Separation Anxiety

Observational Insights to Understanding Wine Filtration
Filtration Goals

- Clarity
- Stability
- Efficiency
Scott Labs’ Specialty

• Filtration sales since 1965
• 90% of our filters used in winemaking
• Global awareness of process
  – Fermentation
  – Packaging
  – Bottling

• Our concern is for the wine, not for the filter.
Micron or μm

How big is a Micron?

2,000 times size

Human Hair
.0035 inch
.0889 mm

.0001 inch
.00254 mm

Micron
.000039 inch
.001 mm

SCOTT LABORATORIES
Suspended Solids

- Grape pulp – 20 to 200 micron, gelatinous
- Tartrate crystals – 5 to 500 micron, rigid
- Protein precipitates – 2 to 20 micron, gelatinous
- Yeast – 1 to 2 micron, gelatinous
- Bacteria – 0.5 to 0.8 micron
Clarification and Stabilization

Fining agents
Temperature
Gravity
Racking
Glossary

• Depth and Membrane Filtration
• Absolute/Nominal
• Rough, Polish & Sterile
• Integrity testable
How does depth filtration work?
The labyrinth or tortuous path
The charge on DE
Depth Filtration

• Goal – Removing Solids
• “Dirt holding capacity”

• Example: Filter pad media; DE Filtration; PP cartridges.
Membrane Filters

• High precision / accuracy
• Very low dirt holding capacity
• Examples: X-Flow, PES, PVDF, Glass matrix. Cellulose Acetate
Oenococcus oeni on membrane surface
Glucans

Clean PES membrane

PES membrane fouled with glucans from *Botrytis*
“Nominal vs Absolute”

• Beta ratings

\[
\beta_X = \frac{n_{\text{Upstream}} \geq X \ \mu\text{m}}{n_{\text{downstream}} \geq X \ \mu\text{m}}
\]

• Testing methodology
  – Typically spherical Glass or Nylon beads of a determined size passed under lab pressures

• Nominal = NOT absolute

• Absolute = maximum sized glass sphere (Absolutely nothing larger than the micron rating will pass through the membrane)
Titer Reduction Values

• Goal-based classification
• The best current method to distinguishing between similar but different filters
• $10^6$ vs $10^9$
Absolute/Nominal vs. Titer Reduction Value

– Two Filter Carts. Same grade, different Titer value:

- **Seitz XLII 0.45**
  - $10^9$ reduction of *Serratia marcescens*
  - 99.9999999% reduction

- **Brand X 0.45**
  - $10^6$ reduction of *S. marcescens*
  - 99.9999% reduction
Example #1

• Take an example of a wine exhibiting 100,000 cells/ml. Expect the following for the Seitz XLII 0.45:

• Reduction of 99.9999999% at $10^9$ would yield 0.0001 cells per ml OR:

• .075 bugs per bottle

\[
\begin{array}{c}
100,000 \text{ cells/ml} \\
\times 0.000000001 \\
\hline
0.0001 \text{ cell/ml}
\end{array}
\times
\begin{array}{c}
750 \text{ ml/bottle} \\
\times 0.0001 \text{ c/ml} \\
\hline
0.075 \text{ cells/bottle}
\end{array}
\]
Example #2

- Now try Brand X 0.45 with a titer reduction of $10^6$ at:
- Reduction of 99.9999% would yield 0.1 cells per ml
- OR:
- 75 bugs per bottle

\[
\begin{array}{c|c}
100,000 \text{ cells/ml} & 750 \text{ ml/bottle} \\
0.1 \text{ cell/ml} & 0.1 \text{ c/ml}
\end{array}
\]

Is this an important difference? Maybe.
# Rough, Polish and Sterile

<table>
<thead>
<tr>
<th>ROUGH</th>
<th>POLISH</th>
<th>STERILE/SANITIZING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than 5 micron</td>
<td>Between 1-5 micron</td>
<td>Less than 1 micron</td>
</tr>
<tr>
<td>-Turbidity reduction</td>
<td>-Brightness</td>
<td>-Brilliance</td>
</tr>
<tr>
<td>-Excessively cloudy</td>
<td>-Final clarity</td>
<td>-Yeast “sterility”</td>
</tr>
<tr>
<td>-Visible solids removal</td>
<td>-Yeast Population reduction</td>
<td>-Bacteria log reduction or</td>
</tr>
<tr>
<td>-Heavy Yeast removal</td>
<td></td>
<td>“sterility”</td>
</tr>
<tr>
<td><strong>DE:</strong> 1 Darcy</td>
<td><strong>DE:</strong> 0.3-0.4 Darcy</td>
<td><strong>DE:</strong> 0.1-0.2 Darcy</td>
</tr>
<tr>
<td><strong>Lenticular &amp; Pads:</strong></td>
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</tr>
<tr>
<td>K700 and up</td>
<td>K100 through K300</td>
<td>EKS through KS80</td>
</tr>
<tr>
<td><strong>Cartridges:</strong> Polypropylene</td>
<td><strong>Cartridges:</strong> Glass or PP</td>
<td><strong>Cartridges:</strong> PES</td>
</tr>
</tbody>
</table>

**HUMAN HAIR:** 55 µ  
**Common PVPP:** 25 µ  
**Saccharomyces:** 1-5 µ  
**Oenococcus:** 0.5-1 µ
Filtration options

- Pads
- Lenticular
- DE Filter
- X-Flow
- Cartridge

POWER

WINE LOSS

CAPITAL

MEDIA COST

LABOR

DISPOSAL
Filter Pads

- Preformed Depth Filters
- Rated from 0.2-55 microns
- Cellulose, DE, Perlite, Resin (or some combo)

- **Pro**: Pre-formed; repeatable; low capital costs
- **Neutral**: Medium media cost
- **Con**: Leakage loss; Disposal; Setup time; Space
Plate & Frame Filter
Assumed Conditions* – Pad Media

• Average filter capacity period: 2 hours
• Optimal flow rate per m² pad media
  • Sterile: 125 gal/hr/m²
  • Polish and rough: 220 gal/hr/m²
• Example: 2500 gallons of red wine to polish

\[ \frac{2500 \text{ gal}}{2 \text{ hours}} \rightarrow \frac{1250 \text{ gal/hr}}{5.68 \text{ m}^2} \rightarrow \frac{5.68 \text{ m}^2}{.16 \text{ m}^2 \text{ Per 40x40}} \]

**RECOMMENDED USE OF AT LEAST 36 40X40 FILTER SHEETS**

*This reality does not exist*
Filter pad regeneration

• 15 minute cold water forward flow
• 15 minute warm water (120F) forward flow
• 20-30 minutes sanitizing with 180F water
• Cool down the pads (slowly) after sanitizing otherwise microbes will breed overnight. (at 78 – 115F you can increase the population from 1 cell to 4 trillion overnight.)
Efficiency Tips - Pads

• Pre-rinse cycles
  – 2.0 pH with Citric and up to 1000ppm SO2

• **DO NOT MIX GRADES WITHOUT CROSSOVER**

• Replace “H” Gaskets every two years OR when hardening of rubber occurs

• Regeneration
  – Forward flushes of 120F
  – If Backflush, DO NOT exceed 7PSI

• Use 2-stage filtration when possible
Lenticular Filters

- THE SAME MEDIA AS PADS
- Modular format with 2 adapter types
- **Pro**: Quick setup/breakdown; repeatable; low capital costs; some backflushable; storable; **VERY LOW LOSS**
- **Con**: Higher upfront media costs; disposal
Lenticular Filter
Efficiency Tips - LENTICULAR

• Be flexible with housings
  – Size filtrations to minimize cost/filtration

• Regeneration
  – Forward flushes of 120F
  – If Backflush, DO NOT exceed 7PSI (use backflush plate for maximum support and efficiency)

• 12” vs 16” modules.

• Different height center posts, dual grade modules.
Cartridges

• Very low dirt holding capacity
• Very high precision and accuracy
• Often polymer based and sold for “T-style” housings in our industry (single open end)

• **PRO**: Standard for bottling; repeatable; regenerable; storable; high filterable surface

• **CON**: Poor for high solids; High media cost
Cartridge Filter & Housing
Integrity Testable

• IS THERE A **HOLE** IN MY FILTER!?

• Tests
  – Pressure diffusion
  – Bubble point
  – Pressure hold
    Same physics. Differs
    in which part of flow spectrum they examine.

• These tests should be preformed BEFORE and
  AFTER a filtration on membrane filters <1 micron.
Efficiency Tips - Cartridges

• REGENERATE AND STORE
  – Decrease expenses
  – Regenerate with Cleanskin K and store in EtOH (cheap vodka) or a pickle of Acid and SO2.
• If storing in SO2, remove gaskets
• In line Regeneration
  – Forward flushes of 130F
  – Backflush depth filters, but use hold-down or Code 7
• Do not wait more than 24 hours after “pre-filtration”
• Integrity test membranes BEFORE AND AFTER
Sample Filtration Strategies

Most Common Routes for Pad Filtration in Whites:

```
K300
\rightarrow\text{Must be a good filtration}
\downarrow
KS80
\rightarrow\text{EK (0.45\mu)}
\rightarrow\text{Pre-Membrane Cartridge (1.0-0.80\mu)}
\rightarrow\text{Membrane Cartridge (0.45)}
\rightarrow\text{Pre-Membrane Cartridge (1.0-0.80\mu)}
\rightarrow\text{Membrane Cartridge (0.45)}
```
Record Keeping

• Maintain Notes
  – Date, Wine, Vintage
  – Where the wine is in process
    (i.e. after two rackings or stuck MLF)
  – Record filter type; capacity; grade; operator
  – Track original/terminal Differential Pressure (dP)
  – Periodically record:
    • Gallons filtered
    • dP for each filter stage
Contacts

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