

Disruptor™ 5293 PAC-S Filtration Media

December 2020

More about the technology and its performance.

Document content Guide

1. What is Disruptor™ 5293 PAC-S Technology?

- | | | |
|----|---|------|
| a. | What makes the Disruptor™ Filter Different? | Pg 3 |
| b. | Additional benefits | Pg 3 |
| c. | How does it work? | Pg 3 |
| d. | Disruptor™ under the microscope | Pg 4 |
| e. | Disruptor™ technology compared | Pg 4 |
| f. | Certification | Pg 5 |

2. Disruptor Media Test Reports

- | | | |
|----|---|----------|
| a. | Bacteria, Virys and Cysts | Pg 6-7 |
| b. | E Coli | Pg 8 |
| c. | Endotoxins | Pg 9 |
| d. | Chlorine | Pg 10 |
| e. | Lead | Pg 11 |
| f. | Emerging Contaminants/Trace Pharmaceuticals | Pg 12-14 |

What is Disruptor™ 5293 PAC-S?

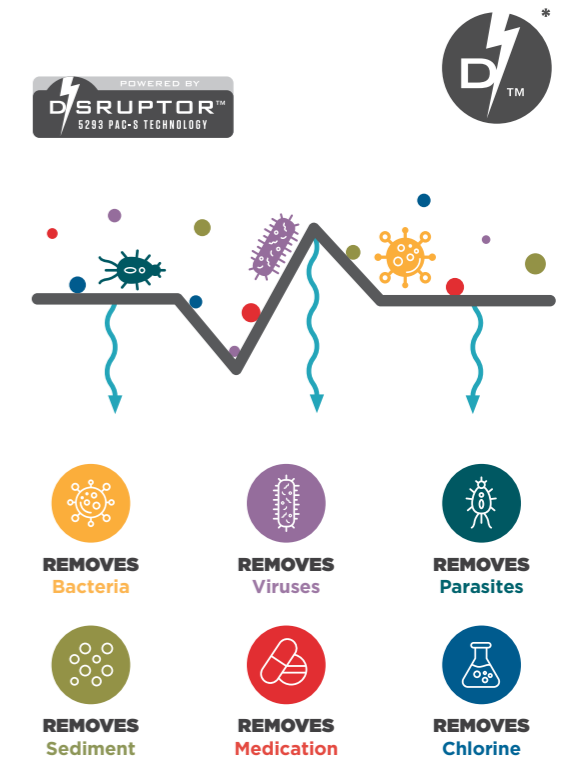
Disruptor™ is a breakthrough technology for the more demanding water purification needs that is not directly comparable to any other water purification media currently in the market.

What makes the Disruptor™ filter different?

- **Electroadsorption** traps and removes viruses, bacteria and various other contaminants
- **Anti-microbial silver** disinfects
- **Powdered Activated Carbon** reduces odours and improves the taste

Additional benefits:

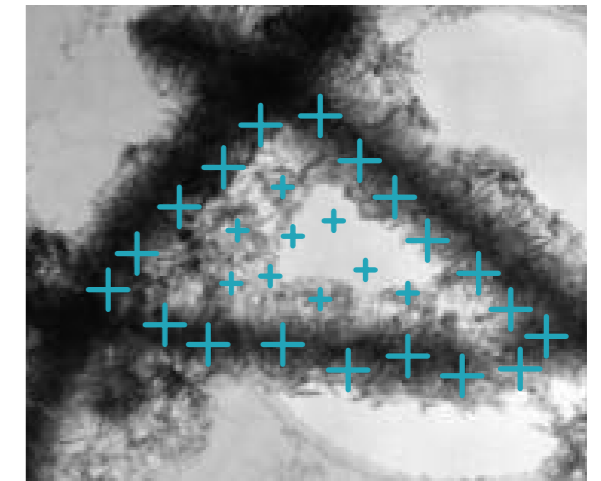
- **Energy savings and sustainability.**
It offers very high flow rates at lower pressure drops compared to competing technologies with similar biological removal performance.
- **Maintains water integrity.**
It effectively removes the pathogens and other contaminants whilst maintaining the minerals for taste.
- **No wastage whilst filtering.**
As part of the filtration process, no water is wasted when using the Disruptor filter.



How does it work?

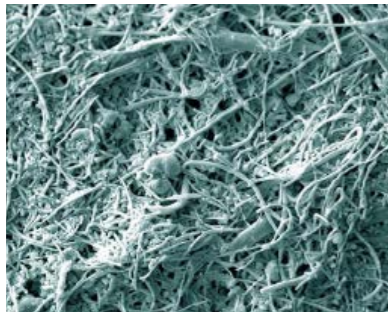
A positive electrical charge is created once water flows through the filter which attracts the negative charge present on most submicron contaminants. Due to the structure of the media, this charge causes the fibers to further overlap into the fibre pore structure.

The Disruptor™ is an electro-positive, wet-laid nonwoven media with a pore size of 1.2 to 1.5 microns. What makes this media unlike any other on the market is that despite the fact that it captures very small diameter substances and pathogens, it also remove larger particles mechanically.

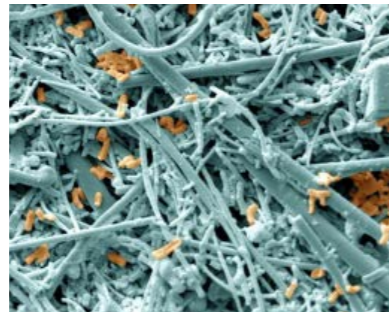


Disruptor™ under the microscope

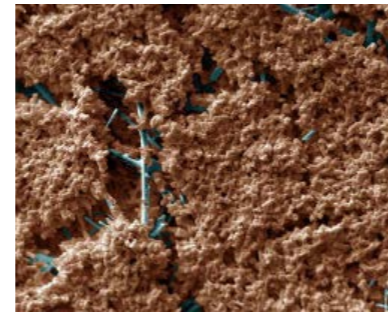
- The Disruptor™ technology removes hundreds of billions of pathogens per m² at 99.9999% efficiency:



1. No filtration/upstream side



2. 1 hour of filtration/upstream side



3. 8 hours of filtration/upstream side

Disruptor™ 5293 PAC-S Technology Compared

| Major contaminants | Disruptor™ 5293 PAC-S | Reverse Osmosis | Nano-filtration | Ultra-filtration | Micro-filtration | Particulate Cartridges | Carbon Block | Ultra Violet |
|--|-----------------------|-----------------|-----------------|------------------|------------------|------------------------|--------------|--------------|
| Dissolved Solids (calcium, magnesium, sodium etc). | | ✓ | | | | | | |
| Endotoxin | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| Viruses | ✓ | ✓ | ✓ | | | | | ✓ |
| Bacteria | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Cysts + parasites | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Polysaccharides (TEP) | ✓ | ✓ | ✓ | ✓ | ✓ | | | |
| Colloids | ✓ | ✓ | ✓ | ✓ | | | | |
| Particulates | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| Chemical reduction | ✓ | ✓ | | | | | ✓ | ✓ |
| Trace pharmaceuticals | ✓ | ✓ | | | | | ✓ | ✓ |

Did you know?

The initial development stages of the Disruptor technology is linked to NASA. In 2000 a small business innovation research (SBIR) contract was awarded by NASA's Johnson Space Center. In 2002 it started out as a Disruptor based NanoCeram filter which was introduced into Space Foundation's Space Technology Hall of Fame in 2005, and in 2006 it was exclusively licensed to Ahlstrom Munksjo.

Certification

- ISO**
9001, 14001, 45001 and Forestry for:
Total production, management, environment, quality and safety systems.



- NSF 42**
NSF follows the American National Standard Institute (ANSI) standards development process. NSF Standard 42 is a certification that is concerned with improving drinking water by reducing specific aesthetic or non-health-related contaminants that may be in the water. This certification applies to drinking water filtration.

Product listing per NSF 42



OFFICIAL LISTING

NSF certifies that the products appearing on this Listing conform to the requirements of
NSF/ANSI 42 - Drinking Water Treatment Units - Aesthetic Effects

This is the Official Listing recorded on November 2, 2018.

Ahlstrom Filtration LLC
122 West Butler Street
Mount Holly Springs, PA 17065
717 486-3438

Facility: Mount Holly Springs, PA

COMPONENTS: Filter Media ^[1]

| | | | | |
|-------------|------------|------------|------------|-------------|
| Grade 4616 | Grade 5281 | Grade 5282 | Grade 5283 | Grade 5283A |
| Grade 5283N | Grade 5284 | Grade 5287 | Grade 5288 | Grade 5289 |
| Grade 5293 | Grade 5294 | Grade 5297 | Grade 5298 | Grade 5299 |
| Grade 5300 | Grade 5301 | Grade 5302 | Grade 5303 | |

DISRUPTOR™ MEDIA TEST REPORTS

Bacteria, Virus and Cysts

| | |
|--------------------------|---|
| Test conducted by | Ahlstrom Munksjö* |
| Test conditions | Water contaminated with: - Bacteria (Raoultella Terrigena) influent* concentration of 10 ⁵ or 10 ⁶ per ml - Virus (MS2 Bacteriophage) influent concentration of 10 ⁵ or 10 ⁶ per ml - Cyst (3 micron bead surrogate) influent concentration of 10 ⁵ or 10 ⁶ per ml |

Virus vs Bacteria

Viruses are the smallest form of micro-organisms capable of causing disease, particularly those of a fecal origin infectious to humans by waterborne transmission. Bacteria are typically single-celled micro-organisms that can also cause health problems in humans, animals or plants.

Bacteria and Virus - 3rd Party Testing

| | |
|--------------------------|--|
| Test conducted by | Biological Consulting Services |
| Sample used | Flat sheet with a surface area of 63.6 cm ² |
| Test conditions | The water was contaminated with: - Bacteria (Raoultella Terrigena): influent concentration of 10 ⁵ - Virus (MS2 Bacteriophage): influent concentration of 10 ⁵ |

Example of COA* for Disruptor 5293



Quality Control Report by Reel

Page 2 09/17/2018 13:27
 Warehouse MT. HOLLY SPRINGS Load Nr. 29223 Load Pos. 1 Ahlstrom Run Nr.
 Order Nr. 2018251470 Order Lot 3 Order Pos. 1 Cust. Order 4500222354 Date of Manufacture 09/14/2018 - 09/16/2018
 Customer AH22221948 KEMFLO (NANJING) ENVIRONMENTAL Grade MHLA5293 Product 5293 952.5 MM X 400 METERS
 C.ProdName C.ProdCode Width 952.5 mm Weight 318.6 g/m² Color I

| | BACTERIA PERCENT | BOND W GRAMS/IN | WEIGHT OSY | CHLORINE PPM | CYST PERCENT | WEIGHT GSM | THICK MICRONS | VIRUS PERCENT | BOND F GRAMS/IN | FRAZIER CFM | THICK MIL |
|------------|------------------|-----------------|------------|--------------|--------------|------------|---------------|---------------|-----------------|-------------|-----------|
| 203354/006 | 99.9999 | 82 | 9.48 | 0.23 | 99.9993 | 321.3 | 983.3 | 99.9996 | 84 | 5.6 | 38.7 |
| 203354/007 | 99.9999 | 99 | 9.29 | 0.23 | 99.9993 | 315.0 | 1006.7 | 99.9974 | 94 | 5.5 | 39.6 |
| 203354/008 | 99.9999 | 82 | 9.43 | 0.17 | 99.9993 | 319.7 | 986.7 | 99.9996 | 99 | 5.4 | 38.8 |
| 203354/009 | 99.9999 | 95 | 9.35 | 0.17 | 99.9993 | 317.0 | 1006.7 | 99.9999 | 84 | 5.6 | 39.6 |
| 203354/010 | 99.9999 | 94 | 9.44 | 0.12 | 99.9993 | 320.0 | 1006.7 | 99.9999 | 75 | 5.5 | 39.6 |
| 203354/011 | 99.9999 | 93 | 9.51 | 0.12 | 99.9994 | 322.3 | 1010.0 | 99.9997 | 85 | 5.3 | 39.8 |
| 203354/012 | 99.9999 | 110 | 9.52 | 0.12 | 99.9994 | 322.7 | 996.7 | 99.9959 | 97 | 5.3 | 39.2 |

Bacteria Removal % Cyst Removal % Virus Removal %

| Tambours: Rolls | | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 203350/001: 532000034940 | 203350/003: 532000034942 | 203350/005: 532000034944 | 203350/007: 532000034946 | 203350/009: 532000034948 |
| 203350/011: 532000034950 | 203350/013: 532000034952 | 203350/015: 532000034954 | 203350/017: 532000034956 | 203350/019: 532000034958 |
| 203350/021: 532000034960 | 203350/023: 532000034962 | 203354/002: 532000034965 | 203354/003: 532000034966 | 203354/005: 532000034968 |
| 203354/007: 532000034970 | 203354/009: 532000034972 | 203354/011: 532000034974 | | |

THIS COMPONENT IS CERTIFIED FOR MATERIAL SAFETY
 REFER TO WQA'S WEBSITE AT WWW.WQA.ORG FOR SPECIFIC FIELD USE INSTRUCTIONS

THIS IS TO CERTIFY THAT THE MATERIAL IN THIS SHIPMENT MEETS THE AHLSTROM SPECIFICATION FOR THIS PRODUCT

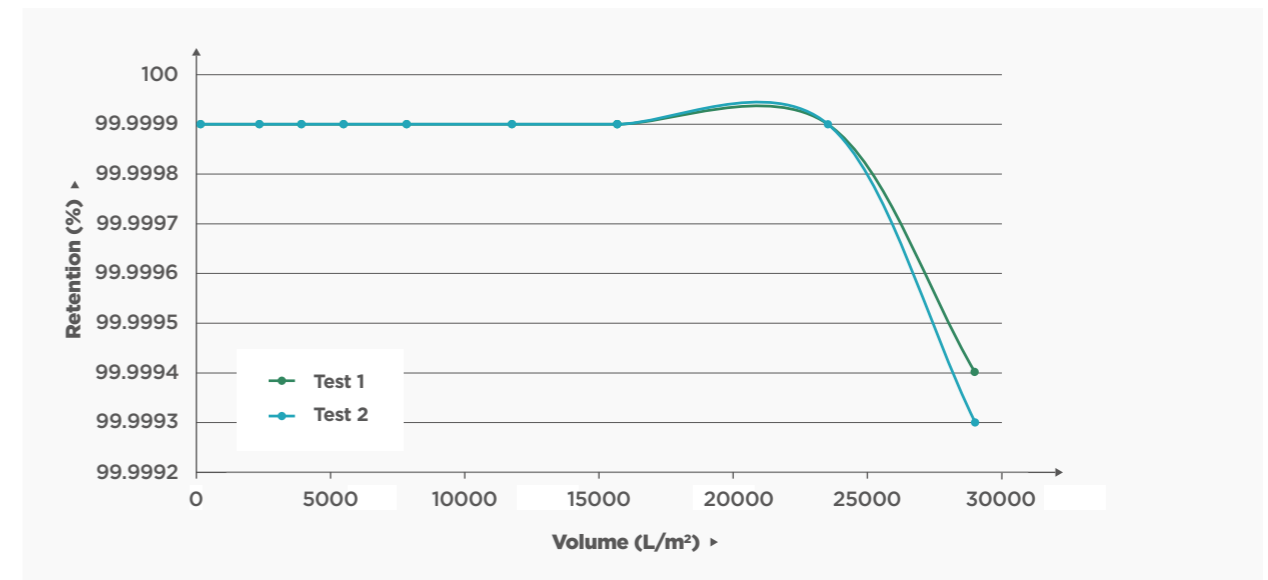
9-17-2018
 SIGNATURE DATE

Ahlstrom Filtration, LLC (Advanced Filtration) Maintains the Following Certifications:
 ISO 9001 and ISO 14001 (Mt Holly Site Only)

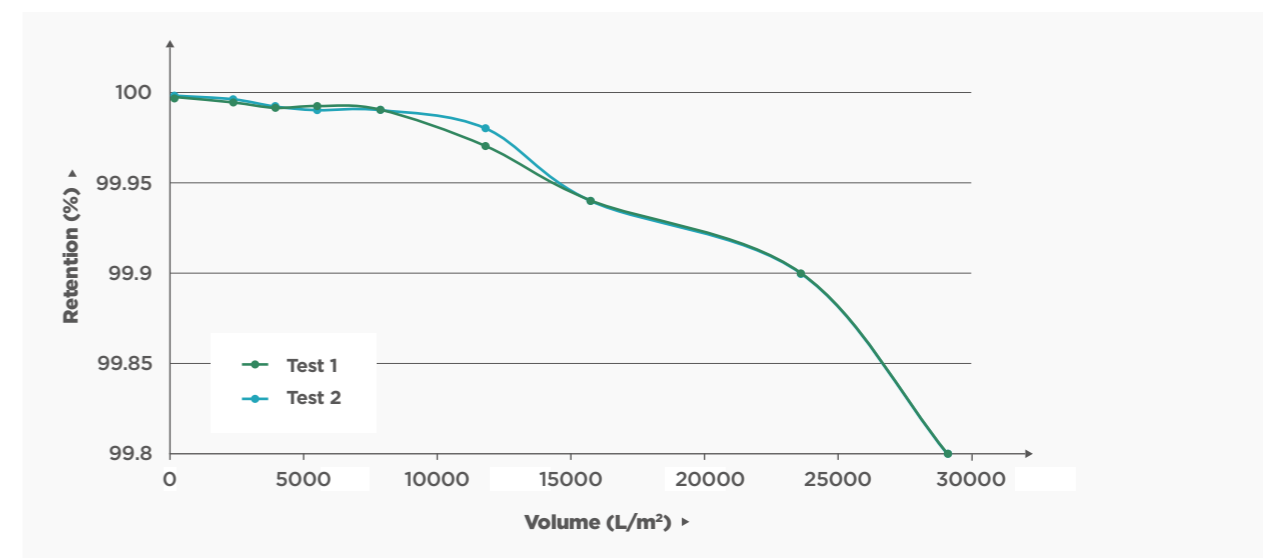
Glossary

- * **COA:** Certificate of Analysis.
- * **Influent:** Water that flows in, usually the raw, untreated water.
- * **Ahlstrom Munksjö:** A multi-billion dollar, globally recognised company that is currently one of the world's leading players in sustainable and innovative fiber solutions.

Bacteria Retention



Virus Retention



E Coli Capacity

| | |
|--------------------------|---|
| Test conducted by | Ahlstrom Munksjö |
| Flow rate | 40 liters/m2/min |
| Test conditions | <ul style="list-style-type: none"> - Water: Ringer - Bacteria - E Coli - Internal Protocol used: TM 140 - Temperature 22°C ± 1°C - pH 7.75 ± 0.25 - Soaking: few seconds with DI water* - Analysis: ATP metry* |

What is E Coli?

A bacteria that is commonly found in the lower intestine of warm-blooded organisms. Most strains are harmless, but some can cause serious food poisoning and may lead to a life-threatening disease especially in cases of young children and older people.

Endotoxin or Lipopolysaccharide (LPS)

| | |
|--------------------------------|---|
| Case study conducted by | Ahlstrom Munksjö |
| Findings | <p>By the end of the study each of the discs had been challenged with 3.85 x 10⁶ EU. The Disruptor range removed a higher percentage of endotoxin than Millipore MF filters.</p> <p>Despite the MF filters having a smaller pore size, the Disruptor removed more endotoxins. This shows that the charge is more effective in retaining endotoxins than the pore size.</p> |

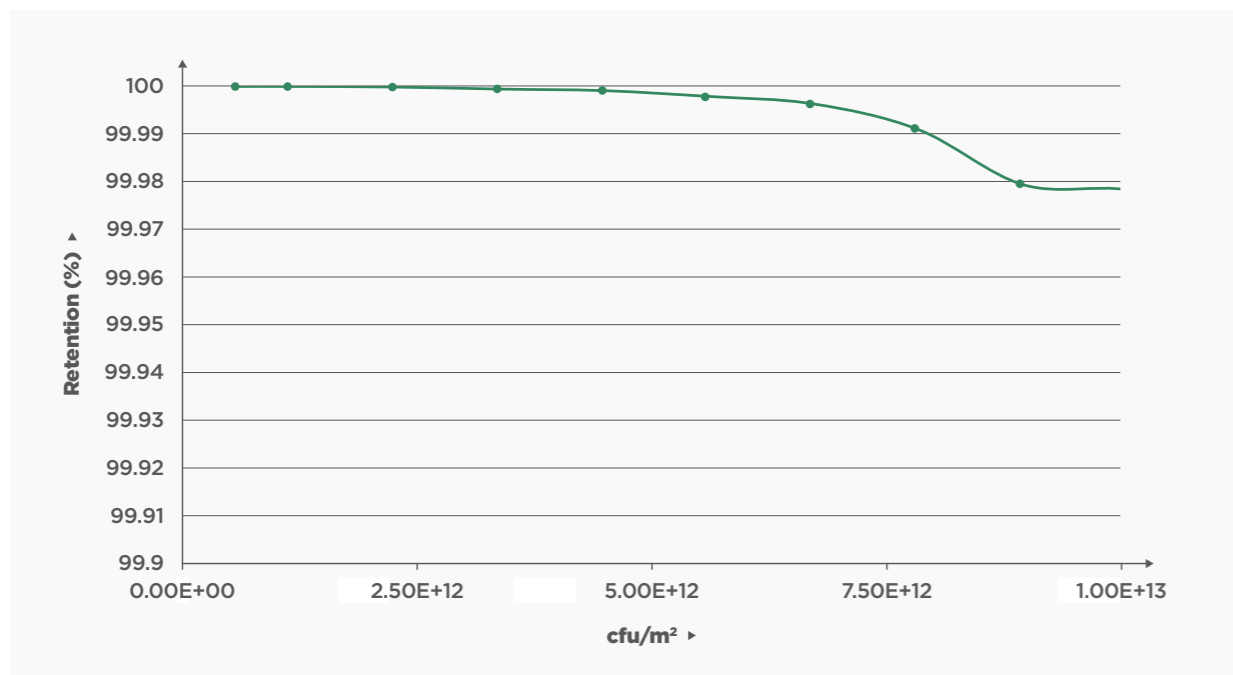
What are Endotoxins?

They are large molecules found in the outer membrane of gram-negative bacteria that can cause severe immune responses in people such as:

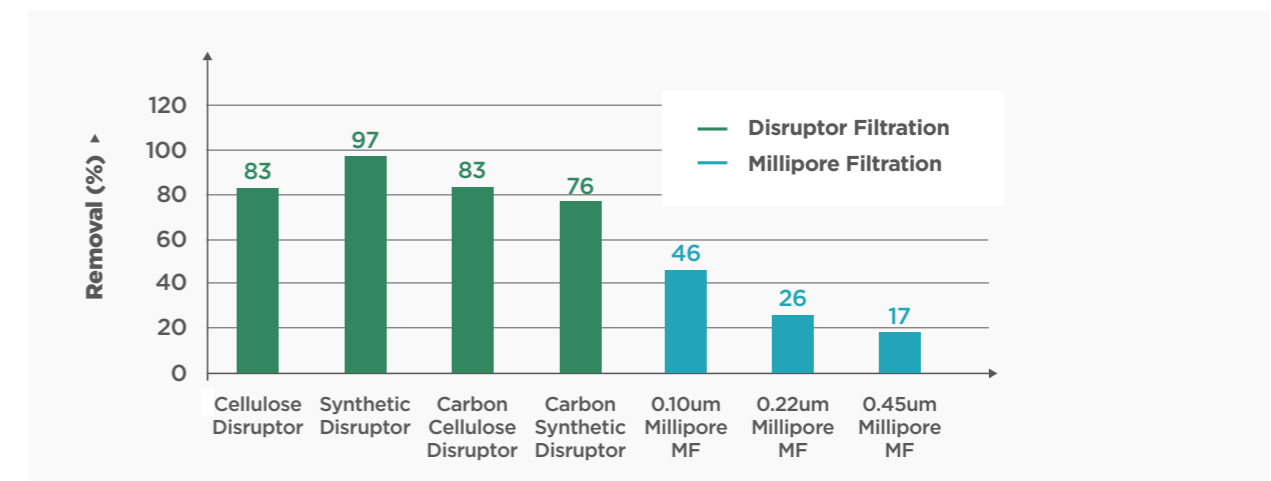
- Elevated temperature
- Increased respiration
- Decreased blood pressure
- Endotoxin shocks (this can be fatal)

Note: the case study was done with lower grade disruptor medias than the 5293 PAC-S used in JoJo's Filtration range, but has been included to showcase the performance capabilities of the filter media.


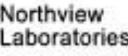
E Coli Retention



Endotoxin Retention - Case Study



Endotoxin Retention - 3rd Party Test Results

CERTIFICATE OF ANALYSIS

| Client: HEATHER MOWERS AHLSTROM FILTRATION LLC 122 WEST BUTLER ST MOUNT HOLLY SPRINGS PA 17065 | | Assignment No.: 09A0800341 PO No.: 4500426032 Page: 1 of 1 | | | | | | |
|---|--------------------|---|-----------------|------------------|-------------|--------------------------|-----------------|--------|
| Product Tested: Misc. Product Date Received: 11-Jan-2008 | | | | | | | | |
| Test/Method: BET Kinetic- Medical Devices, USP <85> Specification: Sample Endotoxin Less Than Limit | | | | | | | | |
| LAL Kinetic Method: Chromogenic Endotoxin Limit: 0.50 EU/mL Extraction Method: Immersion | | | | | | | | |
| Sample No. | Sample Description | Number of Samples | Test Extraction | Extract Dilution | Result | Positive Product Control | PPC Limit Check | Status |
| 09S08001586* | Heat Seal 9830 | 1 | 75 mL | 1:10 | <0.05 EU/mL | 83.6 % | VALID | Pass |
| Evaluation | | | | | | | | |
| *09S08001586 This sample passes the test for bacterial endotoxins at 1/10 of the client specified endotoxin limit. Validation (Inhibitor/Enhancement Testing) declined by client. | | | | | | | | |

Glossary

- **ATP Metry:** A molecular biology technique, based on the principle of bioluminescence, which allows measuring a quantity of ATP in a sample.
- **DI water:** De-ionized water.
- **cfu:** A colony-forming unit (CFU or cfu) is a measure of viable bacterial or fungal cells. CFU measures only viable cells. For convenience the results are given as CFU/mL (colony-forming units per milliliter) for liquids, and CFU/g (colony-forming units per gram) for solids.

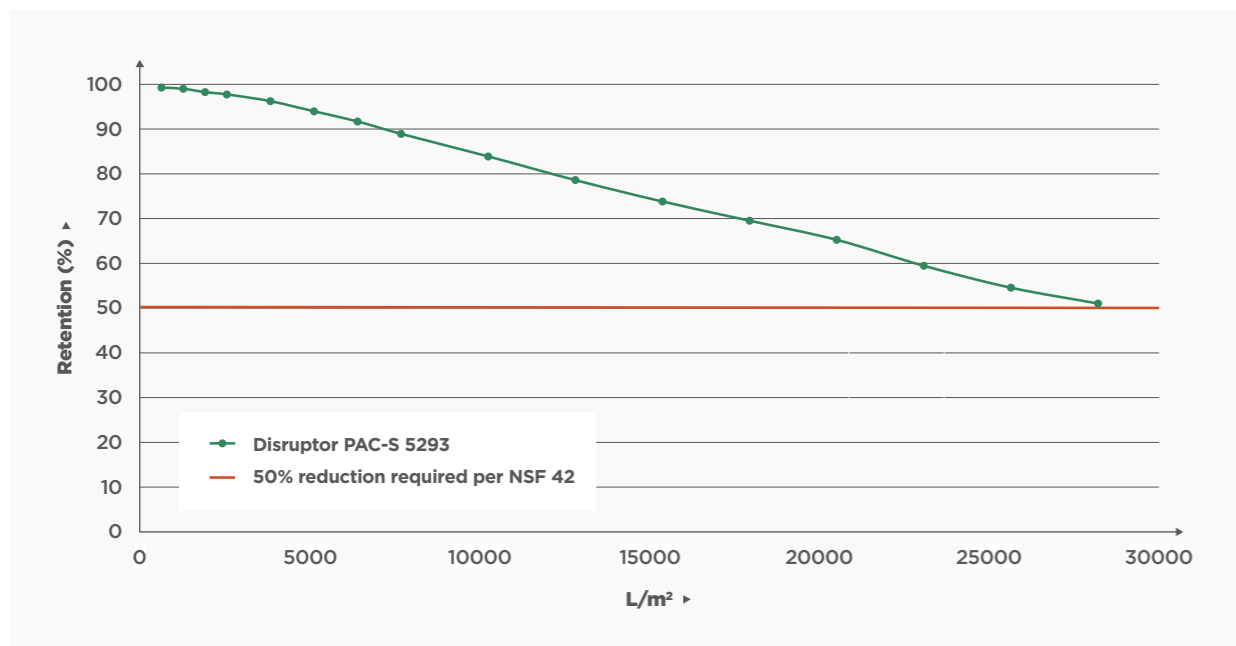
Chlorine

| | |
|--------------------------|--|
| Test conducted by | Ahlstrom Munksjö |
| Sample used | Flat sheet with a surface area of 3.9 cm ² |
| Flow rate | 15.9 ml/min |
| Test conditions | Tap water from Pont Eveque-PEV: - Temperature 20 °C - TDS* 310 mg/L - pH 7.4 - Chlorine initial concentration of 2 ppm* - Concentration range between 0 and 2 ppm |

NSF Requirements

- * The NSF 42 standard requires 50% reduction for chlorine
- * The Disruptor™ 5293 PAC-S is above 50% retention until 28 000 L/m

Chlorine Retention



Glossary

- * **TDS:** Stands for total dissolved solids, and represents the total concentration of dissolved substances in water.
- * **PPM:** Parts per million or ppm means out of a million. Usually describes the concentration of something in water or soil. One ppm is equivalent to 1 milligram of something per liter of water (mg/l) or 1 milligram of something per kilogram soil (mg/kg).

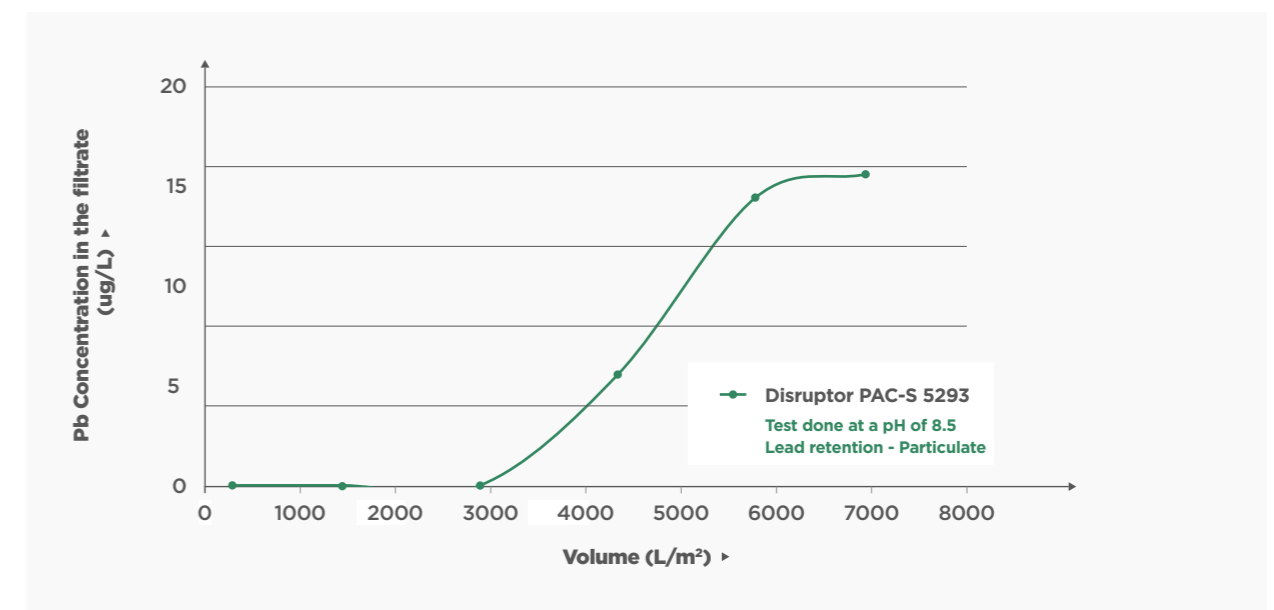
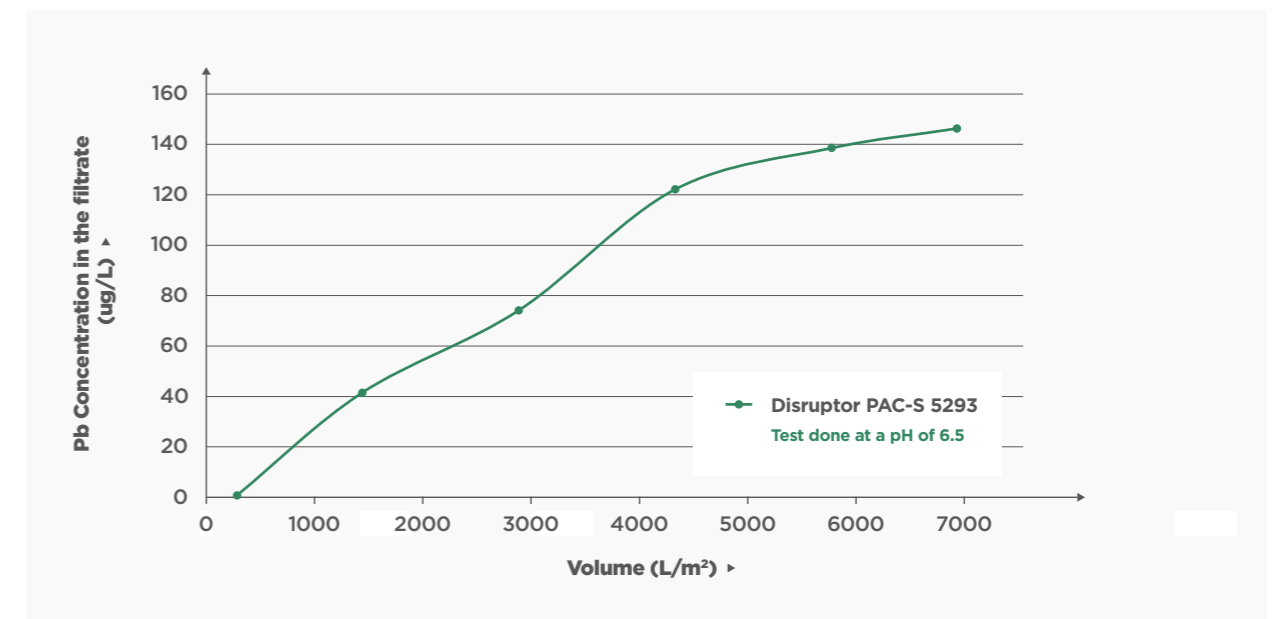
Lead - 3rd Party Testing

| | |
|---------------------------|--|
| Test conducted by | Aquadiagnostics (recognised by Water Quality Association, USA) |
| Sample used | Flat sheet with a surface area of 17.3 cm ² |
| Pressure/Flow rate | Pressure maintained at 0.65 bar and measurement of the flow rate variation |

Lead Health Effects

The widespread use of lead has resulted in extensive environmental contamination. At high levels of exposure (or long term exposure), it attacks the brain and central nervous system which can lead to a series of illnesses and disorders.

Lead Retention - Dissolved



Emerging Contaminants* - 3rd Party Tests

| | |
|---------------------------------|---|
| Test conducted by | NSF International Laboratories |
| Standard conducted under | NSF 401 |
| Test conditions | Testing based on a life estimation of 1000 liters/ft ² * corresponding to 100% in the tables |

Prescription Drugs

Phenytoin: a anti-epileptic drug

Atenolol: a beta blocker drug

Carbamazepine: an anti-convulsant and mood-stabilizing drug

Trimethoprim: an antibiotic medication

Estrone: a prescription birth control drug

| Analyte | Sample Point | | | | |
|---------------|--------------|------|------|------|------|
| | 50% | 100% | 150% | 180% | 200% |
| Phenytoin | Yes | Yes | Yes | Yes | Yes |
| Atenolol | Yes | No | No | No | No |
| Carbamazepine | Yes | Yes | No | No | No |
| Trimethoprim | Yes | Yes | Yes | Yes | No |
| Estrone | Yes | Yes | Yes | Yes | Yes |

Glossary

- * **ft²:** Square feet
- * **Analyte:** A substance whose chemical constituents are being identified and measured.
- * **Emerging contaminants:** contaminants such as pesticides, herbicides, prescription drugs and detergents.

Chemical Compounds

TCEP: a chemical compound used as a flame retardant, plasticizer and viscosity regulator in various types of polymers including polyurethanes, polyester resins and polyacrylates

TCP: a chemical compound used as a flame retardant

BPA (Bisphenol A): a chemical compound used as a plasticizer

Nonyl phenol: a collection of compounds often used as a precursor to commercial detergent

| Analyte | Sample Point | | | | |
|--------------|--------------|------|------|------|------|
| | 50% | 100% | 150% | 180% | 200% |
| TCEP | Yes | Yes | No | No | No |
| TCP | Yes | Yes | Yes | Yes | Yes |
| Bisphenol A | Yes | Yes | Yes | Yes | Yes |
| Nonyl phenol | Yes | Yes | Yes | Yes | Yes |

NSF 401 Certification

The NSF 401 filter certification is for "incidental contaminants and emerging compounds."

This means that the NSF Public Safety and Health Organization has verified that the Disruptor™ filter meets their high standards for emerging compound and incidental contaminant reduction through a variety of tests done by experts from NSF.

Over-the-counter Medications

Ibuprofen: an over-the-counter pain reliever and anti-inflammatory medication

Naproxen: an over-the-counter pain reliever and anti-inflammatory medication

DEET (N,N-Diethyl-meta-toluamide): a pesticide and common active ingredient in insect repellents

Metolachlor: an organic compound that is widely used as an herbicide

Linuron: a herbicide often used in the control of grasses and weeds

| Analyte | Sample Point | | | | |
|-------------|--------------|------|------|------|------|
| | 50% | 100% | 150% | 180% | 200% |
| Ibuprofen | Yes | Yes | No | No | No |
| Naproxen | Yes | Yes | Yes | Yes | Yes |
| DEET | Yes | No | No | No | No |
| Metolachlor | Yes | Yes | Yes | No | No |
| Linuron | Yes | Yes | Yes | Yes | Yes |

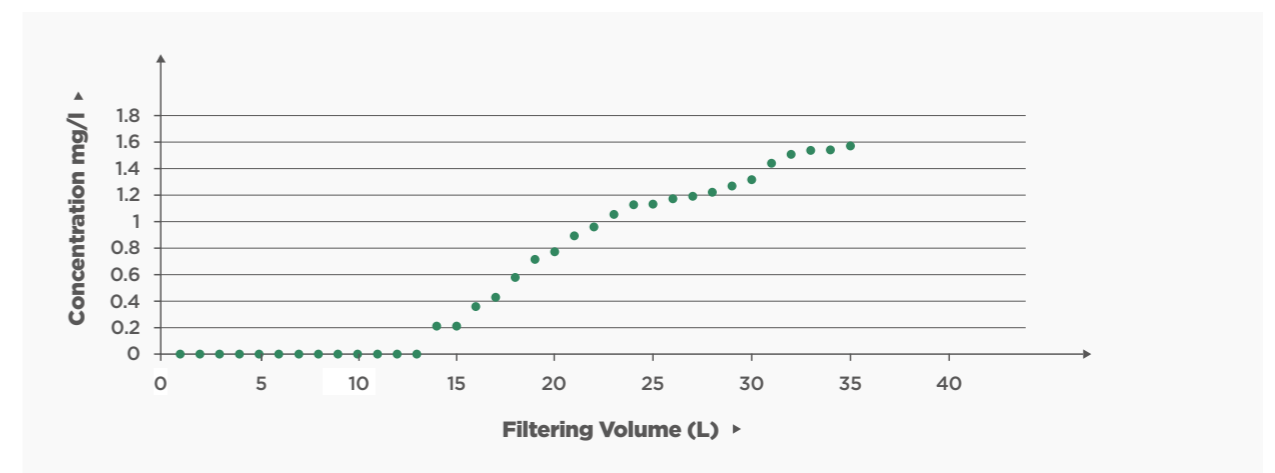
Other Trace Pharmaceutical/Micro Contaminant Reduction Results

Test conducted by

Ahlstrom Munksjö

Penicillin G Removal

Penicillin G was used for testing as a representative antibiotic. It was first studied using a challenge solution of 2 mg/l. This graph shows that the entire antibiotic was removed from 13 liters of water. At more typical concentration in the range of 2 micrograms per liter, a square foot of Disruptor could theoretically process more than 900,000 liters of water if it were free of other contaminants.



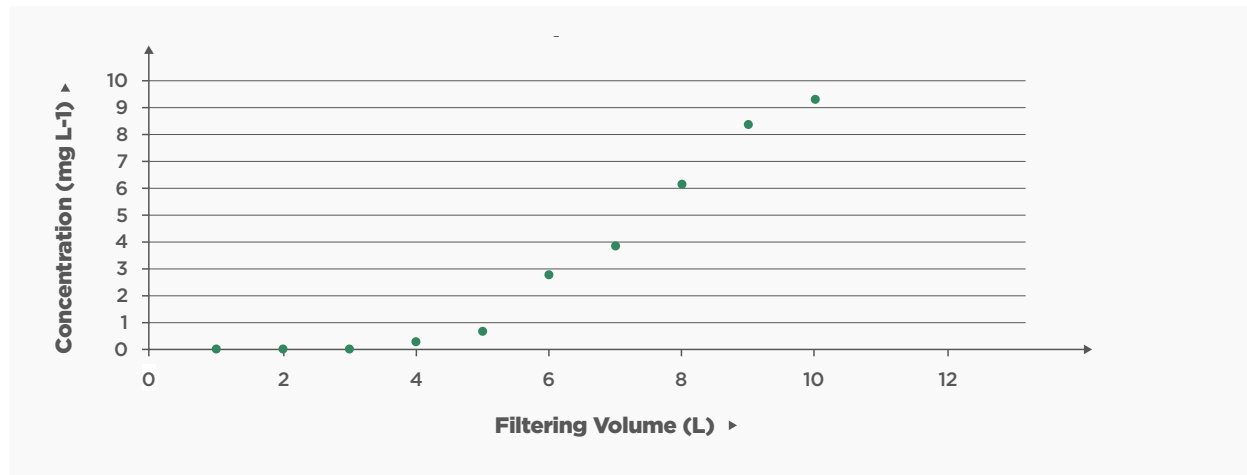
Micro Contaminants

Various micro contaminants are now being detected in many waste water and in some potable water sources.

Although the dangers these contaminants present to humans and the environment are not well understood, reduction or removal of these compounds is a concern to many health authorities and agencies.

Flumequine Removal

Flumequine is a chemotherapeutic antibiotic implicated in tendon rupture, DNA damage and anaphylactic shock. It has been taken off the market but is representative of the flumequine drug class. The data shows complete removal from 3 liters of water with a concentration of 10 mg/l. At more typical concentration in the range of 2 micrograms per liter, a square foot of Disruptor could theoretically process more than 1 million liters of water if it were free of other contaminants.



PCB Removal

Polychlorinated biphenyls (PCBs) are man made organic chemicals that are known for their toxic and carcinogenic effects. Independent testing has shown Disruptor to be effective in removing PCBs from water as indicated in the above chart. **Note:** the tests shown below were done with lower grade Disruptor medias than the 5293 PAC-S used in JoJo's Filtration range, but has been included to showcase the performance capabilities of the filter media.

| Congener Group | ng/L influent | 5284 ng/L effluent | 5283 ng/L effluent |
|-----------------------------|---------------|--------------------|--------------------|
| Total monochloro biphenyls | 158 | 2.36 | 0.377 |
| Total dichloro biphenyls | 629 | 0.85 | nd |
| Total trichloro biphenyls | 1260 | nd | nd |
| Total tetrachloro biphenyls | 4490 | nd | nd |
| Total pentachloro biphenyls | 4870 | nd | nd |
| Total hexachloro biphenyls | 4460 | nd | nd |
| Total heptachloro biphenyls | 2460 | nd | nd |
| Total octachloro biphenyls | 1810 | nd | nd |
| Total nonachloro biphenyls | 473 | nd | nd |
| Decachloro biphenyls | 187 | nd | nd |

Glossary

- * **Influent:** Water that flows in, usually the raw, untreated water.
- * **Effluent:** Water that flows out, in this context the water once it has been filtered.