

# “Virus-free” Electropositive Charged Filter



## ENVIONEER

### NANOPURE-Plus®

Usable with natural pressure

Make of human friendly water

What is the electropositive charged filter?

- Micro filter with 0.5 – 0.9 $\mu\text{m}$  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

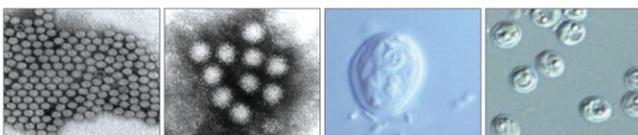
Virus? Bacteria?

- Virus is an infectious pathogen smaller than bacteria (size 10 – hundreds nm)
- Bacteria has the cell wall and proliferates by itself

Category	Bacteria	Virus
Size	Several micrometer ( $\mu\text{m}$ )	Hundreds nanometer (nm)
	Checking by general optical microscope	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)

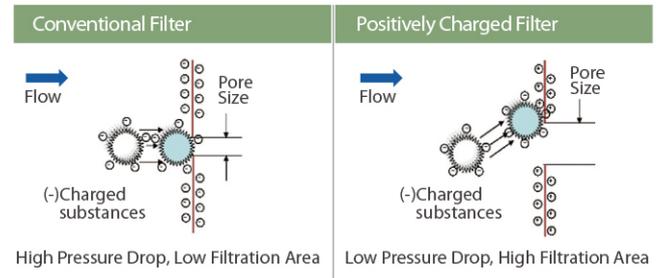
Importance of microorganisms in water

- In the late 1980s, it was come out as true that the pathogenic microorganisms such as Virus, Cryptosporidium, Giardia are the reason of waterborne diseases
- So most countries manage these microorganism as the standard of water purification
- But, these Protozoa & Virus have a tolerance of disinfection so it is not removed by the chlorine



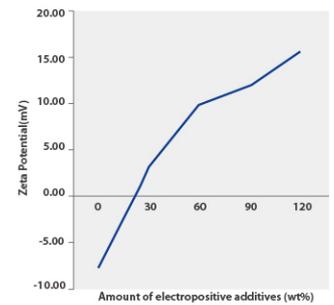
Mechanism of electropositive charge

- Almost all pollutants including microorganisms have 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



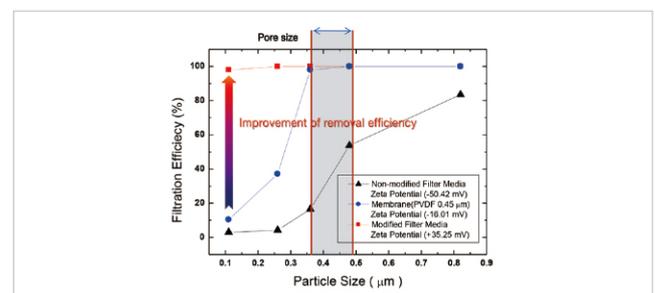
Measurement of electropositive charge

- 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

Particle removal effects of electropositive charge



## Features of NANOPURE-Plus®

- High filtration efficiency and low pressure drop at high flow rate
- Removes virus and bacteria (Over 5 log Norovirus removal efficiency)
- Uses 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

## Virus removal performance of NANOPURE-Plus®

### Bottle Type Test

Accumulated Vol. of water (L, Applox.)	Raoultella terrigena (CFU/ml)			MS2 coliphage (PFU/ml)		
	Influent	Effluent	Log <sub>10</sub> Removal	Influent	Effluent	Log <sub>10</sub> Removal
100	2.5x10 <sup>6</sup>	7.3x10 <sup>0</sup>	5.53 (99.9997%)	1.3x10 <sup>6</sup>	7.3x10 <sup>2</sup>	3.26 (99.9447%)
200	1.1x10 <sup>6</sup>	2.7x10 <sup>0</sup>	5.60 (99.9997%)	1.4x10 <sup>6</sup>	1.4x10 <sup>3</sup>	3.00 (99.9000%)
300	1.2x10 <sup>6</sup>	6.0x10 <sup>0</sup>	5.28 (99.9995%)	6.9x10 <sup>5</sup>	6.9x10 <sup>2</sup>	3.06 (99.9124%)
400	2.0x10 <sup>6</sup>	1.7x10 <sup>0</sup>	6.09 (99.9999%)	1.4x10 <sup>6</sup>	1.0x10 <sup>3</sup>	3.14 (99.9278%)

※ Detection methods : NSF Protocol P248 / EPA method 1602 (Double agar layer)

### Dispenser Type Test

Accumulated Vol. of water (L, Applox.)	Raoultella terrigena (CFU/ml)			MS2 coliphage (PFU/ml)		
	Influent	Effluent	Log <sub>10</sub> Removal	Influent	Effluent	Log <sub>10</sub> Removal
50	1.4x10 <sup>5</sup>	ND	>5.55 (100%)	3.0x10 <sup>5</sup>	ND	>5.87 (100%)
100	1.1x10 <sup>5</sup>	ND	>5.45 (100%)	4.1x10 <sup>5</sup>	ND	>6.01 (100%)
200	2.8x10 <sup>5</sup>	3.0x10 <sup>0</sup>	4.96 (99.9989%)	3.2x10 <sup>5</sup>	ND	>5.91 (100%)
300	1.6x10 <sup>5</sup>	8.0x10 <sup>0</sup>	4.30 (99.9950%)	4.0x10 <sup>5</sup>	ND	>6.00 (100%)
500	1.7x10 <sup>5</sup>	2.3x10 <sup>0</sup>	4.86 (99.9986%)	5.1x10 <sup>5</sup>	ND	>6.10 (100%)
1,000	1.0x10 <sup>6</sup>	1.4x10 <sup>2</sup>	3.88 (99.9867%)	1.8x10 <sup>6</sup>	ND	>6.66 (100%)

※ Detection methods : NSF Protocol P248 / EPA method 1602 (Double agar layer)

### Water purifier Type Test

Volume of water(L)	Ct value		Quantity (copy/carrier*)		Reduction rate	
	Influent	Effluent	Influent	Effluent	Percentage	Log <sub>10</sub>
2000	24.60	N/A	2.3X10 <sup>5</sup>	-	99.999	5.36
4000	24.31	N/A	2.8X10 <sup>5</sup>	-	99.999	5.45
6000	24.38	38.17	2.7X10 <sup>5</sup>	1.0X10 <sup>2</sup>	99.963	3.43

Test Conditions:

- 1) Microorganisms : Murine Norovirus (MNV-1)
- 2) Stock concentration: 10<sup>4</sup> PFU/ml
- 3) Flow rate: 0.2 LPM (Liter per minute)

## Product Safety Data

- ROHS test
- NSF Certification

Test Item	Test Method	Unit	Specification	MCL	Test Result
Cadmium(Cd)	mg/kg			2	Not detected
Lead(Pb)	mg/kg			100	Not detected
Mercury(Hg)	mg/kg			10	Not detected
Hexavalent Chromium (Cr(VI))	mg/kg			0.4	Not detected
Lead(Pb)	mg/kg			0.05	Not detected
Chromium(VI) (Cr(VI))	mg/kg			0.1	Not detected
Organotin Compound (as organotin)	mg/kg			10	Not detected
Organotin Compound (as organotin)	mg/kg			0.01	Not detected
Organotin Compound (as organotin)	mg/kg			0.02	Not detected
Organotin Compound (as organotin)	mg/kg			0.2	Not detected
Organotin Compound (as organotin)	mg/kg			0.2	Not detected



## Comparison of RO/UF vs NANOPURE-plus®

Category	R/O Membrane Filter	UF Filter	NANOPURE-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 <sup>2</sup> )	2.2l/min (Using pump by 2kg/cm <sup>2</sup> )	2.4l/min (Using pump by 2kg/cm <sup>2</sup> )
Water tank	Necessity	Needlessness	Needlessness
Wastewater	O	X	X
Maintenance cost	Non-economic electricity and water rate	Economic	Economic
Water pressure	Nothing to do	Using below 2kg/cm <sup>2</sup>	Using between 0.5 to 7kg/cm <sup>2</sup>
Chemical compounds	Possibility dissolution (using adhesive)	Possibility dissolution (using adhesive)	No possibility of dissolution (ultrasonic welding)

## Media grades of NANOPURE-Plus®

Model	Weight (g/m <sup>2</sup> )	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

## Application

- Food & Beverage
- Water & Bottled Water
- Pharmaceutical & Biomedical
- Power generation
- Micro-electronics
- Fine chemicals
- Pre-filtration of RO. UF (Reverse osmosis, Ultrafiltration)

