Final Bottling Filtration

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Final Bottling Filtration

- The final bottling filtration is the only and ultimate guarantee for a finished wine's quality and stability
- Integrity testing the membrane ensures micro retention

Presentation

- Overview of filters and types
- Membrane differences
- Total Costs of Filtration
- Optimization and Operation
- Cleaning and Sterilization
- Integrity Testing
- Troubleshooting

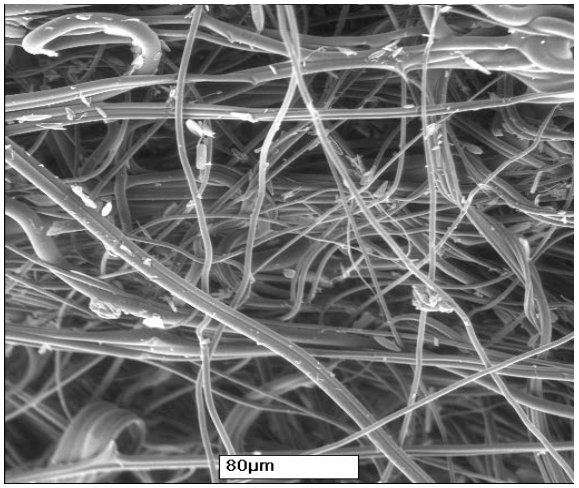
Filter Types and Selection

Two Types of Filter Structure

Depth Filter

Thick and fibrous

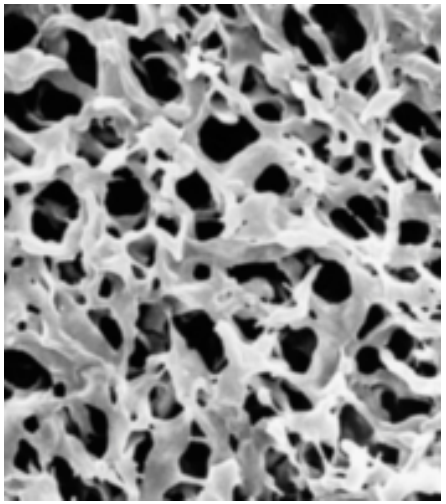
High dirt holding



Membrane Filter

Thin single-layer film

Low dirt holding

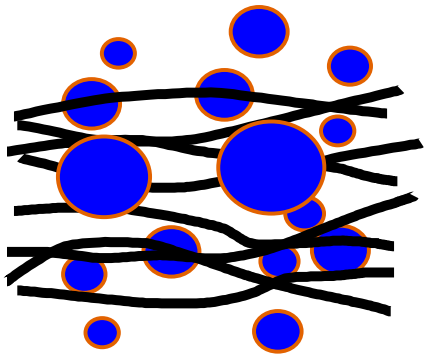


Filter Types and Selection

Two Types of Filter Performance

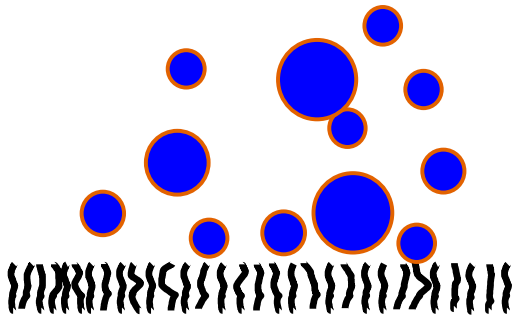
Depth Filter

Random pore structure
50 to 99.9% retention
Flexible structure
Particle unloading



Membrane Filter

Controlled pore structure
>99.9% retention
Rigid structure
No particle unloading



Filter Types and Selection

Depth Filter

Benefits:
- Higher holding capacity
- Lower cost per filter unit

Problem:
- Low retention
- No integrity test

Best use:
- Remove bulk particles (PREFILTERS)

Membrane Filter

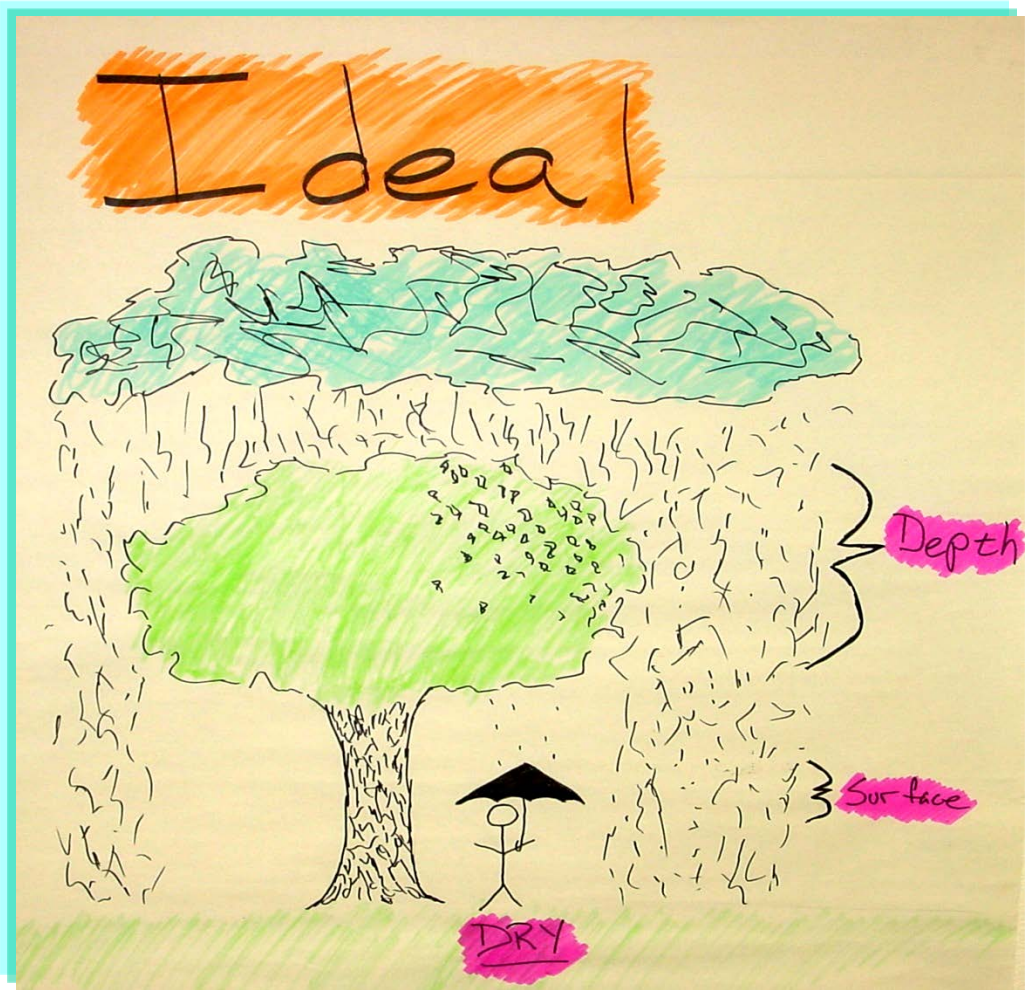
Benefits:
- High retention reliability

Problem:
- Lower holding capacity
- Higher cost per filter

Best use:
- Remove micro-organisms (FINAL FILTERS)

Filter Types and Selection

Optimized Filtration Train



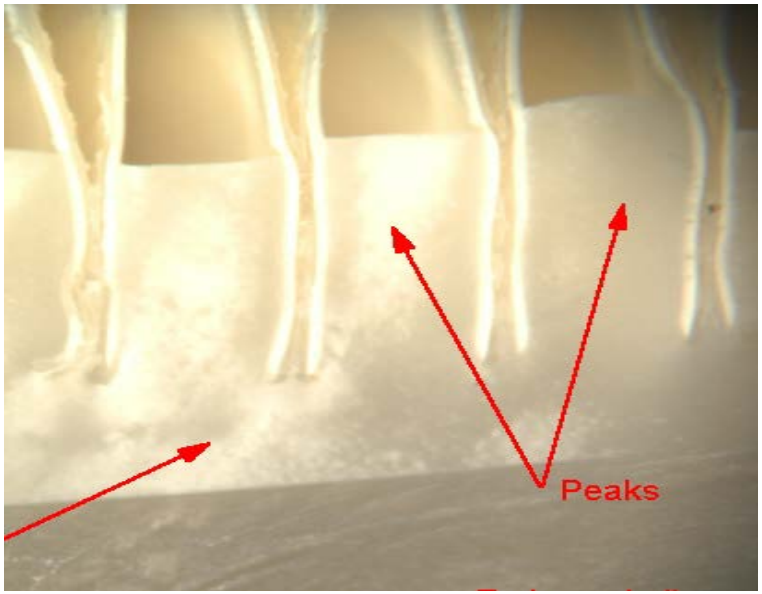
Pore Size Removal

Removed entities	**Final filter requirements**
- Cryptosporidium - Particles - Brett	1.0 µm filter
- Yeast	0.65 µm filter
- Some bacteria (All for wine and beer)	0.45 µm filter
- All bacteria	0.2 µm filter
- Virus	0.1 µm filter


FANUC Robot M-6iB

Cartridge Manufacturing

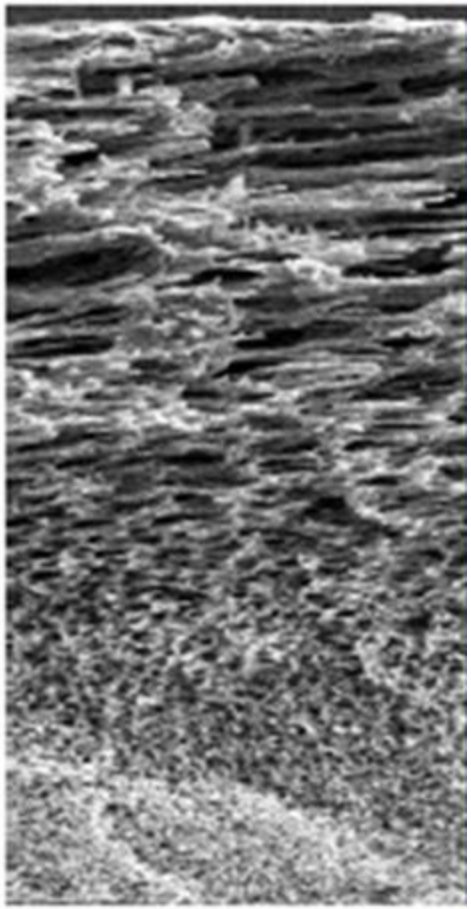
- What Manufacturing Differences Might you See?
  - Pharma-grade clean room
  - Pharma-grade materials
    - High temp ok, no oils, extractables
  - Semi-automated manufacturing
  - Stringent QC/QA controls
    - 100% testing, high safety factors, no re-work
  - Edge lamination
  - Spinning end cap during bonding
  - Pull back of support layers during sealing
  - Dual-viscosity end-cap (MP only)
  - 100% cartridge IT testing (prefilters too)
  - Increased membrane area/number of pleats
    - Some filters have 30% less membrane
    - Like having 8 filters in a 12-rd



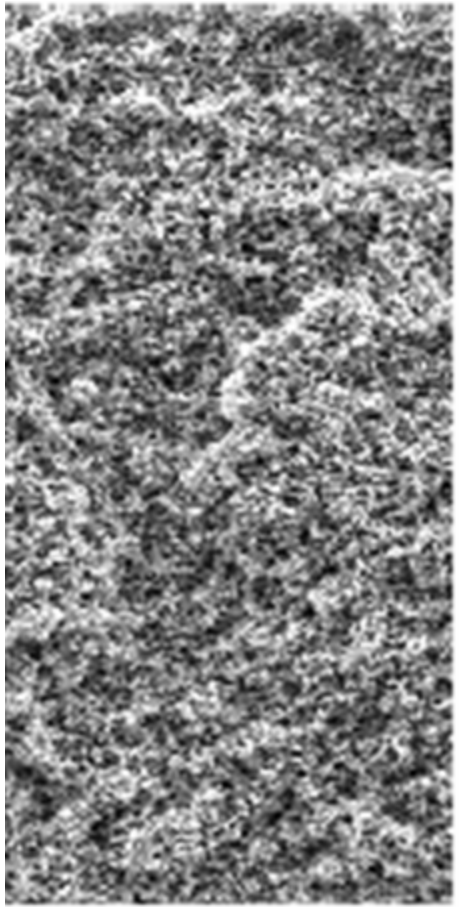
The Membranes

- PVDF and PES are cast polymer membranes
  - PVDF is polyvinyl difluoride
  - PES is polyether sulfone
- The membranes have different structures
  - PVDF is a symmetric membrane
  - PES is an asymmetric membrane
- The membranes have different surface treatments

Membrane Cross-Sections



Flow

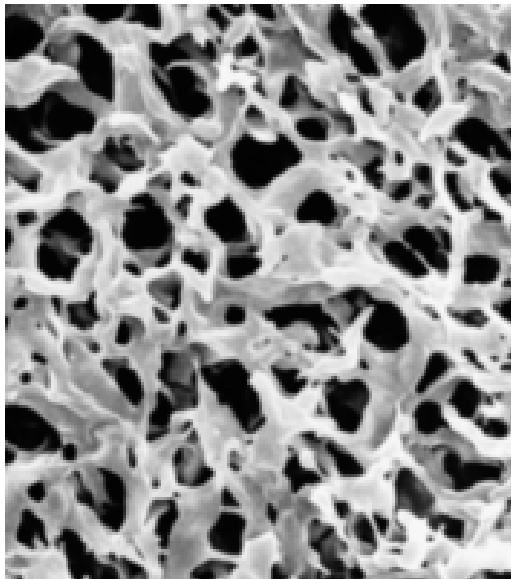


PES

PVDF

The Membranes

- Membrane chemistry and surface treatment affect the properties and operation of the membrane
  - Protein and color binding
  - Chemical stability
  - Cleanability
- Symmetry also affects many important membrane properties and operation
  - Membrane strength
  - Flow rate and pressure drop
  - Integrity testing
  - Surface tension of fluids



Why we recommend PVDF?

- Less color and protein removal
- More cleaning cycles before loss of permeability
- Slower loss of permeability
- Higher general robustness
- More reliable IT testing
- **Increased throughput offsets higher unit cost**

Lower Total Costs of Filtration

Throughput

- Gallons throughput per filter or change-out is the key metric to monitor.

Total Costs of Filtration

- Each scenario is a little different
  - How to value liquid wine ?
  - What does the operation look like ?
  - After throughput, frequency of plugging (even when not leading to a change out) is important
- Three angles to look at
  - (1) A higher throughput filter can usually directly match or beat a lower quality and priced cartridge based on fewer cartridges used
  - (2) The Total Costs of Filtration savings (wine loss, downtime, utilities, operator labor) are usually comparable to total filter spend
  - (3) A single QA incident costs many years of filter purchases

The Costs of Filtration

- Membrane filters are expensive when they prematurely plug …
- ... They are inexpensive when they achieve their full life
  - A 30” Vitipore II Plus could filter 100,000+ gallons
  - The cost at that level for filtration is $.004 per gal or 8 hundredths of a cent per bottle

System Sizing

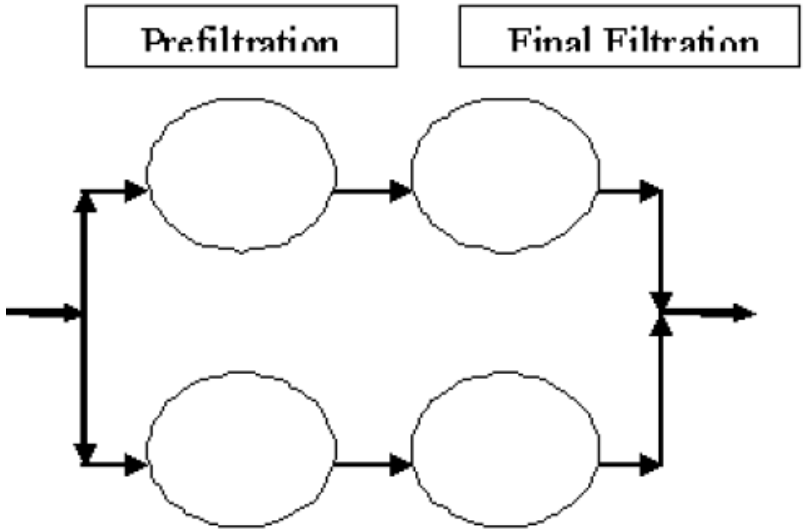
- Size your final Vitipore II Plus Filter at 6 to 10 gpm per 30 inch cartridge, rounding to the nearest housing size as shown in the table
- Recommend using one size larger than the final filters for the Bevigard prefilters
- Water prefiltration should be sized 1.5x final filtration

- Clarification housings and other applications need individual sizing

Flow Rate	Housing Size
0-10 gpm	1-Rd 30"
10-30 gpm	3-Rd 30"
30-50 gpm	5-Rd 30"
50-80 gpm	8-Rd 30"
80-120 gpm	12-Rd 30"

Parallel (Dual) Filtration Skids

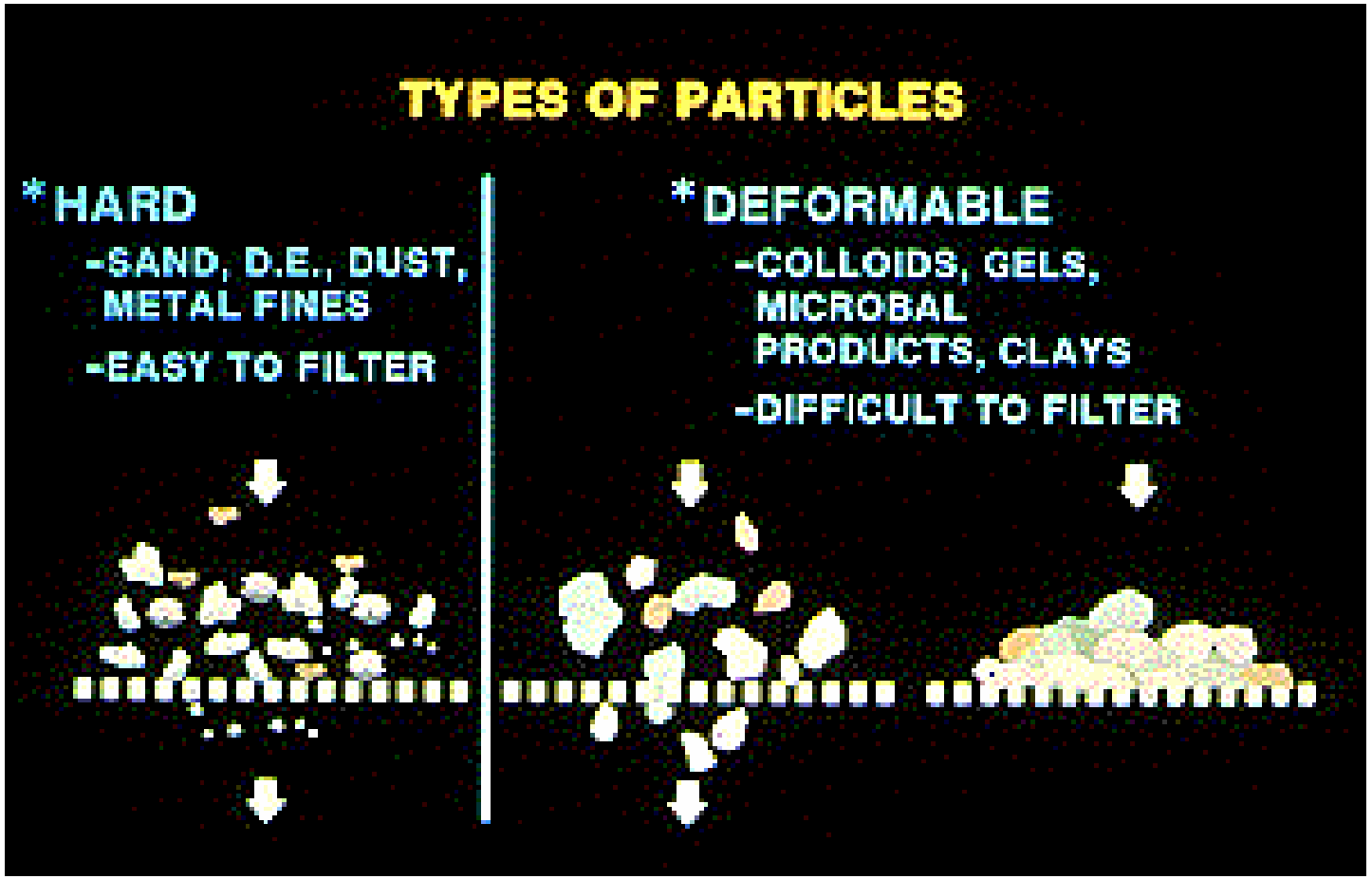
- Allows continuous bottling in the event of plugging, cleaning, wine or tank changes, etc.
- Allows for longer cleaning cycles
- Allows for specialized cleaning cycles (eg. citric acid to remove flavors or water deposits)



Operation

- Frequently Vent Housings
  - Especially on start-up and CIP
- Monitor differential pressures
- Track gallons throughput

Plugging Mechanisms



Conclusions on Filter Plugging

Filter plugging depends on:

- The **type of filter** used (depth/membrane, pore size rating)
- The **quality/filterability of the feed**
- The **speed (flow rate**) at which particles are deposited on the filter

Filter plugging's visible result is:

- Increase in **Pressure Drop** across the filters over time

Filter plugging can be delayed by:

- **Consistent operation**
- **Feed preparation**
- **Controlling water quality** used for cleaning
- Proper **Cleaning** regimens

Filter Cleaning

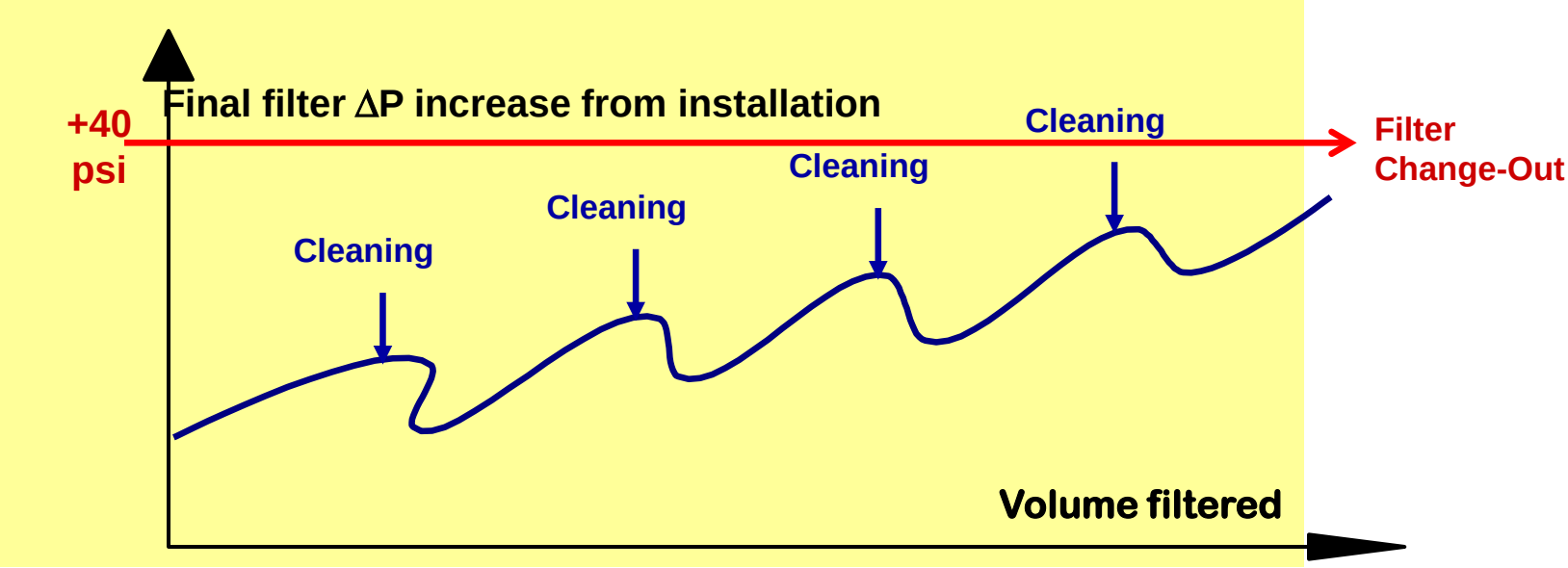
→Purposes:

- Improve overall filtration costs by extending filter life
- Eliminate flavor and color carryover

→Limiting factors:

- Bound proteins at high temperature
- Nature of plugging materials (inorganics not cleanable – Si, Al)

Filter Cleaning



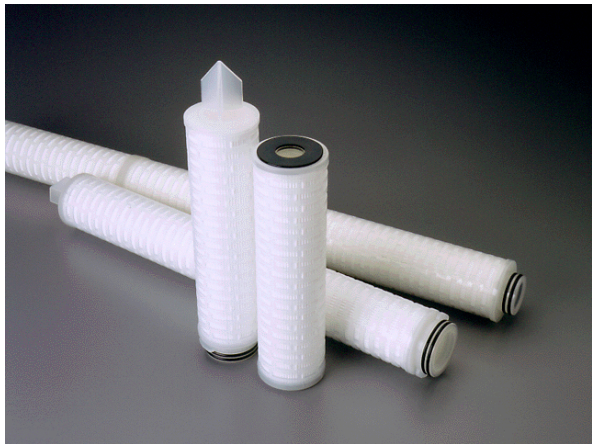
Cleaning Extends Filter Life

Filter Cleaning

- **Recommended procedure:**
  - **Cold water rinse; at least 10 minutes**
  - **Hot water cleaning and/or sanitation**
  - **Cold water cool-down**
- **Use the same flow rate as the process is run**
- **Gradual warm and hot water temperature increases to the final 180 F offers more efficient cleaning**

Filter Sanitization and Storage

- Purpose:
  - Kill micro-organisms to prevent bioburden growth
  - Prevent biofilm attachment to stainless steel surfaces (piping, housing)
- Limiting factors:
  - Contact time, temperature



Temperature

→ The maximum allowable pressure drop across the cartridges varies with the fluid temperature.

Fluid temperature	Maximum DP allowed
25 C (77 F)	80 psid
80 C (176 F)	25 psid
93 C (200 F)	20 psid

→ 135 F is the temperature at which many proteins are baked onto the membrane – always cold and/or warm water rinse before reaching this temperature

- → Nothing, outside of terrible feed quality, can impact filter life more

Cleaning and Sanitation Water

- Water used for cleaning and sanitation must be softened and filtered prior to use
- Water can be very high in plugging materials and build un-cleanable deposits onto the membrane
- Facilities that have properly cleaned water have seen as much as a 25% decrease in cartridge filter spend

Integrity Test Principles

→Why Perform an Integrity Test?

- Assurance of filter retention and bottled product quality

→Method to Detect System Leaks From:

- Improper filter installation
- Damaged filters
- Damaged filter o-ring or other gasket seal

Integrity Test Principles

When to Perform an Integrity Test ?

- → Whenever new final filters are installed
  - To ensure proper installation
- → After every cleaning and sanitation procedure
  - Especially at high temperature
  - Most common time of cartridge damage
- → After long term storage
  - To ensure integrity has been maintained
- → End of run
  - To show bottled product is safe
- → When post-final filter tests show micro counts
  - Are the filters by-passing / non-integral ?
  - Is there post-filter contamination ?

Troubleshooting

- Vitipore II filters are all double integrity tested in manufacturing with proprietary gas
  - No defective cartridges or membrane defects leaving the plant
- Carefully inspect shipping boxes for damage
- If ever an IT failure, contact Gusmer and arrange for a filter evaluation.
  - Every IT failure will be verified and sent back to Millipore for analysis free of charge if needed
- Filter end of life should be throughput based – never IT failure

Troubleshooting

- In multi-round setups, with good clarification, we want each Vitipore II to get 100,000 gallons throughput over its life.
  - When protected by Bevigard M
  - Wine must be properly prepared and clarified
  - Water should be filtered, softened
  - Cleaning must be carried out efficiently
- Contact Gusmer for recommendations on filter optimization
  - Always track throughput!!
- We've helped customers who super-optimize get as high as 300,000 gallons per 30" in multi-rounds (>3M per 12-Rd)
  - This is rare but shows the capacity for filter optimization

Thank you, Questions?