Separation Anxiety

Observational Insights to Making Filtration Day Easier
The 3 Filtration S’s

-Solids

-Stability

-Simplicity
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.
Depth Filtration

• Goal – Removing **Solids**
• “Dirt holding capacity”

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

• High precision / accuracy / Sterile
• Very low dirt holding capacity
• Examples: X-Flow, PES / PVDF Cellulose Acetate cartridges
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
TWO STAGE FILTRATION WITH DIVERSION CHAMBER

VIEW FROM TOP

MOVING HEAD
END PLATE
FILTER PAD
DIVERSION PLATE
END PLATE
FIXED HEAD

INLET
OUTLET
Filter Pads

• Challenges:
  – Edge leakage
    • Check gaskets
    • If using closure device, be sure to maintain closure pressure or use a “locking collar”
  – “Paper taste”
    • Sweetening cycle – SO2 & Citric
    • Buffer tank if direct to filling
Lenticular Filters

• Challenges:
  – Expense
    • Use on core products with high volume runs
    • Regenerate with back and forward flow cycles
  – Bypass
    • Use reinforced modules to prevent mechanical damage
    • Maintain low pressures during backflush
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**: High media costs; disposal
DE (or Perlite) Filtration

- Very high dirt holding capacity
- DE or Perlite Earth used
- Continuous addition of media creates capacity

**Pro:** Low cost media; very high DHC

**Con:** High capital costs; labor intensive; disposal; safety concerns
DE (or Perlite) Filtration
DE (or Perlite) Filtration

• Challenges
  – Variability between operators
    • Maintain notes
    • Train off a master sheet or periodically ask for retraining from factory trained tech
    • Regularly maintenance
    • Downstream “equalizer” such as a bag filter
  – Oxidation
    • Maintain dosing pump/feed pump
    • Use inert gas in dosing vessel
DE (or Perlite) Filtration

• Challenges
  – DE grades
    • Units measured in Darcy
    • Think of DE like gravel or sand filters. The larger the stone the bigger the gap
    • Best guide is historical data/performance
  – Setup, breakdown time
    • Use floc to minimize recirculation at setup
    • Only run vibration motors during breakdown
Crossflow

- High Efficiency filtration of wide range of %solids wine
- Employs tangential flow which minimizes permanent fouling
- NOT STERILE FILTRATION

- **PRO**: Single stage; automation available; reduces handling; low disposal and wine loss
- **Neutral**: Media cost medium to high
- **CON**: Capital cost high; media is not indestructible; requires good training
Crossflow
Crossflow
Crossflow

• Challenges
  – Clogging - Capillary
    • Most often this is a clog in the capillary, NOT the pore
    • Once clogged very difficult to regenerate because there is no longer flow
    • Consider VERY coarse filtration with pad or module prior if it has bento/carbon
Crossflow

• Challenges
  – Clogging-Pore
    • If premature, could be high pectin/glucan load.
    • Bacteria also common problem
    • Enzyme use, racking most helpful
    • Colloidal matrix can also be cause.
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
• Challenges
  
  – Premature clogging – precarts
  
  • Duration between filtrations
  • Was not previously filtered to sub-micron level
  • Pectin/Glucan issues
  • Resolve with backflush or more likely forward flush of warm water (140F)
Cartridges

• Challenges
  – Premature clogging – Membranes
    • High Bio-load
    • No prefiltration
    • Pectin/Glucans
    • Colloidal matrix
  – Resolution
    • Forward flow with warm water (140F)
    • Enzyme use
    • Tighter pre-filtration
Cartridges

• Challenges
  – Integrity test failure
    • Set tolerance levels
    • Secondary testing in single round housing
    • Avoid terminal pressures with air
Lab testing

• Turbidity
  – Helpful at higher turbidities to identify filtration strategy
  – Not helpful at lower turbidities. Only gives half the story

• Filterability testing
  – Good as a “go/no-go” analysis, but will not predict consumption
Filtration Foes and Friends

• Foes
  – Concentrate
    • Notorious for high pectin/glucan loads. Experiment with enzyme use
  – Gum Arabic
    • Not all created equal. Pre-filtered GA like Perdomini has almost negligible clogging index (1%). Other can be as high as 5%. Filter at around 24-72 hours post addition.
  – Gelatin
    • Will generate higher clogging index. Filter off racked wine after 72 hours
Filtration Foes and Friends

• Friends
  – Filtration Enzymes
    • Can be used as late as concurrent to filtration
    • Experiment during filtration testing to see if there is a distinct improvement
    • Best to use broad based enzymes at this point rather than specific (eg. Betaglucanases)
  – Fining and racking
    • Good solids separation in tank will significantly improve filtration.
  – Soluble products
    • Products like some tannins or other 100% soluble products can be filtered after the prescribed time without impact on filtration
Observations

• Things to keep notes on:
  – Specific wines which are problematic
    • Merlot always tough
    • Sweet wines (denser and may be associated with glucans)
    • Wines directly post MLF
  – Pressure evolutions
    • Maintain notes to train others on “normal” pressure changes
      on any given filtration type
  – Final filter integrity failure
    • Track lots that have been filtered between the previous
      successful test and the failure
Cost Considerations

- Filter Pad – 60x60 ~ $2.75
- Filter Pad – 40x40 ~ $1.40
- Cartridge Filters – Pre ~ $150.00
- Cartridge Filters – Finals ~ $300.00
- Crossflow Element ~ $5,000.00
General Strategy

- Use historical records to plan filtrations
- Give yourself time to get the work done
- Scale up and down for
  - Volume
  - “Dirtiness”
  - Speed
- When filtering the first time, use general guidelines for Optimal Conditions
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

\[
\begin{align*}
2500 \text{ gal} & \quad \rightarrow \quad 1250 \text{ gal/hr} & \quad \rightarrow \quad 1250 \text{ gal/hr} \\
2 \text{ hours} & \quad \rightarrow \quad 220 \text{ gal/hr/m}^2 & \quad \rightarrow \quad 5.68 \text{ m}^2
\end{align*}
\]

RECOMMENDED USE OF AT LEAST 36 40X40 FILTER SHEETS

*This reality does not exist
Assumed Conditions* – DE Media

- Average filter capacity period: 2 hours
- Setup/Breakdown is 1.5 hours
- Optimal flow rate per m² filter surface: 300 gal/hr/m²
- 8 hour work day
- Example: Average lot size is 6,000 gallons

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\begin{align*}
6000 \text{ gal} & \quad \rightarrow \quad 3000 \text{ setup} & \rightarrow \quad 1500 \text{gal/hr} & \rightarrow \quad 5 \text{m}^2 \\
2 \text{ set ups} & \quad \rightarrow \quad 2 \text{ hours/} & \quad \rightarrow \quad 300 \text{ gal/hr/m}^2 & \quad \rightarrow \quad \\
& \text{setup} & & \\
\end{align*}
\]

A 5m² filter should allow for 6,000 gallons to be filtered in 7 hours including setup/breakdown

*This reality does not exist
Sample Filtration Strategies

Most Common Routes for Pad Filtration in Whites:

- K300
- KS80
- EK (0.45μ)
- Pre-Membrane Cartridge (1.0-0.80μ)
- Membrane Cartridge (0.45)

Must be a good filtration
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
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
Efficiency Tips - Cartridges

• **REGENERATE AND STORE**
  – Decrease expenses
  – Regenerate with NaOH and store in ETOH (cheap vodka)
• 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 48 hours after “prefiltration”**
• Integrity test membranes BEFORE AND AFTER
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 16”units for maximum support)
Efficiency Tips – DE Filter

• Challenge the filter – minimize passes
• All good filtration start with the precoat
  – Consider Cellulose “Floc”
• Study your goals and keep records
• Regular maintenance reduces O2 pickup and improves filter efficiency
• “Heel” or Residual filters minimize losses
• Train new operators from written, NOT oral histories
Efficiency Tips – Crossflow

• Educate operators on theory before practice
• Consider “prefiltration/fining”
  – Most units have cartridges but of varying grades
  – Avoid Bentonite and Carbon
• Beware large bacteria populations
• Extra input in clean cycles can greatly increase filter efficiency
• Hold emergency stock of filter element/s
• **DO NOT TRASH “BROKEN” ELEMENTS**
Efficiency Tips – No Filtration

TEST, TEST, TEST, TEST
Continuing Education

• Scott Labs
• Laboratory resources
• UC Davis Filtration short course
• Practice and History!