AlwaysFresh®
Water the way you want it®

Microbiological Water Disinfection
Multi Barrier non chemical 4 log reduction system

Multi-Barrier Drinking Water Alternative Filtration & Primary Disinfection > 4 Log Reduction System

Log Reduction/Inactivation: This Multi Barrier System Package Design meets and exceeds the 4 Log (LRV) 99.99% disinfection requirements established by the EPA guidance manuals. Validated by third party to the UVDGM (US EPA's Ultraviolet Disinfection Guidance Manual)

Tested, Evaluated and Performance Verified for Public or Private Water Supply Systems

Home, Industry, Municipal & Commercial.

Flow Rates from 3 gpm to 480 GPM & higher.

Proudly Made in USA

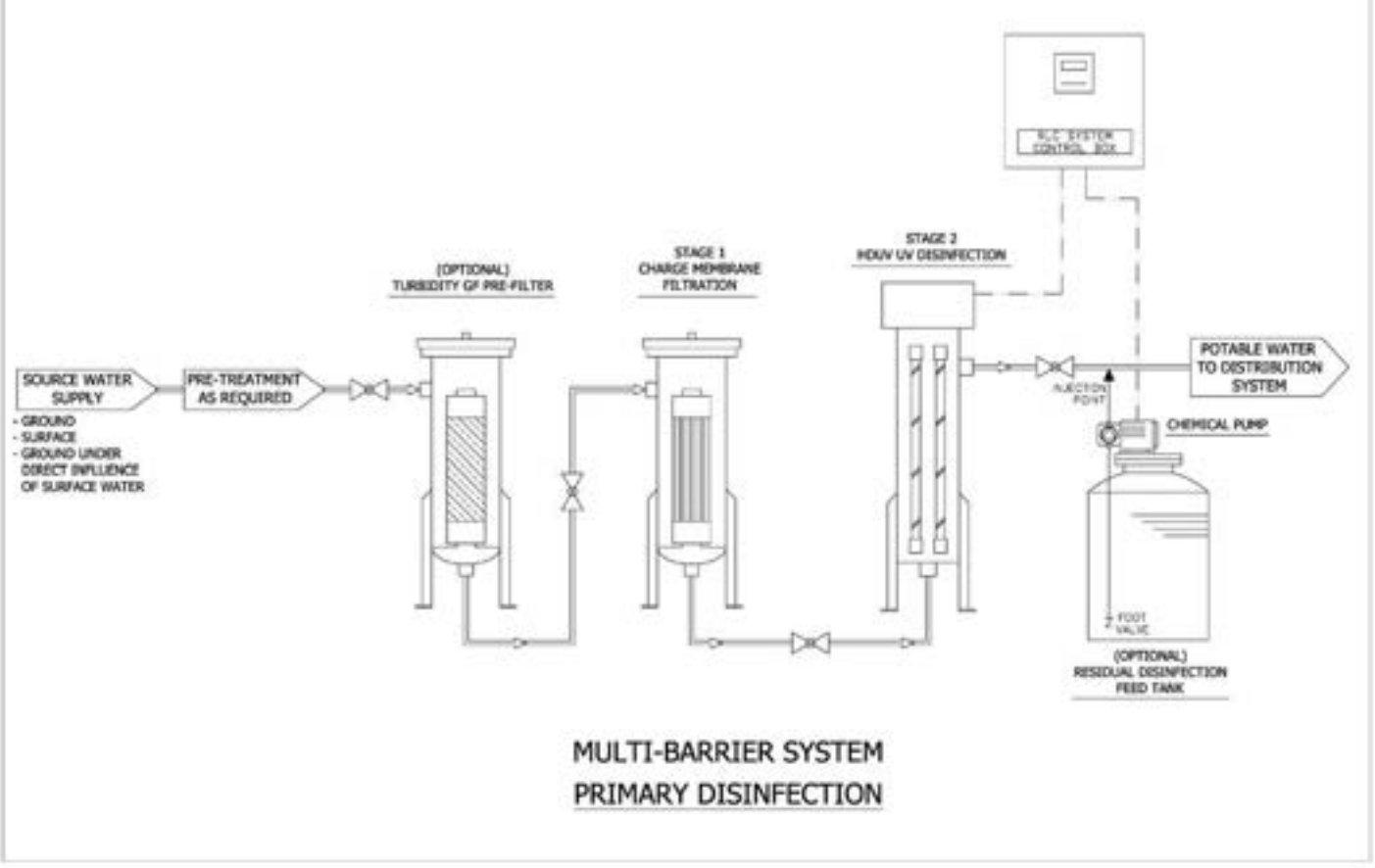
Current EPA and State Log Reduction Regulations

The Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) and Ground Water Rule (GWR), requires all public water treatment supplies to provide treatment that reliably achieves at least 99.99% or 4-log treatment of bacterial pathogens, cryptosporidium and virus (including Adenovirus) using: inactivation, removal or a State approved combination of 4-log inactivation and removal technologies providing a multi-barrier fail safe system. In Establishing drinking water regulations for microbial and disinfection by-product (M-DBP) control, the U.S. EPA is promoting a multi-barrier approach for treating drinking water.

A multi-barrier treatment process provides a number of protective barriers against contamination by using more than one method of prevention and treatment to remove or inactivate microorganisms and minimized disinfection by-products (DBP'S). Source: LT2EWSTR Toolbox Guidance Manual, April 2010.

Multi Barrier Approach - Public / Private Water Supplies - Primary Disinfection

Integrating a Particle Filter then a Charge membrane filtration system followed by High Dose Ultraviolet light (UV) system (see below) provides three barriers for particulate reduction, microbial log reduction, as well as filtration and inactivation of Cryptosporidium, Giardia, and Viruses.



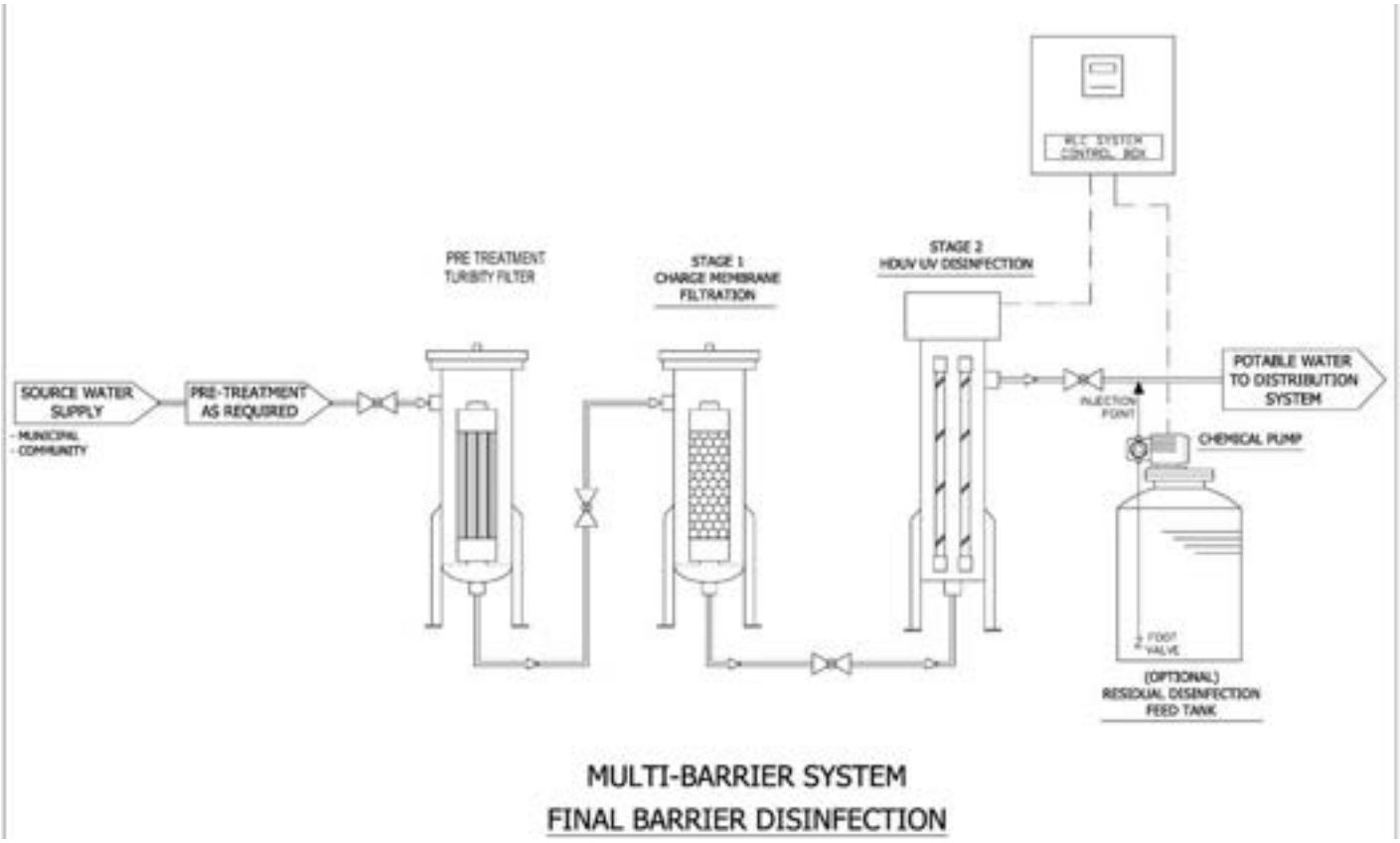
Multi Barrier Approach - Commercial / Industrial Water - On Site Disinfection

Emerging pathogens that can be resistant to current disinfection practices, aging infrastructures, water main leaks / breaks, waste water overflows, upsets to municipal disinfection processes, budgetary constraints, new drinking water regulations **c*ontinue to challenge public water districts.***

Statics show that 20% of disease outbreaks in the U.S. were associated with distribution system deficiencies! With an average age of ~200 years and expected life of 75-120 years the infrastructure in the U.S. continues to challenge water utilities to provide safe drinking water to the end user. Approximately 20% drinking water produced by water utilities never reach the end user. Point of Use / Point of Entry On-Site Disinfection solutions are quickly becoming the ***responsibility of the end user.***

Central treatment and distribution cannot guarantee 100% treatment efficiencies 100% of the time despite state of the art treatment technologies at the treatment plants.

End users, commercial and industrial companies are electing to install a water disinfection system for their public water supplies to provide a safeguard against these issues facing the public water supplies. Installation of ***On Site Disinfection*** will provide a Final Barrier of Protection of Microbiological Disinfection for their customers and products! This approach protects their customers, employees and brand.



AlwaysFresh®
Water the way you want it®

3 Stage Multi Barrier Solution

4 log reduction
Microbiological Water Disinfection
Fully Engineered Skid Systems
SKMB-3S-xxx-186KG
Flow rates 20-480 GPM per Skid

Multi-Barrier Disinfection Systems

- Powder Coated Skid - Fully Assembled for Easy Installation
- Pre-Plumbed - factory tested w/ isolation valves and test ports
- Stage 1 Pre Filter particles to reduce influent Turbidity <1 NTU
- Stage 2 CMF™ Charged Membrane Filtration
- Stage 3 High Dosage 186K mJ/cm2 UV
- Amalgam UV Validated lamps 12,000 hours
- Stainless Steel 304 Vessels, valves & interconnecting piping
- Monitor - Micro-Processor Electronic Controls
- Flow Rates from 20 to 480 GPM
- Performance: 3rd Party Tested & verified
- NSF standard 61 components
- Nema 4 type control panel
- See specifications for standard features / options

Stage 1 - Pre Filtration System - Turbidity Reduction

Absolute and Nominal 0.45, 1, & 5 micron options, Standard - 5 micron

Increases the LRV efficiency & life cycle of the Stage 1 CMF™ Charged Membrane by removing competing particles

PSID: initial <7 psi, max 35 psi.

Clean water backwash kit (auto or manual) optional

Stage 2 - CMF™ Charged Membrane Filtration - Microbial Retention Bacteria, Virus & Cryptosporidium

Log reduction of Bacteria, Virus, Adenovirus, Endotoxins and Protozoan Cysts thus contributing to the Total 4-Log Reduction of the Multi Barrier System. Provides high quality water (increased UVT -ultraviolet transmission) to Stage 3 UV Chamber for maximum UV disinfection efficiency!

Stage 3 - HDUV-186K™ high dosage ultraviolet chamber - Kills/Inactivates Bacteria, Virus & Cryptosporidium

HDUV Disinfection provides for inactivation / destruction of Bacteria, Virus, including Adenovirus, and Protozoan Cysts without producing M-DBP's . Our High dosage UV provides the 186 mJ/cm^2, at end of life, required to receive the full 4 LRV credits for Viruses. The result is Multi-Barrier Disinfection System which provides >4-Log Reduction. Validated to UVDGM

254 nm NIST Water Quality Monitor and Remote Logic Controller

Continually monitors all stages and alerts operator via alarms on site and remotely. Maintenance requirements, flow rate, water quality, UV transmission, voltage monitoring, and more. See Montior specifications for details. UV chamber includes a 254 nm NIST traceable sensor probe that continually monitors & displays UV transmission as indicator of feed water quality, in real time, during hydraulic conditions and provides alarm functions as required for most any application. This feature insures the system is performing to your needs and with the alarm features onsite & remote to provide the maintenance and/or operator personnel with immediate alerts.

AlwaysFresh®
Water the way you want it®

Multi Barrier Solution

4 log reduction
Microbiological Water Disinfection
Fully Engineered Wall or Floor Mounted System
3-15 GPM Flow Rate

Multi-Barrier Disinfection Systems

- Powder Coated Skid - Fully Assembled for Easy Installation
- Pre-Plumbed - factory tested 1" npt standard, optional sanitary flanges
- Optional Pre Filter (not required for low turbid waters)
- Stage 1 CMF™ Charged Membrane Filtration with exclusive oval end cap w/dual O-ring sealing
- Stage 2 High Dosage 186K mJ/cm2 UV
- Amalgam UV Validated lamps 12,000 hours (qty 2)
- Stainless Steel 304 vessels
- Sanitary Tri Clamps for quick cartridge maintenance
- 254 nm NIST Water Quality Monitor
- RLC built in remote logic controller
- Flow Rates 3-15 GPM
- Performance: 3rd Party Tested & verified
- NSF standard 61 components
- Nema 4 type control panel
- See specifications for standard features / options

Ideal Flow Rate for many of these applications:

- Food Service Establishments
- Industrial Process
- Residential Homes
- Marine
- Medical
- Rainwater collection
- and More

Custom Skid System Available
when post Chlorine feed system required.

Call for quotation -
multiple feed pump sizes to meet most any application.

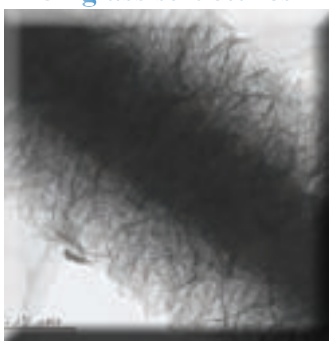
CMF™ Charged Membrane Filtration pleated electro-adsorptive technology

This pleated cartridge utilizes innovative media's for entrapment of Bacteria, Virus, Endotoxins and Cysts. The media uses mechanical filtration, and a Charged Membrane Filtration media. We convert the media into pleated cartridges of various lengths with flow rates from 3 to 40 gpm per cartridge. The material is pleated and integrally sealed using Sonic Welding technology of the side seams and end caps. Quality control systems ensures the cartridge integrity with non destructive performance testing. The exclusive dual O-ring cartridge is then housed in a stainless steel filter housing with a patented sealing design. Silver zeolite ions are added to the raw material during the production process for filter protection and all components are NSF Std 61 Compliant for material safety for drinking water applications . The water effluent from this treatment stage UVT% is continually monitored with the 254 nm NIST UV sensor housed within the UV Chamber.

agion® Nature's antimicrobial

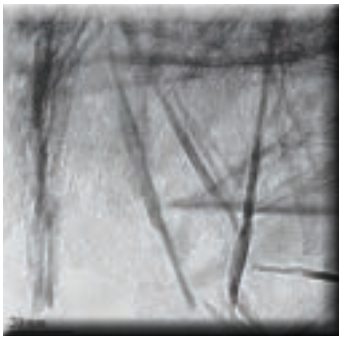
Media - An Inside Look

Alumina fibers on glass structures



- Aluma fibers are the mineral pseudoboehmite AlO(OH)
- One gram of fibers have a surface area of >500 m2
- Square meter of filter media has >42,000 square meters of surface area
- Zeta potential 51 millivolts at pH 7.2

Alumina Fibers Filtration & Adsorption characteristics



- Alumina fibers are 2 nm in diameter and approximately 250 nm in length
- Electrokinetic charge from the exposed Al+++ ion on the surface of the fibers
- Pore size distribution range 1-3 micron, mean 1.5 micron

Stage 1 & Stage 2 Features

- 304 Stainless Steel housing with 304 Stainless Steel cartridge core
- Temperatures up to 200 degree F
- Adjustable legs
- Exclusive Cartridge Patented Sealing Design
- Low Flux rate for maximum adsorption contact time
- Pressure Differential Gauge (inital <7 psid, end of life 35 psid)
- Pressure Relief Valve
- Swing Bolts for easy maintenance
- Quick Change Cartridge with built in lift handle
- Pre Plumbed at factory tested
- Isolation Valves
- Test Ports

Influent Water Quality Guidelines

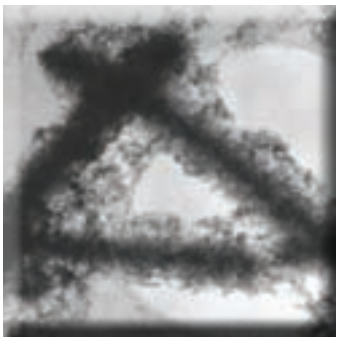
Maximum LRV Efficiency

This treatment stage requires pretreatment for particulates, color, iron, manganese & total organic carbon. Treatment must be installed upstream to maintain the life of the CMF cartridge. The CMF cartridge is a critical component of the Multi-Barrier System and is designed for microbial reduction. Influent Total Suspended Solids (TSS) must be kept to a minimum to prevent premature clogging of this sub micron filter.

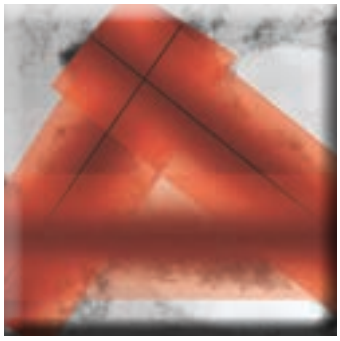
Capacity Retention of Bacteria, Virus & Cysts excced 1 Million organisms per gpm of design flow rate. When pretreatment guidelines are adherred to this will achieve maximum life of cartridge!

CMF™ Charged Membrane Filtration

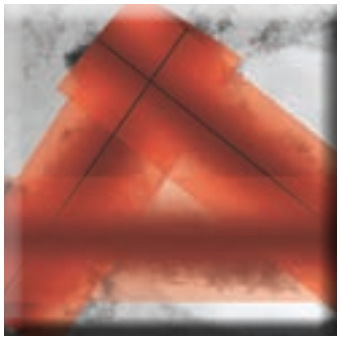
Mechanical Filtration + Electro positive charge field = Mechanical & Adsorptive Filtration



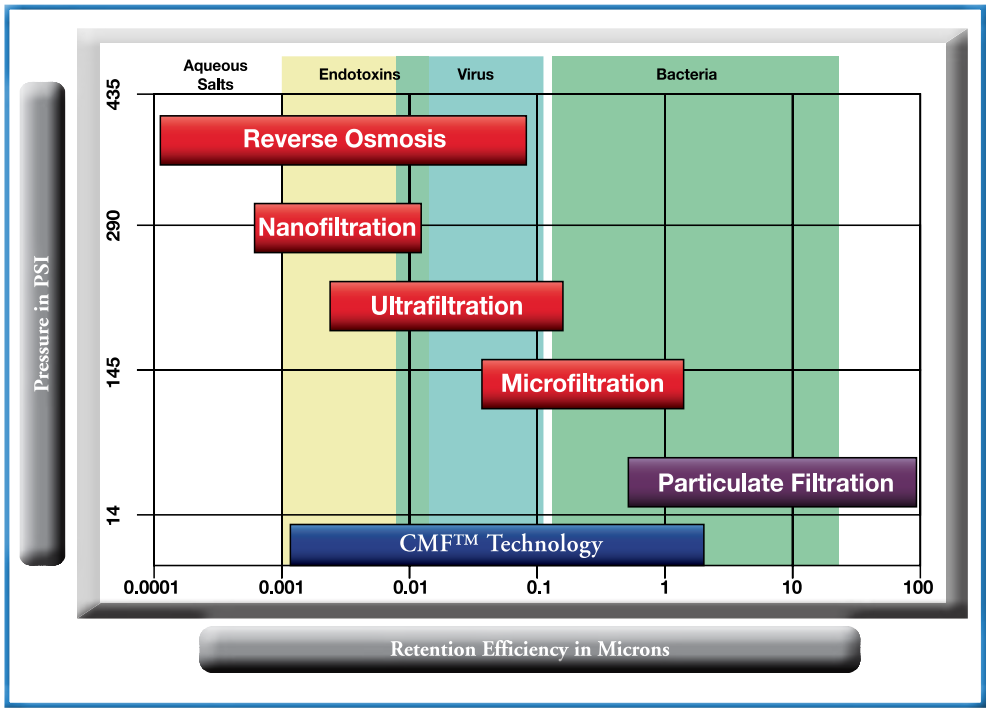
Three, 0.65 micron micro glass fibers coated with alumina fibers- forming a pore approximately 3 x 2 microns.



>51 millivolt Charge field extends up to 5 micron along the Alumina fibers in water and other polar solutions.



- The charge field creates a nearly total capture cross section of the entire pore volume.
- There are approximately 400 such layers in the 0.8 mm thick filter media.



Retention Efficiency vs other Membrane & Traditional Filtration

- Approaches Nano filtration with Significantly less Pressure required
- Outside / in flow pattern does not require drain
- Torturous flow pattern for full media utilization
- User Friendly
- Exclusive Patented sealing design!
- Simple cartridge replacement without tool
- System controller provides unmanned alarm and operational data

Operating Specifications

Pressure differential - Initial <7psid new cartridge, End of life 35 psid
Min/Max Pressure - 10 psi (.68 bar)-150 psi (10.3 bar), Max Temperature 200° F
Flow rate by cartridge in 5 gpm per 10" length

Note: Maximum flow rates for tested LRV microbiological reduction values
Mean Pore Size: 1.5 micron, range 1 - 3 micron
Zeta Potential 51 millivolts to achieve nearly total pore capture

Influent Water Quality Guidelines for Maximum Microbial LRV Efficiency.

Turbidity 1 NTU	TDS: <30g/L
TOC <10 mg/L	Iron: <0.3ppm
pH 5-9	Manganese: <0.05 ppm

Optional Turbidity Reduction Pre filter with 1 um high efficiency cartridge for NTU >1 is available for additional pre treatment and can be included on this engineered skid multi barrier system.

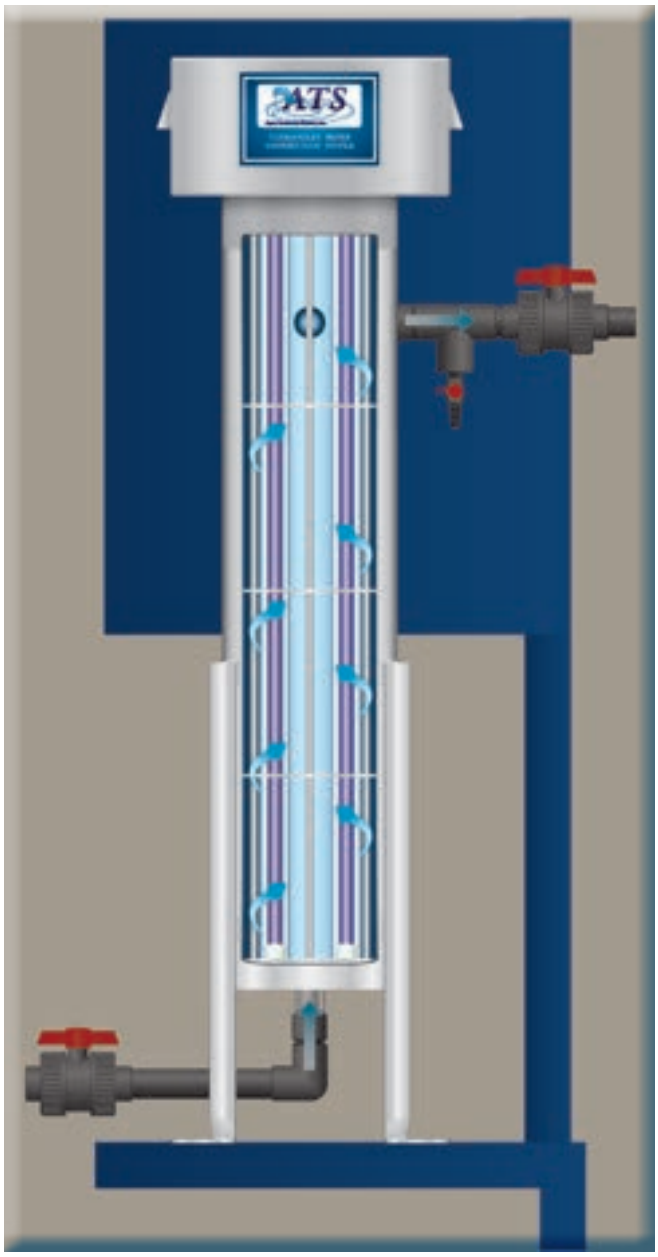
Stage 2: HDUV-186K™ Ultraviolet Disinfection System

Chamber Design:

Provides a minimum UV dose of 186,000uws/cm2 (186mJ) at rated flows and water quality transmission throughout the UV chamber at the End of Lamp Life (EOL).

Features

- 304 Stainless Steel or 316L Stainless Steel
- L – Flow Hydraulic Profile
- Vented UV Lamp Cover
- Internal Inlet Water Flow Diverter
- Internal Multi-Level Flow Balance Assembly
- Internal Multi-Level UV Lamp Quartz Sleeve Stabilizer
- Removable UV Lamp/Quartz Sleeve Service Rack Assembly
- Stainless Steel Adjustable Mounting Stand Assembly



Sensors

- 254NM Photo-Discrete, Calibrated and Documented NIST Traceable UV Sensor
- Hot Water Temperature Valve keeps chamber cooled during Low flow/ no flow conditions
- Temperature probe

Ultraviolet Lamps

- 254NM Wavelength for germicidal disinfection
- Validated UV Output @ 100 hours
- High Output Amalgam UV Lamps – Efficient, Low Power Consumption
- 12,000-Hour Lamp Life

Electrical

- Nema 4 Type S.S. Electrical Enclosure
- All Components are UL Certified
- 120 VAC/60Hz or 220-240VAC/50/60Hz (specify with order)
- Meets NECS (National Electric Code Standards)

Dosage Requirements -

Pathogens are inactivated/killed at different dosage levels with 254 nm Ultraviolet light. The chart below lists the log inactivation and dosage for cysts and virus. This system high dosage levels provides >4 LRV for most any pathogen currently known.

Table 1.4	UV Dose Requirements - millijoules per centimeter squared (mJ/cm2)							
	Log Inactivation							
Targeted Pathogen	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
Cryptosporidium	1.6	2.5	3.9	5.8	8.5	12.0	15.0	22.0
Giardia	1.5	2.1	3.0	5.2	7.7	11.0	15.0	22.0
Virus	29.0	58.0	79.0	100.0	121.0	143.0	163.0	186.0
Source: EPA UV Disinfection Guidance Manual for the Final LT2ESWTR								

Remote Logic Controller (RLC)

Microprocessor System Control Package.

Touch Pad LCD Display:

Integral to the NEMA 4 type 304 Stainless Steel enclosure.

Continually Self Monitors:

The Multi Barrier Stage 1 & 2 Cartridge System, Stage 3 UV Disinfection System as well as Operation, performance and maintenance requirements.

Nema 4 Type Electrical Enclosure:

Contains: Ballast, solid state circuitry and UV Monitor quick connection of system monitoring devices.

Monitor Display Key Features: Some non-operational without optional component installation.

Water Quality & UVMonitoring
- •Continuous monitor of (CMF) Effluent water quality
- • Ultraviolet Intensity readings from the UV Sensor Probe
- • UV System Ultraviolet Intensity total output
- • Display UVT Intensity (dose) & milli-watts of UV produced
- • Ultraviolet Low Level Alarm
- • UV Lamp Watts

Water Temperature
- • Water Temperature inside the UV Chamber at the UV Sensor Probe
- • Overheat Safety Control

Flow & Pressure Monitoring
- • Flow Meter GPM
- • Flow Meter Number of Gallons Totalizer
- • Pressure differential for Stage 1 & Stage 2 filtration

Electrical
- • Ballast Operation for UV Lamps
- • Detect and register incoming line voltage
- • Power On/Off Status
- • Ultraviolet Lamp Type

Alarms
- • Alarm Silence function
- • Pressure Differential Alarm for Stage 1 filtration
- • Onsite and Remote communication options
- • Ultraviolet Lamp failure
- • Low UVT% (70%)
- • History

Maintenance / History
- • Elapsed total Hours of System Operation use
- • Countdown Number of Hours on UV Lamps
- • Provide Technician Module with Operation Alarm History

Optional Equipment Management
- • Auxiliary Contacts for Alarms
- • Auxiliary Contacts to operate adjoining systems (such as post chlorination, if required.)
- • Solenoid valve downstream shutoff operation
- • Remote PLC Monitoring connections

Patent Pending.

NTU vs Particle Size Distribution

NTU is measurement of Turbidity which is a estimate of particles in water supply determined by light scattering technology and not the type or size of the particles. Color in the water will blind the meter! TSS or Total Suspended Solids in the water is a superior indicator of filter life. The lower the number the longer the life of these cartridges. LRV capacity is based upon TSS levels of <1ppm.

Particle Size Distribution Analysis (PSDA): This test is recommended and will determine the size and distribution by micron size. It will allow us to determine if the pre treatment upstream or the Option Turbidity Filter for this system is sufficient to provide the maximum LRV efficency and life cycle of the CMF Filtration System. Call for details

Estimated Organism Capacities: Even though life cycle testing has shown the organism capacity to be in excess of 1million organisms per square foot ofmedia, we recommend changing these cartridges at least annually for maximum efficency of microbial reductions or when the pressure differential >=35 psi!

InfluentWater Quality Guidelines: The CMF Charged Membrane Filtration cartridge design(s) application is for Microbial LRV reduction. For the best cartridge performance and life cycle time pretreatment is recommended to eliminate competing contaminants. Dirt, TOC, TSS, Color (NOM) tannic, fulvic, & humic acids) or irons will create pressure differential resulting in shorter cartridge life and/or lower UVT%.

Pretreatment Guidelines (influent feed water to CMF Filter for Optimum Microbial LRV

- Turbidity <1 NTU
- TOC <10mg/L
- pH 5-9
- TSS <1 ppm
- Iron <.03 ppm
- Manganese 0.05 ppm
- TDS 30g/L

Pretreatment Guidelines (influent feed water of UV System)

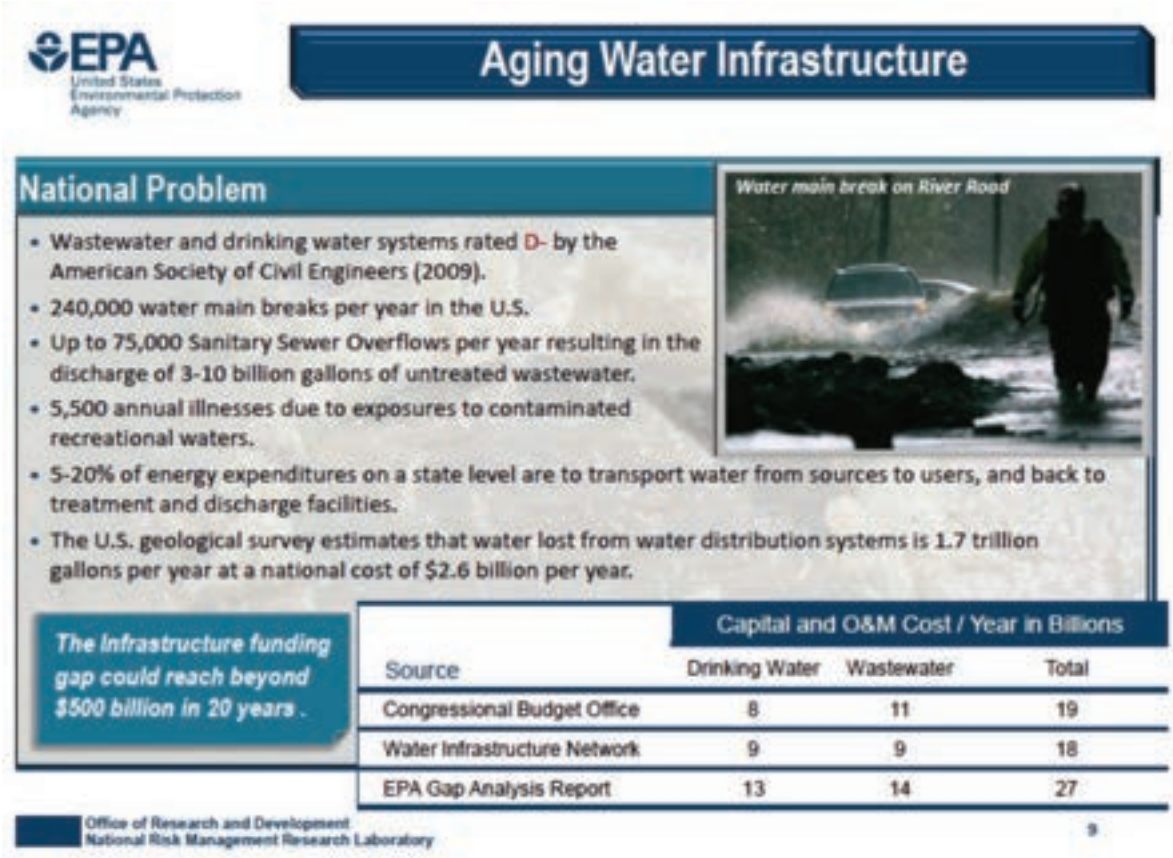
Color: <10 Pt-Co

Measured by Platinum-Cobalt color units (Pt-Co)can be caused by particles, algae, acids (tannic, humic, fulvic), etc. Our GF and CMF filtration design will reduce color units but depending on its source can reduce cartridge(s) life cycle.

Hardness: <7 gpg or (120 ppm) $CACO_3$

Hardness minerals can scale the quartz sleeves resulting in low UVT% . >7 grains or 120 ppm will result in higher maintenance of quartz sleeves. Monitor system will alarm when UVT% <70%.

Caution: UVT potable meters measure UVT% in static conditions, The Water Quality Monitoring system measures the actual UVT dose under hydraulic operating conditions.



Infrastructure leaks can introduce contaminants in the distribution lines & which go undetected for years before the lines finally burst and repaired are completed.

Leaks & Repairs are always after the fact and installing disinfection protection for your home or business is a great preventative measure for a final barrier of protection.

Wastewater overflows, faulty septic systems, and waste water spills, cross connections all can introduce enteric viruses into our water supplies which disrupts the disinfection process.

Bio film and organic loads within water lines and dead end distribution water mains are all enemies to the infrastructure and the public water suppliers to provide potable water 100% of the time by increasing free chlorine demand.

Enteric viruses can live extended periods of time and is a major cause of water borne disease in the USA and around the world.

Centralized treatment protects public health, however once the water leaves the water plant these infrastructure & environmental challenges can result in re-contamination.

These Microbiological Disinfection issues facing our drinking water infrastructure can result in loss revenues. Installation of a Multi Barrier Disinfection System at your home or business will provide a final barrier of protection.

Protect your customers, employees and product brand and consider using a Multi-Barrier Disinfection System for all critical areas in your facility.

Applications

Private Water
-Wells
-Cisterns
-Lakes & Ponds

Industrial
-Laboratories
-Bio Tech
-Pharmaceutical
-DI Water
-Ingredient / Process Water

Rain Water Collection
-Drinking Water
-Gray Water

Commercial & Food Service
-Restaurants
-Coffee Shops
-Convenient Stores
-Grocery Stores
-Bottled Water Plants

Applications

Public Water Supplies (as defined by USEPA)
-Municipal
-Community
-Transient (rest stops, RV parks, Camp grounds, etc)
-Non Transient (schools , churches, business, etc)

Industrial & Farming Process
-Food & Beverage
-Beer & Wine
-Aqua Culture
-Poultry/Diary/Swine

On Site Disinfection of Potable Water
Point of Entry/Point of Use:

Providing Final Water Disinfection Barrier
for Drinking/cooking ,Bathing/showers

Markets Typical
-Day Care Centers/Assisted Living
-Schools and Universities
-Home/Office/Business

Homeland Security: Micro Biological Issues
-Government Offices
-Fire and Police Stations
-Potable Water Stations

Natural Disasters

Floods/Hurricanes/Earthquakes

Drinking Water Dispensing Stations

Multi-Barrier
Third Party Independent
Performance Tested & Verified

Accredited Independent 3rd Party Test Facility.

The USEPA Test and Evaluation Facility in Cincinnati, OH.
Performed by: Shaw Environmental and Infrastructure, Cincinnati, OH.
With analysis and results of Adenovirus by: The USEPA National Exposure Research Laboratory (NERL) Cincinnati, OH.

Challenge Organisms: Three live organisms were selected for testing the Multi-Barrier System Log Reduction Value (LRV) and performance. MS2 Bacteriophage, Cryptosporidium oocysts and Adenovirus.

Log Reduction/Inactivation: This Multi Barrier System Package Design meets the 4 Log (LRV) 99.99% as tested and evaluated by the Test results using the MS2 bacteriophage, Adenovirus and Cryptosporidium for GWR & LT2 ESWTR USEPA regulations. Validated to US EPA UVDGM guidance manual.

See data sheets and test reports for performance details.

The GWR: (Ground Water Rule) allows States to approve and set compliance monitoring and performance parameters for any alternate treatment, including UV light or UV light in combination with another treatment technology, which will ensure that systems continuously meet the 4-log virus treatment requirements. Source: epa.gov. Ground water that fails the monitoring test must provide corrective action which includes installation of a disinfection systems which achieves 4 LRV of virus and microrganisms.

LT2ESWTR: (The Long Term 2 Enhanced Surface Water Treatment Rule) requires all public water supplies that use surface water or ground water under influence of surface water to provide treatment that reliably achieves at least 99.99% or 4-log treatment of bacterial pathogens, cryptosporidium and virus using: Inactivation, removal or a State approved combination of 4-log or higher inactivation and removal technologies providing a multi-barrier fail safe system.

Testing Protocol: ***EPA Federal Guidance Manuals . Analilical results of Testing available for Stage 1 and Stage 2 as components as well as the Multi-Barrier System.***

Performance Evaluation of Waterline Technology's Charged Membrane Filter (CMF) and Aqua Treatment Service's (ATS) 186K Ultra-Violet (UV) Drinking Water Treatment System for Removal/Inactivation of Microbial Contaminants

Final Report

U.S. Environmental Protection Agency
Contract No. EP-C-11-006
Work Assignment No. 3-46, Task 4
Pegasus Project No. 500003

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July 21, 2015

AlwaysFresh®
Water the way you want it®

Microbiological Water Disinfection

Multi Barrier 4 log reduction system

Sales, Service, Engineering & Application Support

Support is available from the initial design phase through installation and start up.
Full engineering project specifications, submittals, and drawing packages.
Contact us for assistance in model selection, standard features and design options.

Service and technical training certification is provided and required by all of our distributors.

Ask about our VOC Multi Barrier Reduction Systems

Regional Distribution Center

Designed and Manufactured in U.S.A. through a collaborative effort by:

Waterline Technology®
961 N. Main St., Mansfield, OH 44903
E-mail: sales@waterlinetechnology.com
Website: www.waterlinetechnology.com
Phone: 419-529-3949
Fax: 419-529-8484

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