

NANOPURE-Plus[®]

Electropositive charged filter

ENVIONEER Co., Ltd.

2019.04.29



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I. Profile of electropositive charged filter

1. What is electropositive charged filter?
2. Virus? Bacteria?
3. Importance of Microorganism in water
4. Mechanism of electropositive charge
5. Measurement of electropositive charge
6. Effects of electropositive charge
7. Bacteria removal efficiency
8. Virus removal efficiency
9. Excellence compared with others

1. What is electropositive charged filter?

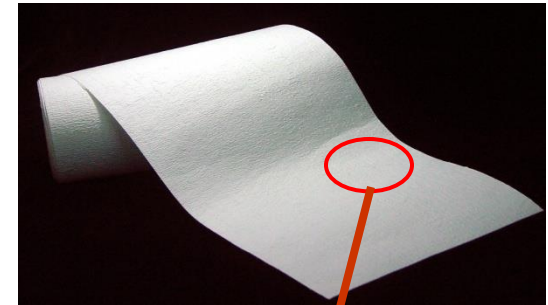
● What is electropositive charged filter?

- Micro filter with 0.5 – 0.9 μm mean pore size
- Electropositive charged on the surface of media and inside its pore
- Removing the organic and inorganic materials such as Virus, bacteria and Colloids

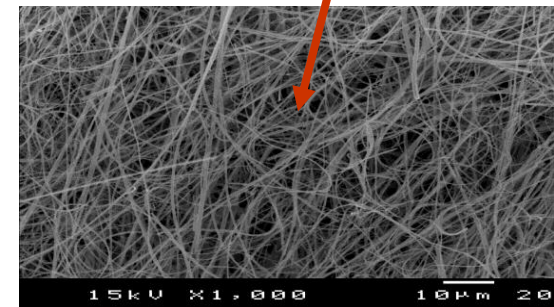
● Features of electropositive charged filter

- High filtration efficiency and low pressure drop at high flow rate
- Removes virus and bacteria (Over 5 log Norovirus removal efficiency)
- How use natural pressure, not motor pressure
- Allows use of nonwoven media that provides the filtration quality of membranes
- Provides the platform for new device that are smaller, less expensive and deliver high efficiency
- Can be used in all household water applications
- Various pore size grade filter media can be supplied
- Manufacturing of the filter assembly can be done by various types such as wounding and pleated types

Media

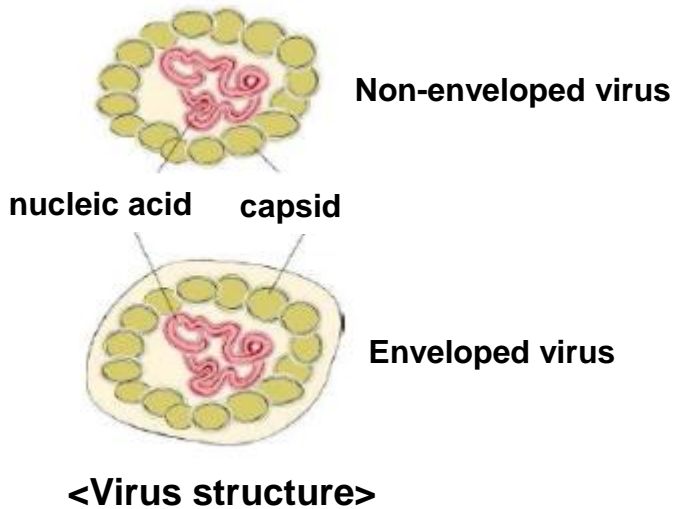


SEM Image



2. Virus? Bacteria?

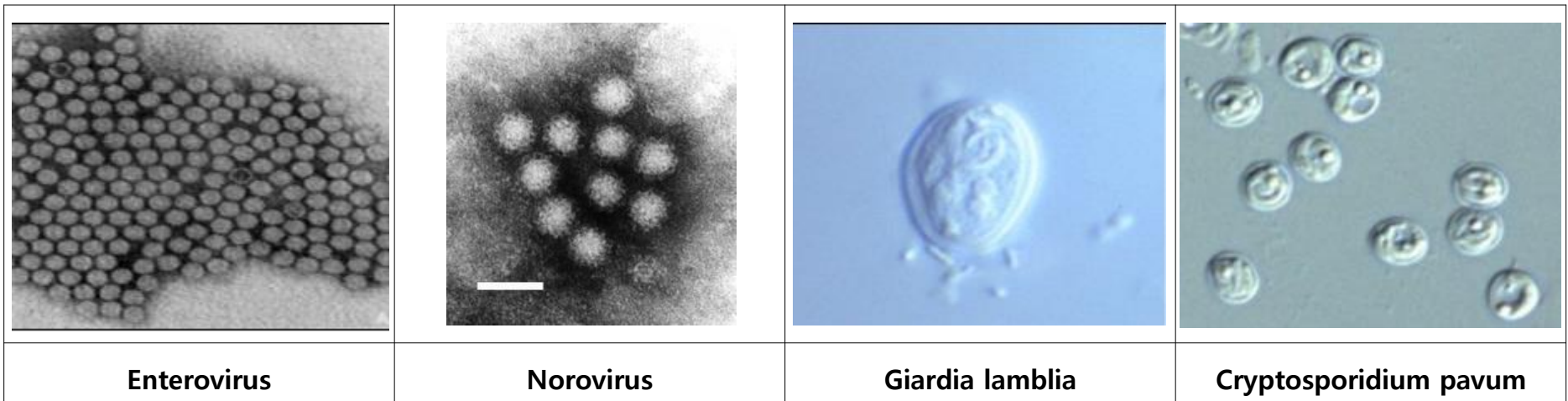
- Virus is an infectious pathogen smaller than bacteria. (size 10 – hundreds nm)
- Virus is composed of the genetic material called RNA and the protein surrounding the RNA.
- Virus cannot exist without the host and it exists with cell membrane without cell wall.
- The lipid layer is come from the cell membrane of host cell.
- Bacteria has the cell wall and proliferates by itself.



Category	Bacteria	Virus
Size	Several micrometer(μm) Checking by general optical microscope	Hundreds nanometer(nm) Checking by general electron microscope
Self-proliferation	Possible	Impossible Possible with host
Amount of pathogenesis	Hundreds ~ millions	Possible with small amount (10 - 100)
Cure	Antibiotics	No therapy & no vaccine
Secondary infection	X	O (Almost of all)

3. Importance of Microorganism in water Human & Environment

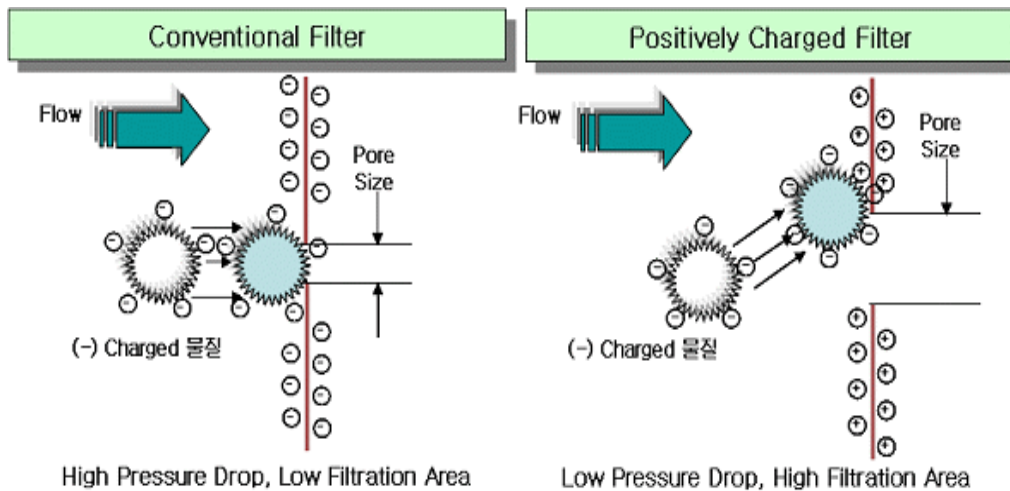
- In the late 1980s, it was come out as true that the pathogenic microorganisms such as Virus, Cryptosporidium, Giardia is the reason of waterborne diseases.
- So most countries manage these microorganism as the standard of water purification.
- In Korea, it must remove Virus 99.99%, Giardia 99.9% and Cryptosporidium 99%. Korea makes the Water Act and checks it regularly.
- But, **these Protozoa & Virus have a tolerance of disinfection so it is not removed by the chlorine disinfection.**



4. Mechanism of electropositive charge

● Mechanism of electropositive charge

- Almost all pollutants including microorganisms has electronegative (-)charge in the water.
- Electropositive (+)charged media collects the (-)charge pollutants by electrostatic force on the surface of media and inside pore.
- Coating the filter media fibers with cationic polymer binder resin



- **Using electropositive technology not mechanical filtration**
- **Low pressure loss and high removal efficiency**

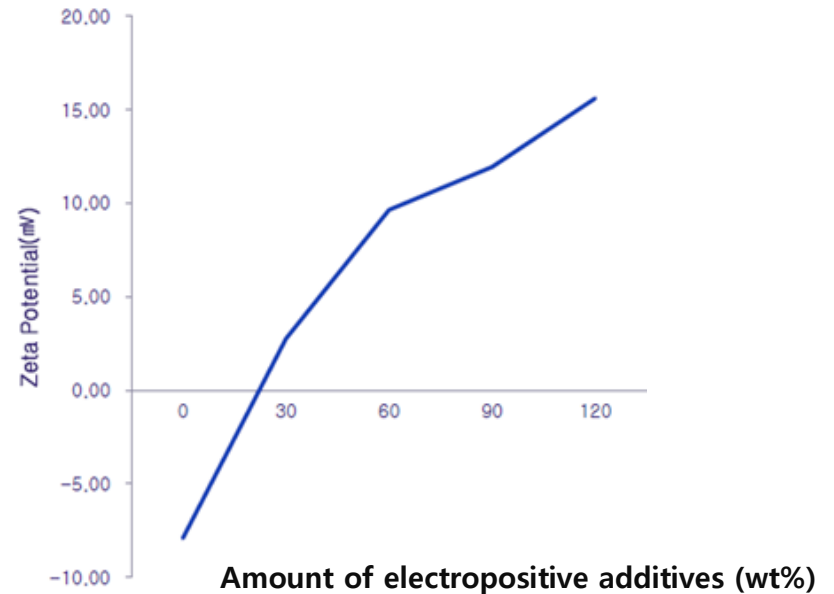
5. Measurement of electropositive charge

● Zeta potential?

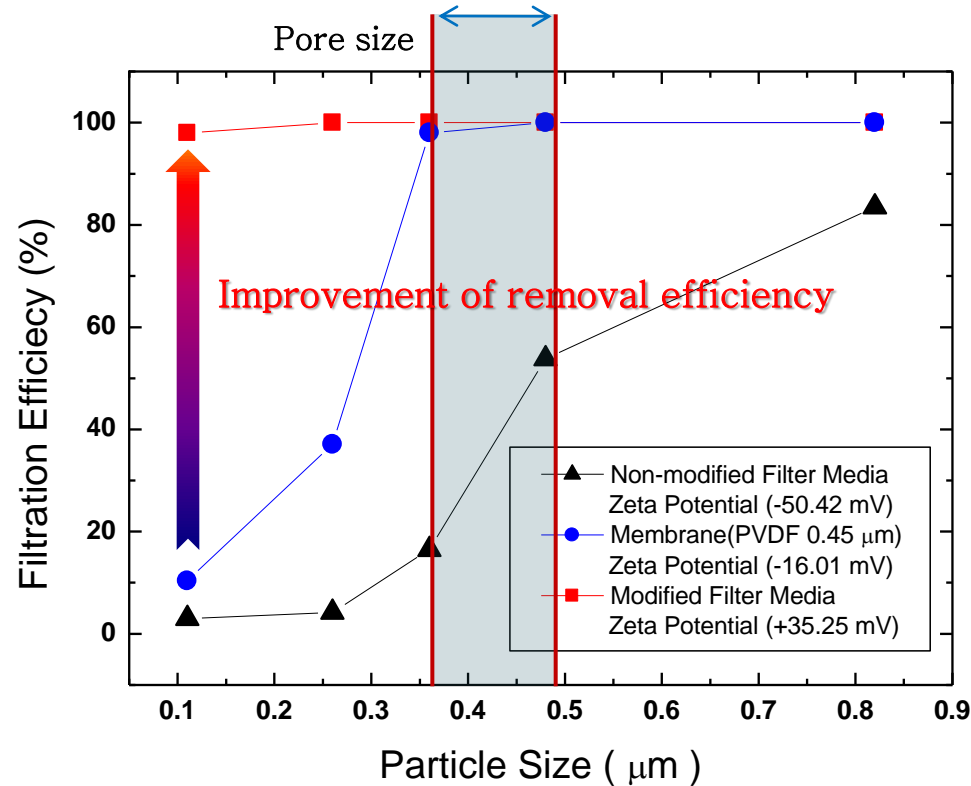
- Zeta potential shows the value(mV) of electropositive charge on the media.
- Comparing with the Zeta potential, it evaluates the virus removal efficiency.

Amount of electropositive additives(wt%)	Zeta potential(mV)	Noro Retention(%)
0	-7.91	90.000
30	2.75	99.000
60	9.64	99.997
90	11.93	99.999
120	15.6	99.999

Measuring the Zeta potential with adding the electropositive additives



6. Effects of electropositive charge



Category		Contents	Zeta Potential (mV)	Filtration efficiency (%) ⁽¹⁾
REMARKS	Membrane	Polyvinylidene fluoride (0.45mm)	-16.01	10.4
	Non-modified filter media	Glass fiber, Cellulose	-50.42	3.0
Modified filter media		Glass fiber, Cellulose, Charge modifier	+35.25	98.0

[Analyzing institution : Korean Institute of Industrial Technology]

(1) at 0.11 µm (PSL particles)

7. Bacteria removal efficiency

시험성적서

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 Tel: +82-2-2637-1234 Fax: +82-2-2631-8787

1. 의뢰자 기 관 명 : ㈜레바이오니아 성적서 번호 : 일반-140803 A
 주 소 : 경기도 성남시 분당구 경자동 159-5 위치지(1) / (총 1) 글.
 박곡프라자 604호 발 행 일 : 2014. 8. 22
 의뢰일 : 2014. 8. 13.

2. 시험사 용도 : 정수용
 3. 품목/물질/시료명 : 나노포지티브 필터
 4. 시험기간 : 2014. 8. 13. ~ 8. 22.
 5. 시험방법 : 막분리수질검정시험기준 (환경부고시 제2013-136호)
 6. 시험환경 : 온도: (최저 22 °C, 최고 25 °C), 습도: (최저 54 % R.H., 최고 69 % R.H.)

시험결과

시험항목	단위	결과			비고
		유입수 농도	유출수 농도	제거율 (%)	
대장균	CFU/mL	2,600	불검출	100	-
박테리아	CFU/mL	4,100	불검출	100	-
황색포도상구균	CFU/mL	1,900	불검출	100	-

* 시험조건 (고격정공) : 정공원 감침여: 조제수(10⁶ CFU/mL) 100 L 통과 후 유출수 분석

비고 : 1. 이 성적서는 의뢰자가 제시한 시료 (지형) 및 시료명으로 시험한 결과로서 전체 정수에 대한 품질을 보증하지는 않습니다.
 2. 이 성적서는 참고자료로서 온도 이외의 총부, 산전, 광도 및 소용돌 등으로 사용할 수 없으며, 서면승인 없이 재발행하지 못합니다.

접수자
 서명: [Signature]

시험자
 박광민

기술책임자
 송민형

한국환경수도연구원장 (인)

FPCD5-2B(13) Korea Environment & Water Works Institute A4(210×297)

Test category	Unit	Results	
		Prepared water (L)	Effluent water (removal efficiency)
E.Coli	CFU/mL	100	Not detected (100%)
Staphylococcus aureus	CFU/mL	100	Not detected (100%)
Pseudomonas aeruginosa	CFU/mL	100	Not detected (100%)

- Before test, it passes the inflow water over 20L to wash filter.
- After passing the prepared water(10⁶ CFU/mL) 100L, and analyze it.
- Korean Standard : Not Detected(100%)

8. Virus removal efficiency

● Norovirus (Virus causes the acute gastroenteritis)

After flowing a proper amount of water in the filter at the rate of 2.0L/min with 400ml of virus stock, take 100ml of the sample and then 100ml of virus stock out of the sample. Perform analysis of the virus amount in the sample quantified by real-time PCR.

Stock concentration 1×10^3 PFU/ml			
Spiking copy number 1.21×10^{11} copy/ml			
Accumulated flow (L)	Quantity (copy/ml)	Reduction	
		percentage	Log ₁₀
500	2.13×10^5	99.9998	5.75
1,000	6.27×10^4	99.9999	6.29
2,000	4.52×10^5	99.9996	5.43
3,000	2.96×10^5	99.9998	5.61
4,000	1.11×10^5	99.9999	6.04

No. 2018-0062-1

ENVIONEER

Recipient : Envioneer

Title : Nano positive filter

Test Conditions

Flow rate of water : 2.0 L/min

Stock concentration : 1.5×10^8 PFU/ml

Flow rate of stock when it's spiked : 0.2 L/min

Water amount(volume) of stock when it's spiked : 0.8 L

0.1 L sample after the filtration of 0.4 L water was taken when it's spiked

Stock concentration 1×10^3 PFU/ml			
Spiking copy number 1.21×10^{11} copy/ml			
Accumulated flow (L)	Quantity (copy/ml)	Reduction	
		percentage	Log ₁₀
500	2.13×10^5	99.9998	5.75
1,000	6.27×10^4	99.9999	6.29
2,000	4.52×10^5	99.9996	5.43
3,000	2.96×10^5	99.9998	5.61
4,000	1.11×10^5	99.9999	6.04

NOROGENE CORP. President Soon-Young Faik 

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[Analyzing institution: NOROGEN, 2013]

8. Virus removal efficiency

● MS2 bacteriophage (Virus surrogate, NSF method)

No. 2014-0075-1

ENVIONEER

Recipient : Envioneer
 Title : EN nano filter
 Test Conditions

Accumulated amount of water : 3600 gallons

Flow rate of water : 1.0 ~ 1.2 gpm

Test microorganisms : MS-2 bacteriophage (ATCC 13397-B)

Raoultella terrigena (ATCC 33257)

Water amount(volume) of stock when it's spiked : 10 L

Accumulated amount of water (gallons)	MS-2 bacteriophage			<i>Raoultella Terrigena</i>		
	Quantity (PFU/ml)		Log ₁₀ Reduction	Quantity (CFU/ml)		Log ₁₀ Reduction
	Influent	Effluent		Influent	Effluent	
360	4.7×10 ⁴	<0.5	4.67	7.2×10 ⁵	<0.5	5.86
1440	8.2×10 ⁴	8.0×10 ⁰	4.01	4.5×10 ⁵	<0.5	5.66
2520	7.2×10 ⁴	3.9×10 ¹	3.27	3.1×10 ⁵	<0.5	5.49
3600	9.2×10 ⁴	7.3×10 ¹	3.10	6.4×10 ⁵	<0.5	5.81

* Below limit of detection for counting

Accumulated amount of water (gallons)	MS-2 bacteriophage			<i>Raoultella Terrigena</i>		
	Quantity (PFU/ml)		Log ₁₀ Reduction	Quantity (CFU/ml)		Log ₁₀ Reduction
	Influent	Effluent		Influent	Effluent	
360	4.7×10 ⁴	<0.5	4.67	7.2×10 ⁵	<0.5	5.86
1440	8.2×10 ⁴	8.0×10 ⁰	4.01	4.5×10 ⁵	<0.5	5.66
2520	7.2×10 ⁴	3.9×10 ¹	3.27	3.1×10 ⁵	<0.5	5.49
3600	9.2×10 ⁴	7.3×10 ¹	3.10	6.4×10 ⁵	<0.5	5.81

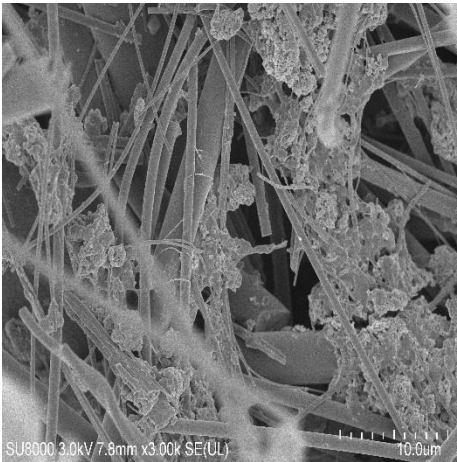
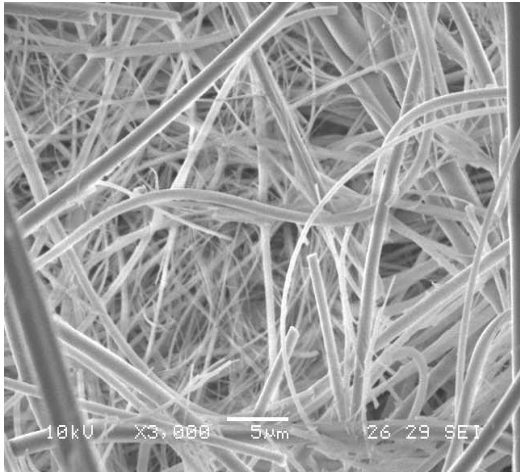
- 99.9% MS2 virus removal efficiency
- Totally passing 3,600 gallons ≙ 13,000L

NOROGENE CORP. President Soon-Young Paik

Drafter(position) Ah-Ra Lee (researcher)	Reviewer(position) Lee-Hyung Kang (researcher)
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[Analyzing institution: NOROGEN, 2014]

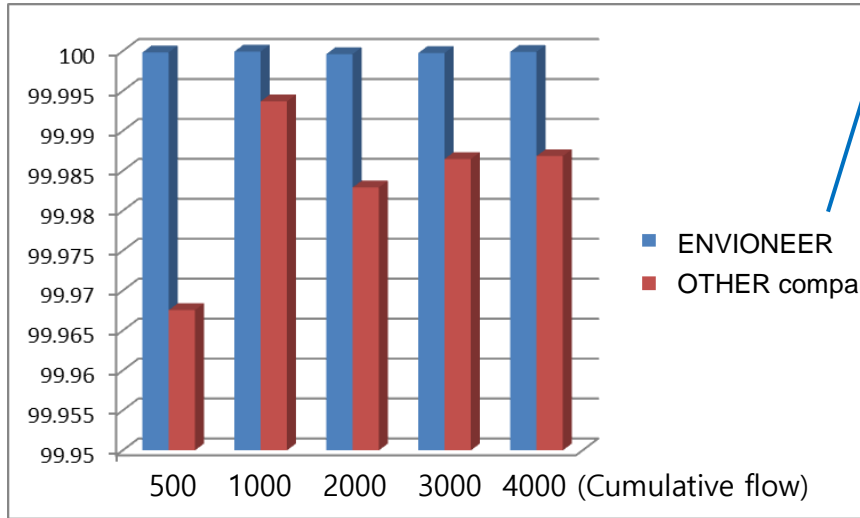
9. Excellence compared with others

Category	A company	ENVIONEER
Electropositive Charge Modifier	Adsorption of Alumina Fiber on fiber	Coating of binder resin a kind of Polyamine of fiber
Zeta Potential(mV)	1.7	8.4
Certified NSF42	○	○
Water passing at gravity pressure	△	○
Virus removal(%)	99.9 (3 log)	99.999 (5 log)
SEM Image	 <p>SU8000 3.0kV 7.8mm x3.00k SE(UL) 10.0um</p> <p>X 3000</p>	 <p>10kV X3,000 5um 26 29 SET</p> <p>X 3000</p>

9. Excellence compared with others

Norovirus removal

After flowing a proper amount of water in the filter at the rate of 2.0L/min with 400ml of virus stock, take 100ml of the sample and then 100ml of virus stock out of the sample. Perform analysis of the virus amount in the sample quantified by real-time PCR.



Efficiency comparison graph of Electropositive Charge Filter & other company's filter

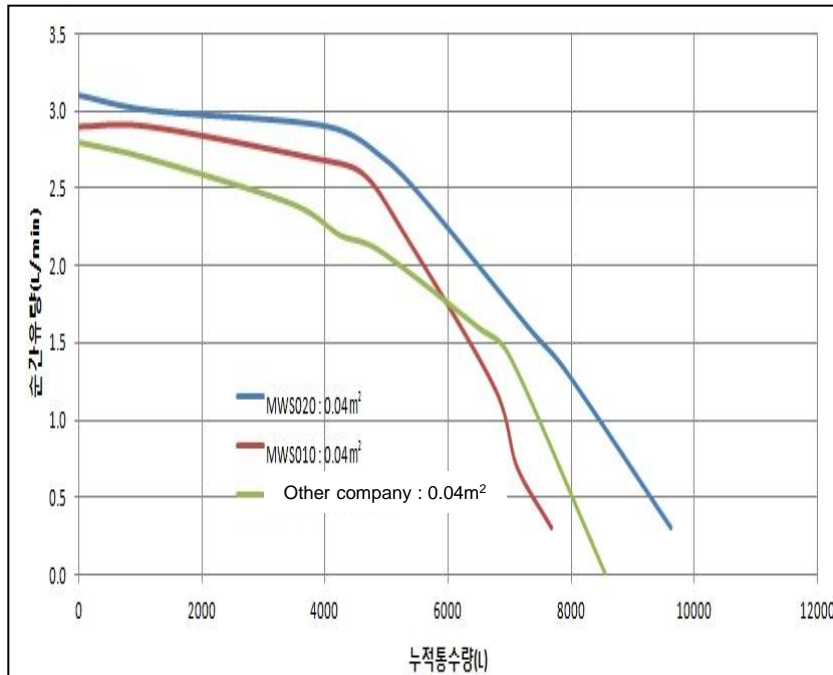
[Analyzing institution: NOROGEN, 2013]

ENVIONEER filter	Stock concentration	1×10^3 PFU/ml 1.21×10^{11} copies/ml
Cumulative flow (L)	Copies after stock filtration	Removal efficiency (%)
500	2.13×10^5	99.99982
1000	6.27×10^4	99.99994
2000	4.52×10^5	99.99962
3000	2.96×10^5	99.99975
4000	1.11×10^5	99.99990

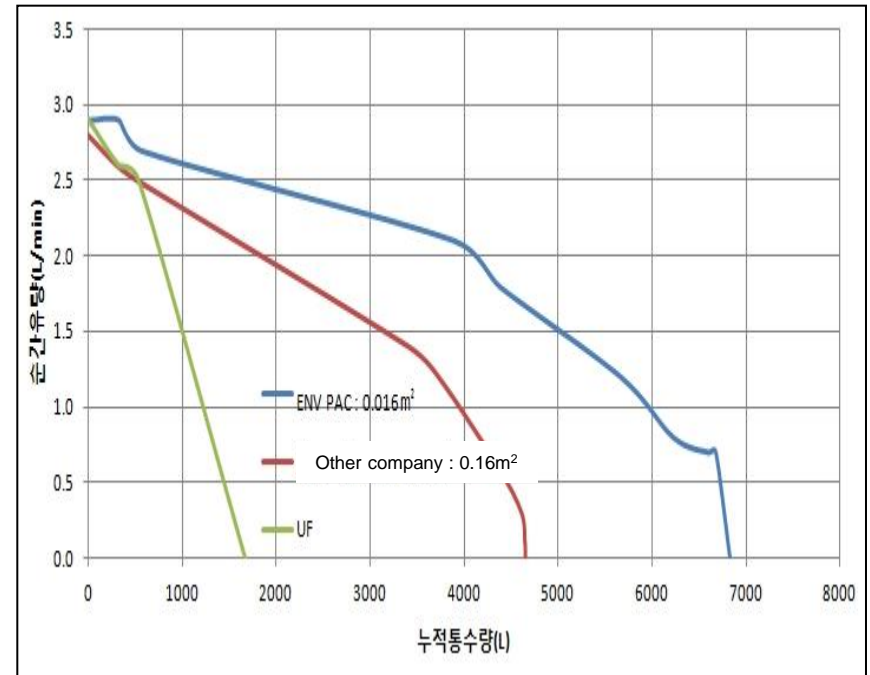
Other company's filter	Stock concentration	1×10^3 PFU/ml 1.68×10^{11} copies/ml
Cumulative flow (L)	Copies after stock filtration	Removal efficiency (%)
500	5.45×10^5	99.96755
1000	1.06×10^4	99.99369
2000	2.87×10^5	99.98291
3000	2.27×10^5	99.98648
4000	2.21×10^5	99.98684

9. Excellence compared with others

1. Test method : Measuring the amount of instant water passing at the regular tap water pressure
2. Test condition : ① tap water pressure : 1bar
3. Test procedure : ① inspecting the pressure change at 1bar
 ② starting the test when there is no pressure change
 ③ analyzing the flow meter during 1 minute and check the instant flow meter (electronic meter)



< ENPURE-plus[®], white media) >



< ENPURE-plus[®], carbon media) >

II. Product safety

1. Product safety
2. ROHS test
3. NSF certification

1. Product safety

Category	Test	Target	Institution
Material Safety	Heavy metal	Not detected for all items	Korea Conformity Laboratories
	Drinking Water Quality	Suitable for 57 all items	Yongin City Waterworks institute
	ROHS	Not detected for heavy metal and Flammable materials	SGS Korea
	Material safety	Safety for all materials (Korean Food Standards Codex)	Korea Testing and Research Institute
Purification performance	Bacteria removal	Not detected for E.Coli, Staphylococcus aureus and Pseudomonas aeruginosa	Korea Environment & Water Works Institute
	Virus removal	99.9% removal	NOROGEN/EcoV (Approved by the Ministry of Environment)
	General water filtration performance	Suitable for all test items (chlorine, turbidity, chloroform, and the color)	Korea Environment & Water Works Institute
	Special water filtration performance	Suitable for all test items	Korea Environment & Water Works Institute

2. ROHS test



Test Report NO. F880101/LF-CT8AYAA14-10480E Issued Date: 2014. 03. 03 Page 2 of 3

Sample No. : AYAA14-10490E
 Product Name : Nano Positive Filter Media
 Item No./Part No. : N/A
 Material : Polyethylene terephthalate

Test Item	Test Method	Unit	Specification	MDL	Test Result
Cadmium(Cd)	KFDA, Food Code "Standards and Specification for Utensils, Containers and Packaging for Food Products"	mg/kg	Not more than 100	2	Not detected
Lead(Pb)		mg/kg		2	Not detected
Mercury(Hg)		mg/kg		0.2	Not detected
Hexavalent Chromium (Cr6+)		mg/kg		0.4	Not detected
Lead(Pb)		mg/L	Not more than 1	0.05	Not detected
Consumption of KMnO4		mg/L	Not more than 10	0.5	Not detected
Evaporation Residue (as water)		mg/L	Not more than 30	3	10
Germanium (Ge)		mg/L	Not more than 0.1	0.01	Not detected
Antimony (Sb)		mg/L	Not more than 0.04	0.02	Not detected
Terephthalic acid (as water)		mg/L	Not more than 7.5	0.2	Not detected
Isophthalic acid (as water)		mg/L	Not more than 5	0.2	Not detected

(1) MDL : Method Detection Limit
 (2) Not detected : <MDL

SGS Korea Co., Ltd. Member of the SGS Group (Stock Exchange: Seoul 031-080) 222, The G valley, 7E, LG-ro, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 031-080
 T: +82 (0)31 4929 000 F: +82 (0)31 4929 009 <http://www.sgs.com>
 Member of the SGS Group (Stock Exchange: Toronto)

F401 Version 1

Test category	Unit	Standard	Results
Lead(elution)	mg/L	Under 1	0.0
potassium permanganate(elution)		Under 10	0
Residue on evaporation(elution)		Under 30	10
Terephthalic acid(elution)		Under 7.5	0.0
Isophthalic(elution)		Under 5	0.0
lead(material)		mg/kg	Under 100 (to sum up)
cadmium(material)	0		
mercury(material)	0		
Hexavalent Chromium(material)	0		
Germanium(material)	Under 0.1		0
Antimony(material)	Under 0.04		0

- Suitable (Standard of Korean Food Standards Codex)

3. NSF certification

NSF International

789 N. Dixboro Road, Ann Arbor, MI 48105 USA

RECOGNIZES

Envioneer Co., Ltd.

Republic of Korea

AS COMPLYING WITH NSF/ANSI 42 AND ALL APPLICABLE REQUIREMENTS,
PRODUCTS APPEARING IN THE NSF OFFICIAL LISTING ARE
AUTHORIZED TO BEAR THE NSF MARK.



Filter cartridge has been Tested and Certified by NSF International against NSF/ANSI 42 for material requirements only.



ANSI Accredited Program
PRODUCT CERTIFICATION
42/4
Certification Program
Accredited by the
American National
Standards Institute



Certification Program
Accredited by the
Standards Council
of Canada

This certificate is the property of NSF International and must be returned upon request. For the most current and complete information, please access NSF's website (www.nsf.org).

COMPONENT



September 29, 2014
Certificate# C0149398 - 01

Clifton J. Mclellan
Vice President, Water Systems

III. Electropositive charge filter application

1. Excellence in technology
2. Products of electropositive charged filter
3. Liquid media grade

1. Excellence in technology



Comparison of filtration features of RO/UF vs ENPURE-plus

Category	R/O Membrane Filter	UF Filter	ENPURE-Plus®
Virus removal	OK	CAN'T	OK
Mineral	No mineral	OK	OK
Pore size	0.01~0.1nm	About 1~400nm	About 850nm
Pump	Necessity	Needlessness	Needlessness
Purification amount	0.25ℓ/min (Using pump by 4kg/cm ²)	2.2ℓ/min (Using pump by 2kg/cm ²)	2.4ℓ/min (Using pump by 2kg/cm ²)
Water tank	Necessity	Needlessness	Needlessness
Wastewater	O	X	X
Maintenance cost	Non-economic electricity and water rate (100~150 \$/year)	Economic	Economic
Water pressure	Nothing to do	Using below 2kg/cm ²	Using between 0.5 to 7kg/cm ²
Chemical compounds	Possibility dissolution (using adhesive)	Possibility dissolution (using adhesive)	No possibility of dissolution (ultrasonic welding)

2. Products of electropositive charged filter

CUCKOO

차세대 건강필터

나노포지티브 필터

쿠쿠 나노포지티브 필터는 탁월한 여과 효과로 입증된 차세대 나노기술을 적용하여

환경 유해물질들

99.9% 깨끗하게 제거!

나노포지티브 필터의 월등한 정수성능

중금속 제거	바이러스 99.9% 제거	일상 포도상구균 대장균 황색표균 99.9% 제거
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나노포지티브 필터의 정수성능 비교

● 중금속 ● 세균 ● 미네랄



차세대 나노포지티브 필터는 양(+)정전기적 작용과 음(-)이온성인 미세 바이오텍 양 이온성 필터에 흡착해 99.9% 깨끗하고 건강한 물로 정수합니다.

3M



RenaWare
INTERNATIONAL



KHNP



3. Liquid media grade



Main Application

- ❖ Electronic Industry: Photo-Resist, Acid, Alkali, Solvent, Pre- and Post-treatment filter membrane for water distillation
- ❖ Chemical and Petrochemical Industry: Treatment process for polymer, glycol, photo-resist, etc
- ❖ Food and Beverage Industry: Manufacturing process of purified water, mineral water, wine, beer, beverages, fruit juice, etc
- ❖ Electric Power Industry: Make-up water, Waste washing water, Pre-treatment filter
- ❖ Medicine Industry: Treatment filter for parenteral, eye and mouth washes
- ❖ Bio-industry: Treatment of serum, serum remnant, cells, microorganism culture medium

Specifications

Model		Weight (g/m ²)	Mean Pore Diameter (μm)	Small Pore Diameter (μm)	Thickness (mm)	Tensile Strength (kN/m)
White media	MWS010	190	0.5	0.2	1.2	0.3
	MWS020	95	0.8	0.6	0.6	0.2
	MWS050	75	1.1	0.8	0.5	0.1
Carbon media	MWC250	250	0.7	0.2	0.7	1.6

Thank you!