and the AquaRain™?

A: The Katadyn TRK Gravity Water Filter is a very good filter and the ceramics are top notch. The Ceradyn ceramic filter elements used in the TRK have an end-of-life gauge similar to ours and are of similar hardness and overall quality. There are several important differences however. Here are a few...

Our Marathon® ceramics have a much smaller pore size than the Ceradyn and a correspondingly higher performance in removing smaller pathogens. Test data have demonstrated that the Marathon® ceramic elements will remove even coliphage virus. No other ceramic has passed this most difficult test. The Ceradyn elements are also filled with a silvered quartz gravel which will not improve the water quality in any way, while our Marathon® elements are filled with a high quality silvered granulated carbon made from coconut shells that demonstrate a superior performance in reducing pesticides, various chemicals, chlorine if present, halogens, pesticides, tastes and odors. Katadyn has recently introduced the Superdyn cartridge, which is filled with a bituminous (coal) carbon filling. Bituminous carbons do not typically have the VOC reduction performance of coconut shell carbon, as used in the AquaRain™ Gravity Water Filter System.

The rugged yet attractive AquaRain™ housing is constructed of heavy duty 18-8 stainless steel while the Katadyn TRK is made of more difficult to sanitize plastic.

Lastly, the Katadyn system uses only three ceramic elements and *costs more* than our AquaRain™ Model 400 with four high quality ceramic elements in a stainless steel housing.

Q: What is the story on “absolute” micron ratings?

A: There is a great deal of confusion regarding “absolute” micron ratings. Just how much of a reduction efficiency should be considered adequate for an “absolute” rating? Is 99.9% (3 log) sufficient, or would 99.9999% (6 log) be more appropriate, since it matches the EPA bacteria requirement? Should a filter be rated by its ability to remove particles of a certain size, or should it be challenged with live organisms of a similar size? Should a filter be tested only when it is new, or should the ratings be based on its end of life performance? The fact is that there is no industry or government standard for “absolute” filtration efficiency.

The Marathon® filter elements used in the AquaRain™ Gravity Water Filter have been extensively tested against live organisms using expended end-of-life elements. We believe this form of testing to be the most stringent, since it tests the filters in a manner similar to the way they would actually be used under worst case conditions. When testing against the .5-.6 micron organism *Klebsiella terrigena*, EXPENDED Marathon® elements demonstrated a 6.6 log reduction (they achieved 8.9 log reduction when new). The EPA only requires a 6 log reduction from NEW elements, which we greatly exceeded under extreme pressures of up to 90 psi, well above normal test pressure. At the very low pressure of ½ psi found in our gravity filter, the efficiency would be far greater still. Does this mean that the Marathon® filter elements have an “absolute” rating of only .5-.6 microns? Expended Marathon® filter elements have also been tested against the Health Industry Manufacturing Association’s test organism, *Brevundimonas diminuta*, and achieved a 99.998% reduction (6 log when new). Since this organism is .2-.3 micron, should we claim this as our “absolute” rating? Here is where it really gets confusing. In another test, expended Marathon® filter elements were challenged with MS2 colophage virus and achieved a 99.99997% (7.7 log) reduction against this organism that is less than .1 micron. Are we now “absolute” at under .1 micron? The British Berkefeld filters claim “absolute” performance at .5 microns here in the USA (.9 microns in Europe). Their own factory literature claims 99.9% efficiency at this level. Is 99.9% sufficient for claiming an “absolute” rating? The bottom line is that Marathon® filter elements out perform all other ceramic filter elements available. Since there is no standard for “absolute,” YOU will have to decide what level of protection you want for yourself and your family.

Q: How much water will the filter produce?

A: We have established a water production rate of 25-30 gallons per day for the AquaRain™ Model 400. This maximum production figure has been established under controlled and optimum conditions with clean and fully wetted elements and relatively clear water. Keeping the upper vessel as full as possible, perhaps refilling every fifteen minutes, is essential to reach the maximum production potential. In normal daily use, a more conservative production figure of approximately one gallon per hour would be appropriate for the Model 400 Filter.

Small particulates and bacteria will eventually clog the walls of the element and slow the production of water through the filter. Proper cleaning will restore the filter to full flow rates, each and every time.

Q: How long do the filters last?

A: There are two parts to the filter elements; the ceramic shell, and the granulated carbon filling. Cleaning of the ceramic shell is what wears out the ceramic portion of the filter. Over time, particulates and bacteria clog the microscopic pores of the ceramic, slowing down the flow rate. Occasional cleaning with a small brush or the enclosed green scrub pad will restore the original flow rates. Our ceramic formulation is very hard and will endure many cleanings, perhaps over 200, if moderate care is taken and light pressure is used when abrading the surface. In normal usage, this equates to thousands of gallons of water that can be filtered.

The inner carbon filter works by adsorbing and/or reducing certain chemicals, and has a finite lifetime based on the concentration of the compounds being reduced. Generally speaking, the carbon capacity should exceed the life of the ceramic portion of the filter when processing normal field water as found in ponds, lakes, rivers, etc. When filtering common tap water or swimming pool water, each element should be able to reduce normal concentrations of chlorine found in about 3000-5000 gallons of water. This would place the chlorine reduction capacity of a Model 400 at around 12,000-20,000 gallons. Please note that when the elements are exhausted from reducing chlorine, that they are still fully effective for the removal of living pathogens, provided the ceramic still has useful life remaining.

Q: Will the filters remove salt from the water?

A: No. Our ceramic elements leave all of the naturally occurring minerals intact and will not single out salt alone. This is generally not a problem with most water sources. If salt is a problem with all of your local water sources, you can collect rain water and use it to dilute or replace your other sources. Collected rain water must still be filtered through the AquaRain™ Filtration System to insure its safety.

Q: Will the filters remove lead or heavy metals from the water?

A: No. Generally this is not a concern. Heavy metal contamination is very rare and is usually found near a water source that is adjacent to an industrial outfall. Always try to collect water in clean waterways from a known acceptable source.

While heavy metals reduction is possible, we believe the trade-off in this application is not justified. When all of the factors are considered, the addition of specialized heavy metals reduction media will not necessarily be an enhancement to our Water Filtration System. Special heavy metals reduction media (often ATC™ or ATS™ lead reduction products from Englehard), will displace volume that could have been used for high quality carbon. This reduces the overall amount of VOC and chlorine reduction that the filter elements are capable of achieving. Further, the fine, powdery particle size of heavy metals reduction media will make the filtration media more dense, thus restricting the flow of water and slowing output. We feel these are not good trade-offs unless there is a legitimate priority for heavy metals reduction, as otherwise the reduction media would actually render a filter LESS effective with these additives.

Q: Will the filters remove nitrates from the water?

A: No. Nitrates are similar to dissolved minerals, and ceramics will not remove them. Nitrates, when concentrated, primarily affect small infants and the aged. Generally, nitrate problems can be avoided with careful water collection procedures, avoiding areas where livestock gather or where heavy farming with chemicals is practiced. Use rainwater when in doubt.

Q How do you clean the ceramic elements?

A: The ceramic elements are very easy to clean. You simply remove them from the upper container, and while holding the threaded end of the filter upright, brush lightly downward toward the end cap. Rinse the element after you have lightly abraded the surface, taking care that contaminated water does not enter the hole in the threaded end of the filter. If the inside of the element becomes contaminated, boil the element for 15 minutes, allow to cool, then reassemble the filter. When reassembling the elements into the upper container, be sure to keep all exterior surfaces clean and free of contaminated water. Do not allow the lower filtered water storage container to become contaminated; disease-causing pathogens may then be present.

Q: How do you store the filter after use?

A: Simply remove the filter elements and allow them to air dry for at least 24 hours. Dry the containers and all parts and then slide the lower container into the upper container to nest them together. Pack the elements carefully with padding to avoid breaking them. For maximum protection, we recommend that you repack the filter system into the original box using the original packing materials when possible.

Q: Will the Marathon® filter elements designed for the AquaRain™ System fit into the housings and replace the British Berkefeld and Katadyn filter cartridges?

A: Yes, the Marathon® cartridges may be used as high performance replacement cartridges for both of these gravity water filter systems. The elements mount in the housings in the same manner as the original filter cartridges.

Q: Why do the sides of the AquaRain™ Filter housings appear magnetic, but the lid and bottoms do not?

A: Our stainless housings are deep drawn from a single piece of #304 (18-8) stainless sheet metal. A hydraulic press forms the can shape into a high powered magnetic form, drawing the stainless down across the iron sides of the mold. A few very fine particles of magnetized iron will adhere to the walls of the stainless when the magnetic form separates to remove the housing from the mold. These particles do not affect the final product in any way whatsoever and will gradually be cleaned away over time. A single piece deep drawn housing is always superior to a welded design, having no welds to alter the stainless formulation or seams to trap bacteria and contaminants.

Q: How long have AquaRain™ and Marathon® been in business?

A: AquaRain™ (originally AquaClear) was started in 1988, providing advanced water treatment systems designed to meet difficult treatment challenges in light commercial and residential environments. Development of the AquaRain™ Gravity Water Purifier began in February of 1998, when we explored methods of purifying water without the use of chemicals, pressure, or man-made energy. We shortly arrived at the conclusion that ceramics held the promise of meeting our design goals. AquaRain™ then began a worldwide search for the best ceramic filter element, ordering samples and comparing independent test data. Marathon® was selected as our manufacturer of choice in July of 1998, and we began working with them to develop the advanced ceramic filter element that is now used in the AquaRain™ Gravity Water Filter. With optimistic anticipation of a favorable outcome to current testing, we are looking forward to meeting our original design goal by attaining the

Testing Summary for Marathon® Ceramic Filter Cartridges

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:

Prinrose Hinton, B.Sc., Hons., M.Sc. and Jerry Orgerth, Ph.D., P.E., University of South Wales, Sydney, Australia

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

Summary:

"The MiniWorks 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." Friedten and Rose.

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

Testing Source:

Blovir Labs, CA

Summary:

The Marathon 205 siphon-feed cartridge 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), Fort Hueneue, California, USA

Summary:

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

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)

Testing Source:

Tests conducted for the U.S. Marine Corps by Jaime Naranjo, B.S., and Charles P. Genba, 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	>99,999% (6 log reduction)	99,99815% removal

Test conditions: Influent concentration of 10⁵ /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 Ogerth, Ph.D., P.E., University of South Wales, Sydney, Australia

Summary:

"The MSR MiniWorks 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 HMA (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:

In comparing test data, one should be alert to data that may not represent how the product will actually be used by the consumer throughout the entire life of the product, up to and including diminished performance at the end-of-life of the filter.

The following four criteria critically impact test results:

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

