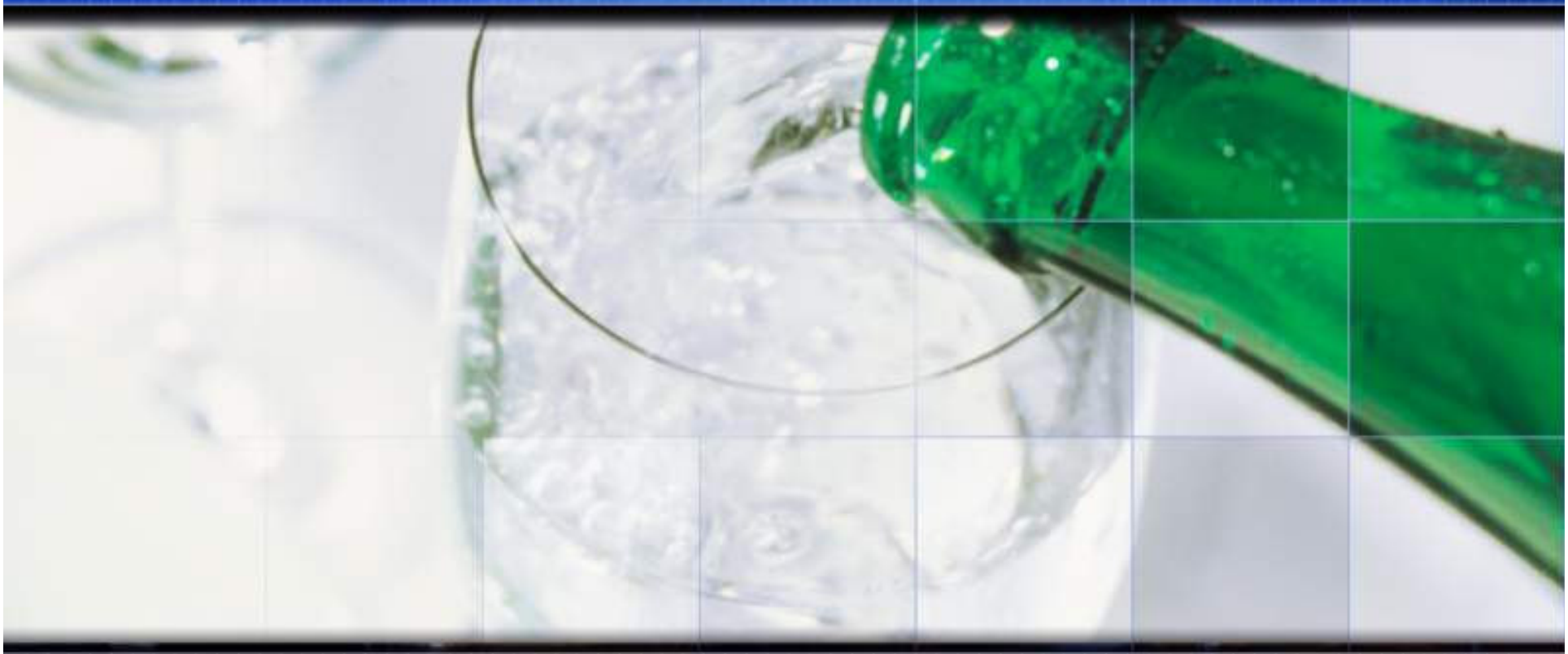
PALL Food and Beverage

Filtration. Separation. Solution.SM



Introduction to Bottled Water Filtration

Ultipleat® High Flow & Pall® Coreless Filters
Bringing Environmental Benefits to the Bottled Water Industry

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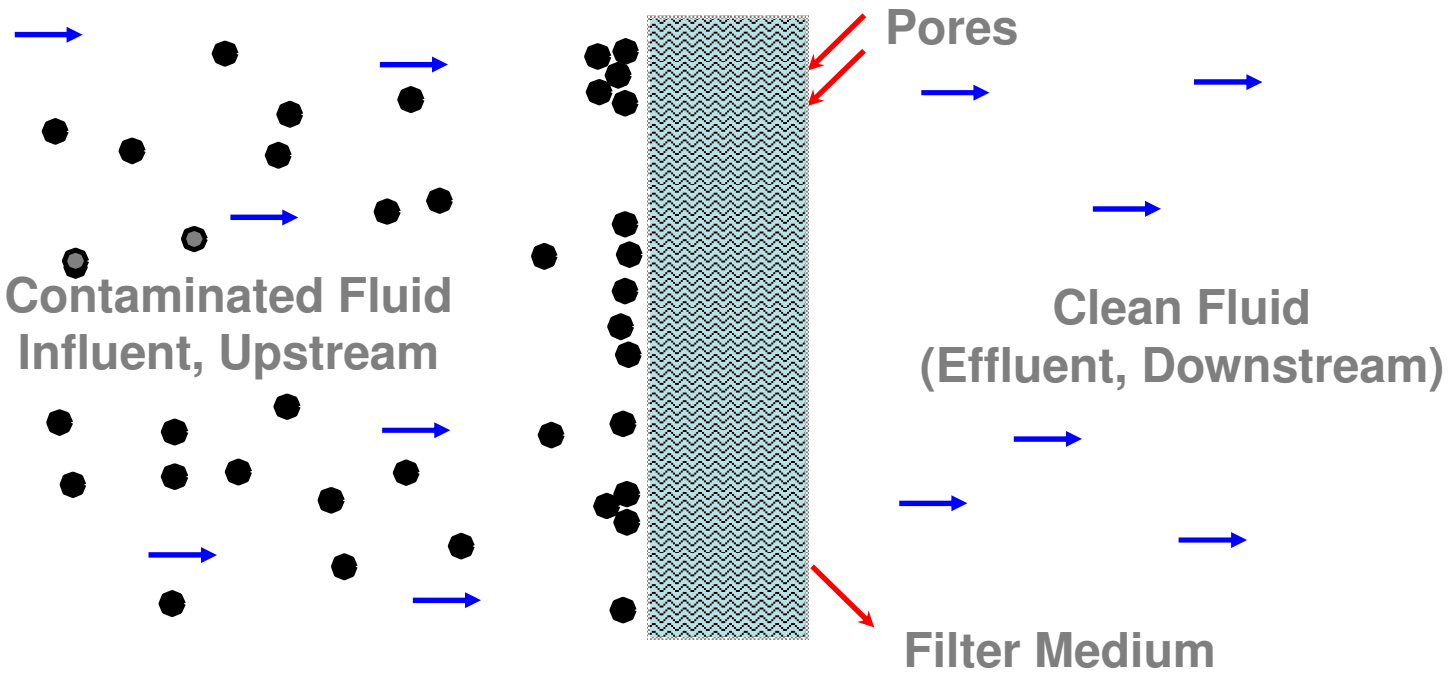
QARAC Approved, FBZ-00100.G

What is Filtration?

The removal of contaminant from a fluid stream (liquid or gas) through the use of a porous medium



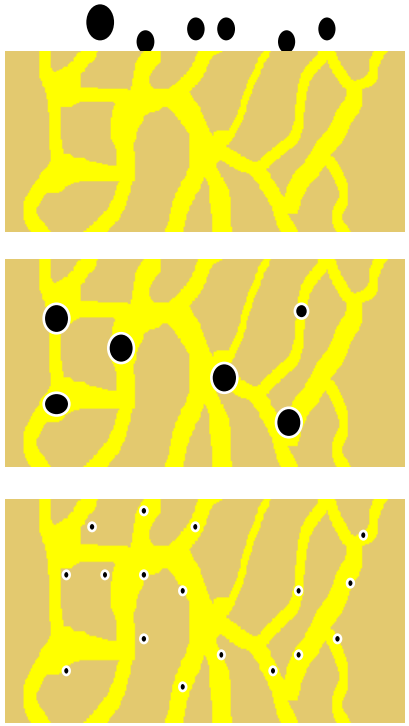
Filtration mechanisms: How can we remove particulates & microbes?

Size exclusion: particle is too large to pass through the filter medium

e.g. screen mesh used to remove large visible particulates

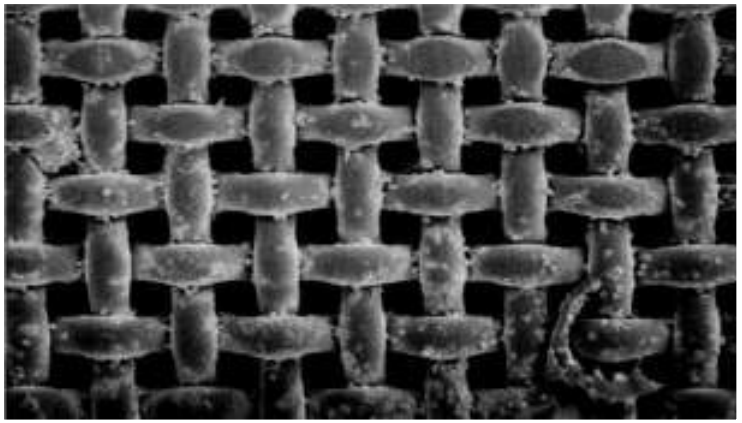
Adsorption: active interaction between particles and the filter medium

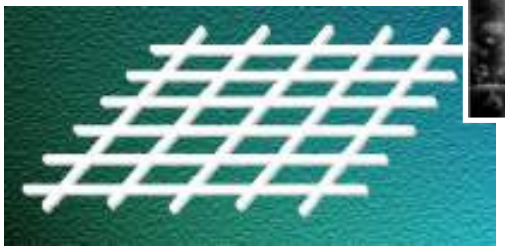
e.g. carbon beds or carbon block filters used to remove chlorine



Function of a Filter

Filters are often thought of as a simple screen or sieve with separation being achieved on a single plane.

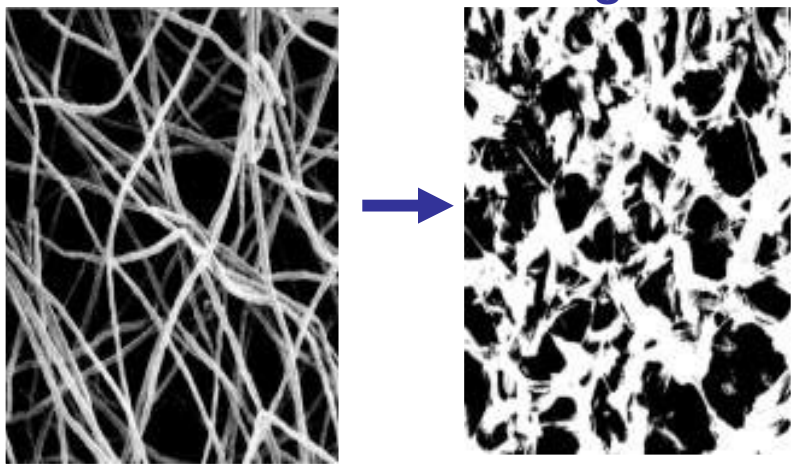




Most filter media has depth resulting in a “Tortuous Path” that aids in contaminant removal

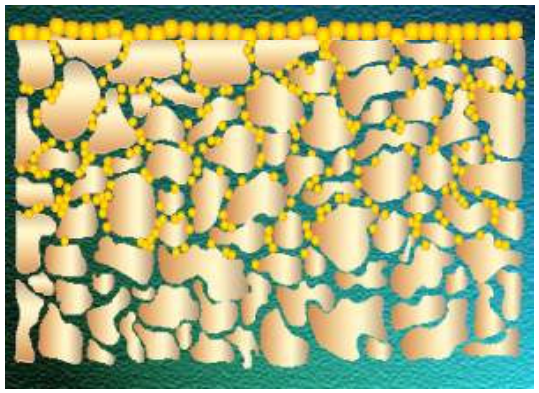
Cartridge Pre-filter

Final Membrane Cartridge Filter



Filter Media Types

Depth filtration retains solids and particles inside filter medium by size exclusion and adsorption



Depth Filter Media

Fibrous (*e.g.* cartridge pre-filters)

Active or adsorptive (*e.g.* sheets)

Membranous (*e.g.* microbial removal cartridge filters)

Limitations:

All: Premature fouling if there is inadequate pre-filtration or an uncontrolled upstream process

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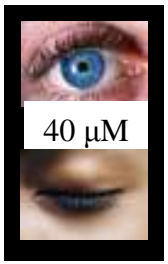
Filtration Objectives: What are we trying to remove?

Visible to the eye



µm or micron
1 millionth of a meter
39 millionths of an inch

1kD = 1000 Daltons
Molecular weight for proteins

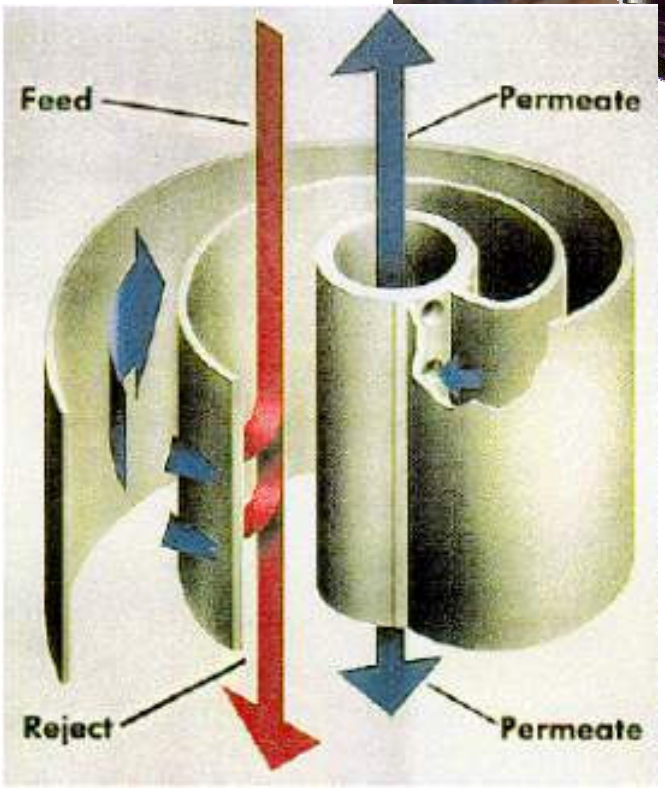
Sand fines
Carbon fines
Algae
Cysts & oocysts
Bacteria
Colloids
Viruses
Metal Ions
Soluble Salts
Insecticides Antibiotics

40 µM
10 µM
1 µM
0.1 µM
100 kD
0.01 µM
20 kD
1 kD
0.001 µM
0.2 kD
0.0001 µM

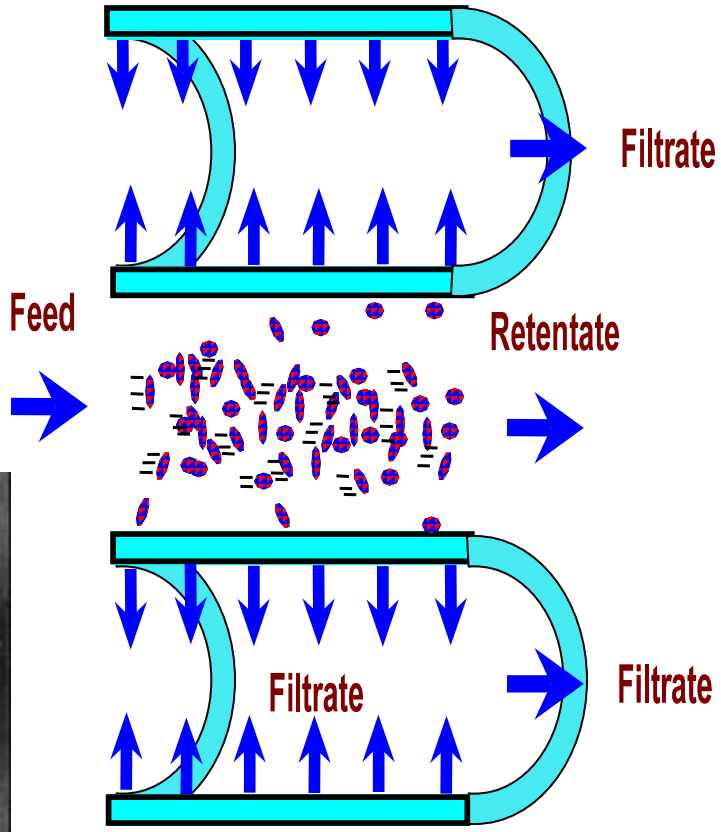
Reverse Osmosis Filtration

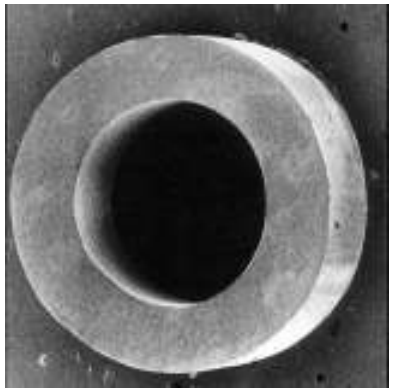
Pressure separates water (permeate) from soluble salts and ions to produce demineralized water.

Incoming water should have an SDI_{15} of less than 3 so fine particulates do not foul the RO membrane.



Tangential or Cross Flow Microfiltration





Liquid Filter Ratings

Particulate

- Nominal (Variable or β_x 10)
- 'Absolute' (β_x 1000-5000)

Microbial

- Titer reduction
- "Sterilizing" grade

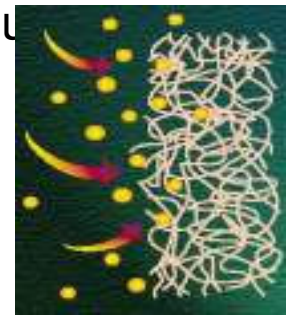
Nominal Ratings

- Weight percentage removal
- Variable, non-reproducible fluid quality
- Non-fixed pore construction
- An arbitrary micron value assigned by the filter manufacturer, based upon removal of some percentage of all particles of a given size or larger. It is rarely well defined and not reproducible

Particulate Ratings

Nominal

Unstable media structure
- Media migration
- Unstable pore structure
- Possible bypass
- Removal performance variable
- Unloading at increased pressu



Stable media structure
- Removal efficiency ~90%
- Performance consistent

Best for use far upstream in the production process
- *e.g.* pre-RO protection or incoming water clarification

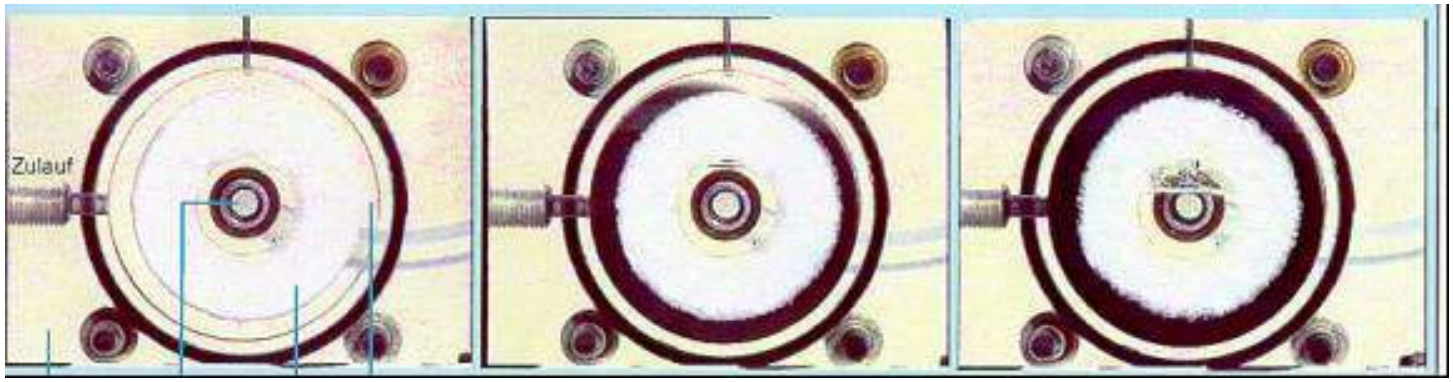
'Absolute'

Stable media structure
- No media migration
- Stable or fixed pore structure
- No bypass
- Constistent removal performance
- Specific ß-ratio
- Removal efficiency >99.9%

Best for use downstream in the production process
- *e.g.* trap filters to protect membrane elements

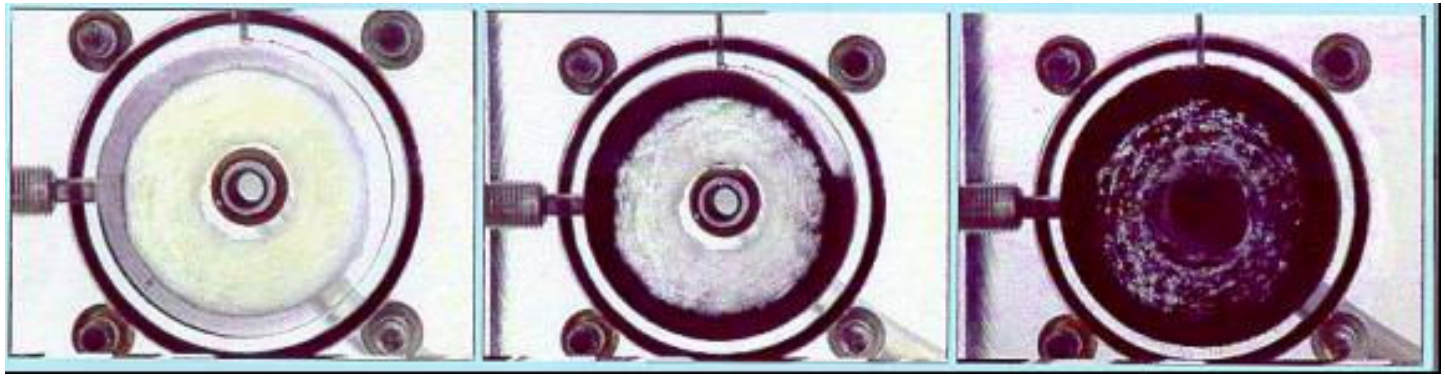
Which filter should I use downstream of a GAC or resin bed?

‘Absolute’ rated cartridge with fixed pore structure



Complete retention even at high particle loading.

Nominal cartridge w/ unfixed pores



Progressive contamination of ‘wound bobbin’ type nominal filter, showing penetration and eventual gross failure at high particle loading.

Microbial Rating

‘Sterilizing’ grade filters remove >10^7 *Brevundimonas diminuta* per cm^2 of filter area.

- FDA definition
- Removal correlated to an integrity test
- Will provide an effluent with 0 recoverable challenge organisms

Micro-reducing grade filters remove a set and reported number of microbes per 10” cartridge or area of sheet filters.

- Will provide a stable product under recommended conditions

Membranes (cartridge filters)

- Removal correlated to an integrity test
- Effluent with 0 recoverable challenge organisms if incoming level is below the log reduction value of the filter (LRV)

Sheets & modules

- No integrity test
- Effluent could provide 0 recoverable challenge organisms but under specific conditions only (flow rate, pressure)

Choosing the right microbial removal filter to remove:

Membranes

Mold & algae→ 1 to 2 micron particulate rating

Cryposporidium & Giardia→1 micron microbial rating

Yeast → 0.65 micron microbial rating

Spores (mold) → 0.65 micron microbial rating

Spores (bacterial) → 0.45 micron microbial rating

Bacteria (coliforms, *E. coli, Legionella, Salmonella, Shigella, etc.*) → 0.45 micron microbial rating

Bacteria (pseudomonads, *Pseudomonas, Brevundimonas, etc.*) → 0.2 micron microbial rating

Diminutive bacteria (mycoplasma, *Burkholderia sp.*, HPC, *etc.*)

Viruses/bacteriophage → complicated – contact your filter supplier for options

Using the basics to gain process security

- Ensure every filtration step has a purpose
  - Protecting downstream equipment or other filter stages
  - Removing and reducing the microbial load to improve the efficiency of downstream processing steps
- Do the filters meet the need?
  - Nominal vs ‘Absolute’ removal
  - Membrane filters with an IT test correlated to microbial removal
- Finding the best value and reducing risk
  - Porosity
  - Microbial Filter Performance (LRV)

Sustainability with Ultipleat High Flow and Pall Coreless Filters which can:

→Reduce filter waste >50%

→Reduce water waste >10%

→Reduce filtration costs >30%

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Pall Coreless & Ultipleat High Flow Filters: Comparison & Application Guide

Pall Coreless Filters

- Profile depth filter technology for improved dirt holding capacity
- All polypropylene
- Water applications ≤22.7m^3/h (<100 US gpm)
- Initial filtration – coarse particulate removal
- Trap filtration – removal of carbon

Ultipleat High Flow Filters

- Unique crescent shaped pleat geometry for large surface area for filtration
- Water applications >22.7 m^3/h (>100 US gpm)
- Initial filtration – coarse particulate removal
- Trap filtration – removal of carbon
- Pre-filtration to protect membrane final filters (fine grades only)

When compared to standard cartridges these large diameter filters can:

- reduce filtration spend by 30%
- reduce filtration waste by 50%
- improve quality while reducing costs
- reduce footprint
  - <10x fewer elements
  - 20 cm (8”) large diameter element vessel *vs* 36 cm (14”) standard vessel for the same flow rate

Reducing Filtration Spend

Typical Causes of high filtration spend:

- Variability of Incoming source or feed water
- Lack of precise control over the separation points
- Poor Carbon bed/Sand bed maintenance procedures

What can Large Diameter Cartridges do?

- Reduce filtration spend by 30%
- Reduce filtration waste by 50%
- Eliminate the effect of feed variability on downstream filtration.

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Environmental Impact:
10 µm Filtration at 22.7 m^3/h (100 US gpm)

	Standard Cartridges (2.5-2.75" diameter)	Pall Coreless Filter	Ultipleat High Flow Filter
# elements	12 x 30"	1 x 40"	1 x 40"
# per year	144	1-6	1-6
Water lost at change out	480 L	140 L	140 L
Plastic Waste Volume (m^3)	0.129	0.007 – 0.042	0.007 – 0.042

- >50% Water Savings
- >67% Reduction of Plastic Waste Volume

Product Details: Pall Coreless Filters

Available in
  - 5, 10*, 40* µm grades in 40” length
- ß-5000*, particulate removal ratings (99.98%)
- Flow path out → in
- Continuously graded media, coarse → fine
- All polypropylene construction
- Differential Pressure data measured in clean water at 20°C
  - 10 µm: 20 m^3/h/140 mbar (88 US gpm/2psid)
  - Max. dP at Ambient temperature 4 bar (58 psi)
- Food Contact Requirements: W-code
  - Declaration of compliance available on the website
    - http://www.pall.com/pdf/Declaration_of_Compliance_Coreless.pdf

Product Details: Ultipleat High Flow Filters

- 40” and 60” length
- Crescent pleated medium
  - UY020, UY045*, UY100*, UY200* and UY400
    - ß-5000*, particulate removal ratings (99.98%)
  - CAS010
    - 1 micron, PES membrane
    - Media qualified to reduce *Cryptosporidium* oocysts
      - http://www.pall.com/pdf/FB_102-T__Ultipleat_High_Fl.pdf
- Flow path in → out
- Flow/clean dP
  - 10µm: 50 m^3/h/25 mbar (220 US gpm/0.36 psi)
- Max dP
  - 3.4bar (49 psid)
- Food contact requirements: W-code
  - Declaration of compliance available soon on website

Trade marks

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