



KEYS TO WINE CLARITY

Natural Settling, Fining Agents and Filtration Resources for Winemakers

Chik Brenneman

Winemaker and Partner, Baker Family Wines

West Sacramento, California

Definitions

- Clarification – The process by which insoluble matter suspended in wine is removed
- Stabilization – Bringing the wine to a state where it maintains clarity by physical or chemical means

What kind of particles are we dealing with?

- Visible things (more or less)

- Skins
- Pulp
- Yeast lees
- Bacteria
- Some Proteins
- Some Tartrates

- Invisible Things (more or less)

- Other Proteins
- Other tartrates
- Tannins/Phenolic Compounds

Is clarification a bad thing?

- Philosophical approach to winemaking
- Esthetics or problem mitigation?

Methods of Clarification



- Natural Settling*
- Refrigeration*
- Fining/Chemical Addition*
- Filtration*
- Centrifugation
- Flotation
- Pasteurization
- Reverse Osmosis

Natural Settling Basics

- Particles moved towards the bottom of a vessel to form a sediment
 - Lees
- The applied force is gravity
 - Applied force not affected by the velocity
- Drag force is the opposite force
 - Drag force is affected by the velocity
- Terminal velocity
 - Particle size, shape, density and viscosity

Refrigeration Basics

- Define refrigeration as anything cellar temperature or below
- Sometimes with applied energy
 - Energy = Cost
- Naturally occurring
- Used in conjunction with natural settling or fining/chemical additions

Fining/Chemical Additions



- WHAT IS FINING?
- DEFINITION: Clarification of wines or juices by additions of insoluble or colloidal particles for the purpose of removing an “undesirable” physical or chemical characteristic

IS FINING NECESSARY?

- Post fermentation wine contains yeast, bacteria, mineral salts, colloids, grapes material and other amorphous material
- At completion of alcoholic fermentation, wine is a colloidal solution and a colloidal suspension
- Natural sedimentation, centrifugation and filtration do not protect wine against colloidal hazes

**FINING AGENTS ARE COMMONLY USED
TO CLARIFY & TO AVOID COLLOIDAL
HAZES**

WHY FINING?

- Particle density (which is close to wine), electrical repulsion forces and diffusion phenomena lead to very slow & insufficient natural sedimentation.
- If you have time, it *may* settle out.

GOAL OF FINING



- Insure long term stability
 - irrespective of the temperature, light exposure, or storage conditions.
- Fining agents in juice or wine are for:
 - Clarity
 - Color and flavor adjustments
 - Stability modifications
 - Processing aids.

SUCCESSFUL FINING




- Fast and efficient result in minimal losses
- The wine should remain clear with no undesirable effect on aroma, flavor or mouthfeel
- Fining should be conducted on the final wine blend!
- Part of aging may or may not include fining

MECHANISMS OF FINING



- Fining agents work via surface actions
- The fining agent and its subject may interact via
 - Electrical Interaction
 - Bond (Hydrogen) Formation
 - Absorption
 - Adsorption
- Complex bi-phasic (non-stoichiometric) process that involves flocculation then sedimentation



WHAT IS YOUR
GOAL & TIME
FRAME?

- To treat as far away from the end consumer as possible

Clarity

Modification: aroma,
flavors, mouthfeel,
color

Improved filterability

Stability...

CLASSIFICATIONS OF FINING AGENTS



- Fining agents are grouped according to their general nature
 - Proteins
 - Earths
 - Synthetic Polymers
 - Colloids/Polysaccharides
 - Non-Allergenic

PROTEIN BASED OPTIONS

	GELATIN	ISINGLASS	CASEINS	EGG ALBUMEN
ORIGIN	Collagen	Fish- swim bladder (Collagen)	Milk	Egg white
USE	Reds, whites and rosés	Reds, whites, rosés wines	Reds, whites, rosés	Aged red wines
	Reduce microbial populations, astringency, moldy aromas, juice browning. Clarify and unmask hidden (positive) aromas	Clarity, unmask aromas, aid filtration, soften mouthfeel	Reduces- bitterness, oak characteristics, color (browning/pinking), Cu. Clarification	Polishes and softens
CONTACT & REACTION TIME	7-21 days	10-28 days	2-15 days	5-21 days
	Flocculation is rapid, but sedimentation is slow	Flocculation is rapid, but sedimentation is very slow	Flocculation is rapid, but sedimentation is slow	Flocculation is rapid, but sedimentation is slow
COUNTER-FINE	Often	No	Often	Depends
LEES VOLUME	Heavy & bulky	Compact, but significant (>2%)	Medium	Compact, can be significant
DOSAGE	50-1500ppm	15-30ppm	20-100ppm	50-150ppm or 1-3 egg whites (per barrel)
SPECIFIC NOTES	More respectful in younger wines-Use early. Effect enhanced at lower temps.	Settling not temperature dependent. Can be used late in the process.	When blended with pot. Bicarb enhance solubility. Can float/coagulate on surface.	Must be formulated/ prepared with KCl so you don't end up with turbid wine. Can be foamy.

*Counter fine with bentonite, tannins or silica gel to prevent overfining

EARTHS

- Bentonite
 - Volcanic Clay (mineral)
 - Classed as a Montmorillonite
 - Complex of hydrated aluminum silicates with exchangeable cationic components
 - Exchangeable cations: Sodium (preferred for general use) and Calcium (sparkling)
 - Rapidly binds with proteins (heat stable and heat unstable), slow to settle
 - When rehydrated enormous surface area (300-900m²/g)
 - When in solution it acts as a multi-plated negatively charged structure that can exchange cations with positively charged components in juice or wine

CHALLENGES WITH BENTONITE

- Large loss in lees
 - 5-20%
 - If you need to compact lees more try aqueous solution of Silicon Dioxide or Gelatin
- Take care with sparkling wine production
 - Removing all the proteins makes it difficult to establish a quality mousse
 - Large bubble size and poor bubble stability
- Reputed to alter the organoleptic quality of your wine
- Can pick up “cellar” odors, store in a clean dry environment

RECOMMENDED ADDITION RATES

- Bentonite and Juice
 - Only juice components adsorbed (Including amino acids)
 - Juice lees lower monetary value than wine lees
 - Can remove herbaceous aromas and reduce browning
 - Generally need less than if only doing a post fermentation addition
- Follow manufacturers guidelines for preparation and make sure addition is homogenized
- Bentonite addition rates: Juice & Wine

Agent	Juice	Wine	Contact Time
Bentonite	0.5-2#/K	1-5#/K (sometimes more)	5-14 days

SYNTHETIC POLYMERS

- Origin
 - Silica gel (Silicon Dioxide)
 - Prevents over-fining (used in conjunction with a protein based fining aid)
 - Aids settling speed, lees compaction and improves filterability
 - Polyvinylpolypyrrolidone (PVPP)
 - Protein like fining agent with selective affinity for low MWt phenolics
 - Adsorbs Catechins and anthocyanins via hydrogen bonding

- Properties

- Insoluble in water and wine
- Flocculates

AGENT	JUICE (ppm)	WINE (ppm)	CONTACT TIME
PVPP	400-800	150-500	10-21 days

- Uses: Juice or wine

- Bitterness and color adjustments (pink and brown pigments)

COLLOIDS (POLYSACCHARIDES)

- **Alginate (Sparkolloid)**

- Polysaccharide on a DE carrier
 - Different formulation due to solubility in alcohol
 - Strong positive charge
 - Helps to settle out finely suspended particles
 - Most effective at $pH 3.5$
 - Enhances clarity and filtration quickly

- **Gum Arabic**

- Polysaccharide (Arabinose)
- Added just prior to bottling
- Prevents colloidal coagulation (protective colloidal)

COLLOIDS (POLYSACCHARIDES)

- **Mannoproteins**

- Fresh yeast/ Yeast autolytic fractions
- Stabilize proteins and tartrates, freshen wine (oxidized),
- bind metal ions

AGENT	WHITE WINE (ppm)	RED WINES (ppm)	CONTACT TIME	LEES VOLUME
Alginates-Cold mix	125-250	NA	7-14 days	Compact
Alginates-Hot mix	125-500	125-500	7-14 days	Compact
Gum Arabics	440-1320	440-1320	No racking	No lees
Manno-proteins	100-300	100-300	Depends	Depends

OTHERS

The background of the slide features a soft-focus image of two wine glasses. The glass on the left is filled with a dark red wine, while the glass on the right contains a lighter, golden-colored wine. In the background, a wine bottle is partially visible, its neck and cork area slightly out of focus. The overall lighting is bright and even, creating a clean and professional aesthetic.

- Carbon, enzymes & copper
 - Carbon
 - Deodorizing and decolorizing carbons available
 - Enzymes
 - B-glucanases & pectinases
 - Copper
 - Sulfide issues
 - Lysozyme
 - LAB's...

BLENDED FINING AGENTS


- Casein & Bentonite
- Casein & PVPP
- PVPP & Bentonite
- ...

Synergistic effect!

FINING AGENT COMPARISON

Color Reduction	Tannin Reduction	Volume of Lees	Clarity & Stability	Potential to Overfine	Quality Impairment
Carbon	Gelatin	Bentonite	Bentonite	Gelatin	Carbon
Gelatin	Albumen	Gelatin	Carbon	Albumen	Bentonite
Casein	Isinglass	Casein	Isinglass	Isinglass	Casein
Albumen	Casein	Albumen	Casein	Casein	Gelatin
Isinglass	Bentonite	Isinglass	Gelatin		Albumen
Bentonite	Carbon	Carbon	Albumen		Isinglass

Order of effectiveness and activity



Dependent upon the wine, the agent used, method of preparation and addition, concentration, pH, metal content, temperature, age, and previous treatments.

Wine Analysis & Production. Zoecklein et. al. 1999

CONDITIONS FOR SUCCESSFUL FINING...

- Perform bench trials prior to treatment of the entire batch
- Surface reactions occur between fining agents and molecules they are reacting with.
- Preparation of agent important
 - As directed by manufacturer
 - Generally in water
 - If in wine coagulation will begin prematurely reducing efficacy
- Addition method important
- Racking is important

FINING CONSIDERATIONS



- Lack of specificity
- Over-fine
- Oxygen exposure
- Lees volume (loss of wine)
- Stability considerations
- Expense
- **Bench trials**

BENCH TRIALS

- Essential
 - Simulate cellar conditions
- Determine/observe
 - Flocculation time
 - Settling speed
 - Resultant clarity
 - Volume and quality of Lees
 - Organoleptic effect



BENCH TRIAL SHEETS, CALCULATORS & REGULATIONS

FINING TRIAL

Suggestions / questions / comments? email the calculator services staff

HOW TO SET-UP A LABORATORY-SCALE FINING TRIAL

- Always carry out a fining trial before any additions are made in the cellar
- incorrect additions might result in under- or over-finings, quality loss (stripping), product loss (lees, added expense etc.
- Always include a control
- Always use the same batch of fining agent in the laboratory trial as used in the cellar
- Use fresh samples
- To measure volumes precisely, invest in a variable volume pipette


Volume of your sample mL

Concentration/strength of your stock solution (fining rate) g/L

Start point of fining rate

End point of fining rate

FERMENTATION
FILTRATION
CORKS & PACKAGING
EQUIPMENT
LABORATORY



FRESHPROTECT
White, Rosé, Fruit
For treatment of oxygen sensitive musts

BENCH TRIAL PREPARATION

Prepare a 10% solution of Freshprotect by mixing 10 g Freshprotect with 80 mL of deionized water in a 100 mL graduated cylinder. Once combined bring the volume up to 100 mL

Bench Trial Recommendations (Per 375ml bottle):

Target Addition	lbs/1000 gal	ml's of 10% Lab Dilution
20 g/hL	1.7	0.75
40 g/hL	3.3	1.50
60 g/hL	5.0	2.25
80 g/hL	6.7	3.00
100 g/hL	8.3	3.75

Allow wine samples to polymerize by waiting 24 hours before viewing results.

- TTB WEBSITE
- [24.246](#)- materials authorized for the treatment of wine & juice

Materials and use	Reference or limitation	TTB notes
Milk products (pasteurized whole, skim, or half-and-half):		
Fining agent for grape wine or sherry	The amount used must not exceed 2.0 liters of pasteurized milk products per 1,000 liters (0.2 percent V/V) of wine.	
To remove off flavors in wine	The amount used must not exceed 10 liters of pasteurized milk products per 1,000 liters (1 percent V/V) of wine.	

- [24.250](#)- wine & juice treating materials administratively

<p>Chitin-glucan: To clarify and to stabilize wine.</p>	<p>Chitin-glucan must be derived from <i>Aspergillus niger</i>. The amount used must not exceed 500g/hL of wine. GRAS Notice No. GRN 000412</p>	<p>Preliminary conclusion allowing use of chitin-glucan derived from <i>Aspergillus niger</i>. 9/22/2016</p>
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TYPES OF MICROFILTRATION

- Surface filtration

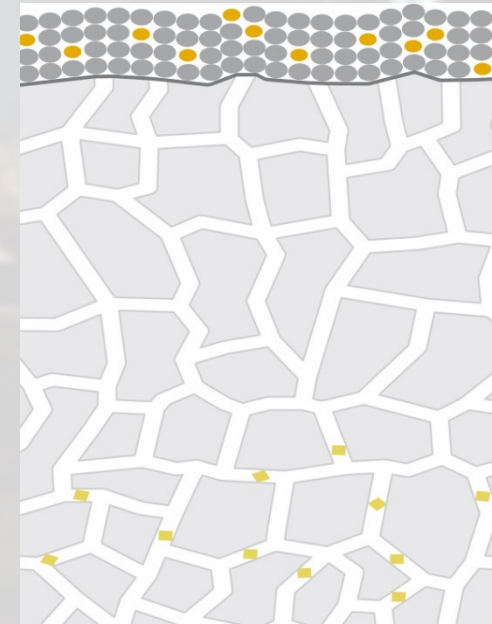


Depth filtration

e.g. filter sheet

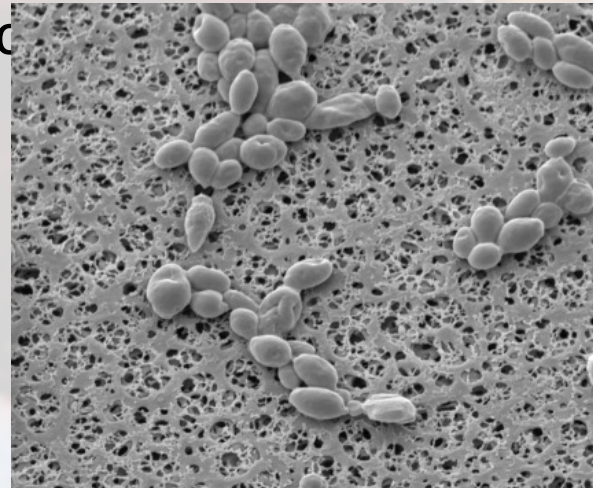
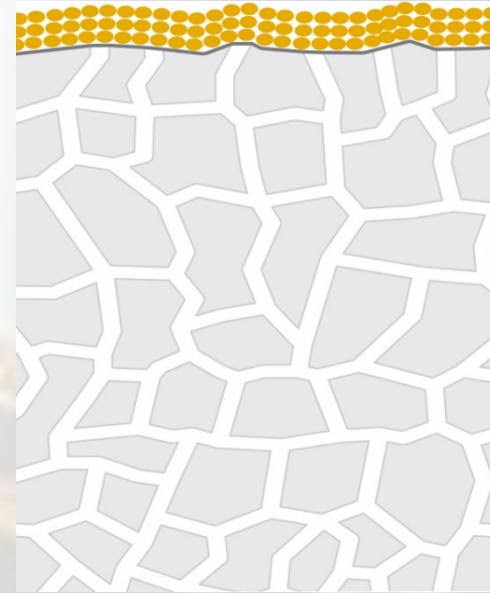


e.g. alluvial filter



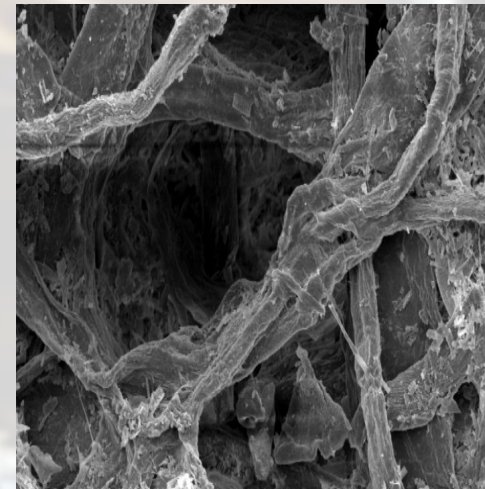
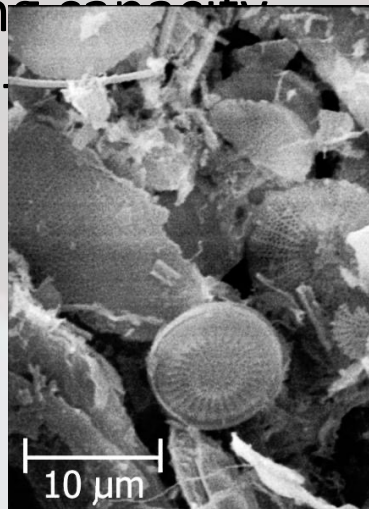
SURFACE FILTRATION

- Surface filtration
 - Mostly absolute filtration
 - „Coffee filtration“
 - Particles bigger than pores
 - Low dirt holding capacity



DEPTH FILTRATION

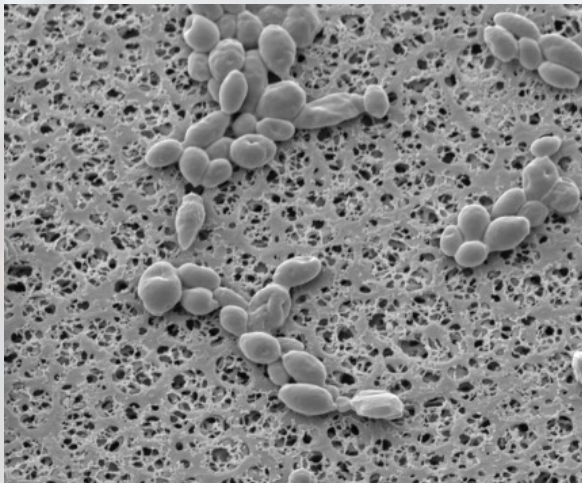
- Depth filtration
 - Mostly nominal filtration
 - Filtration through 3-dimensional porous body
 - Torturous paths/channels
 - Large dirt holding capacity
 - Economical solution



ABSOLUTE vs. NOMINAL

- Absolute filter

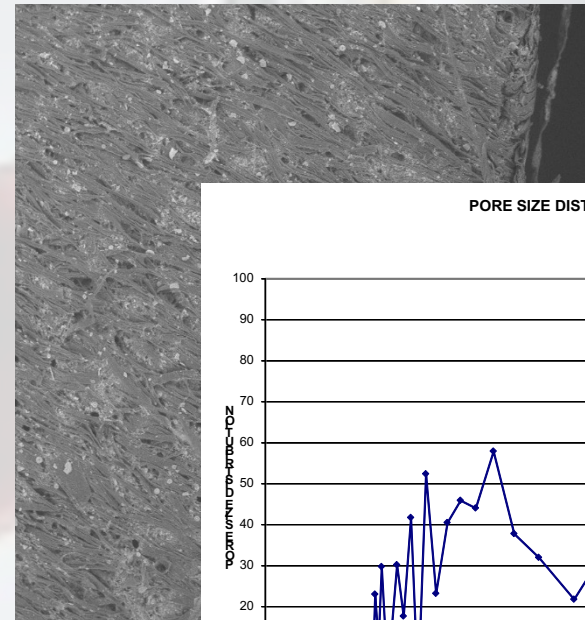
- +/- defined pore size
- can be measured
- „police filter“



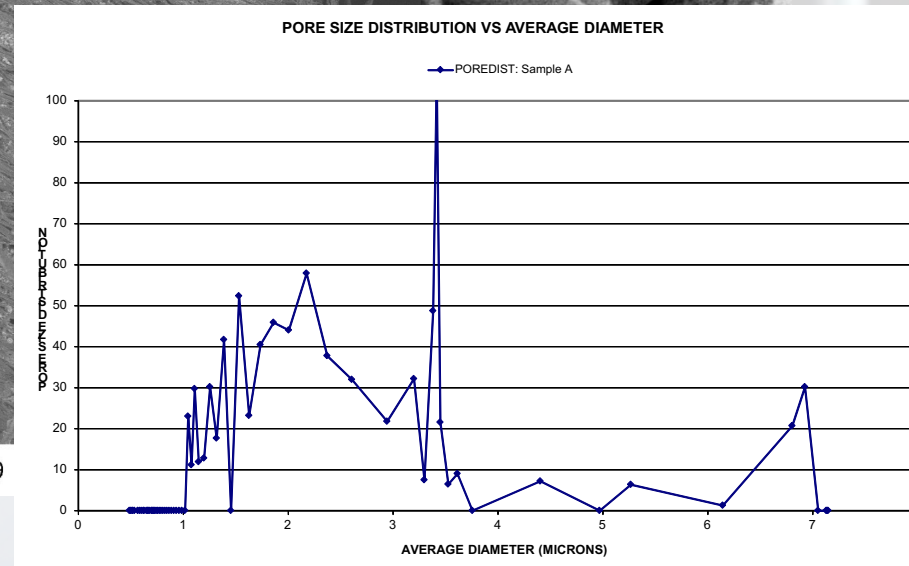
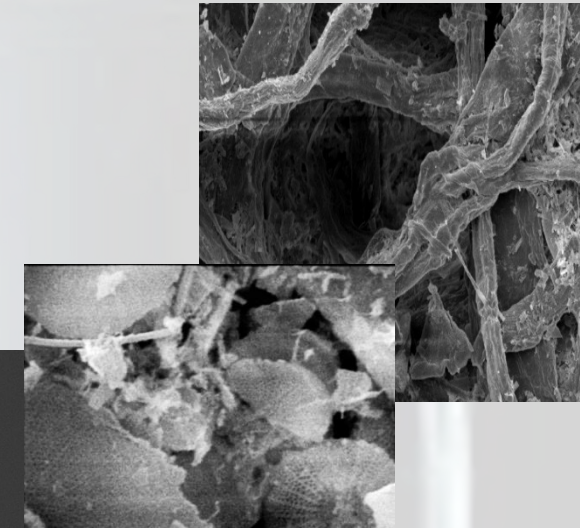
Saccharomyces cerevisiae on 0.65µm PES-membrane

Nominal filter

- relative retention rate
- indirectly determined
- particles of variable sizes can be retained



TM-1000_0019



COMPOSITION OF FILTER SHEETS

- Materials

- Cellulose fibers
 - Milled cellulose fibers for 3D structure of filter
- Filter aids
 - Enlarge inner surface
 - Enhance straining effect of filter
- Resin binder
 - Wet strength agent
 - Positive zeta potential binds negative charged particles



PLATE & FRAME FILTER

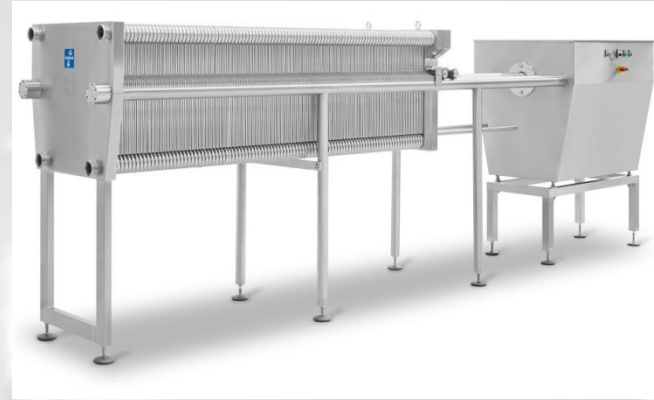


PLATE & FRAME FILTER

Functional principle – with crossover plate

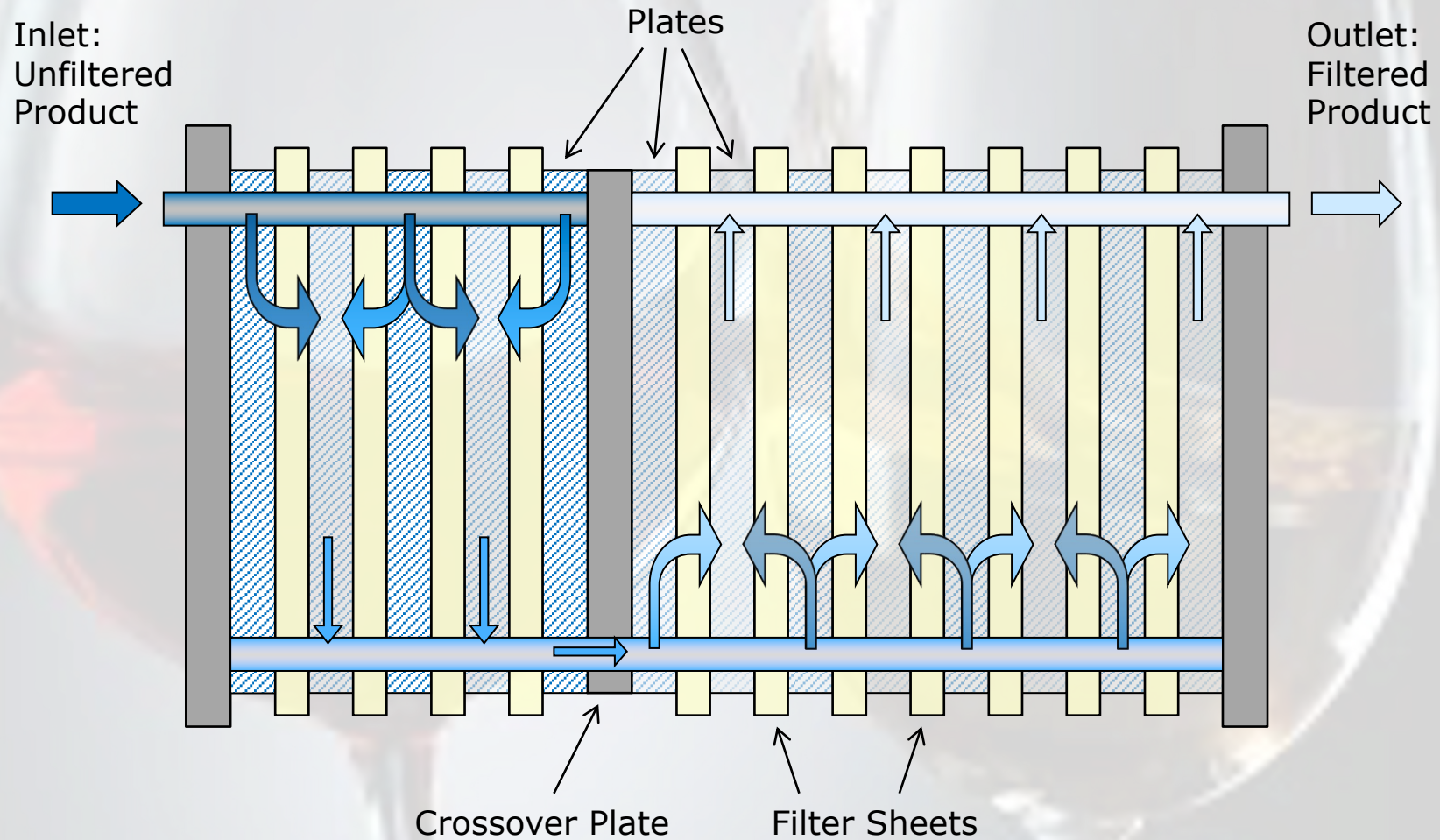
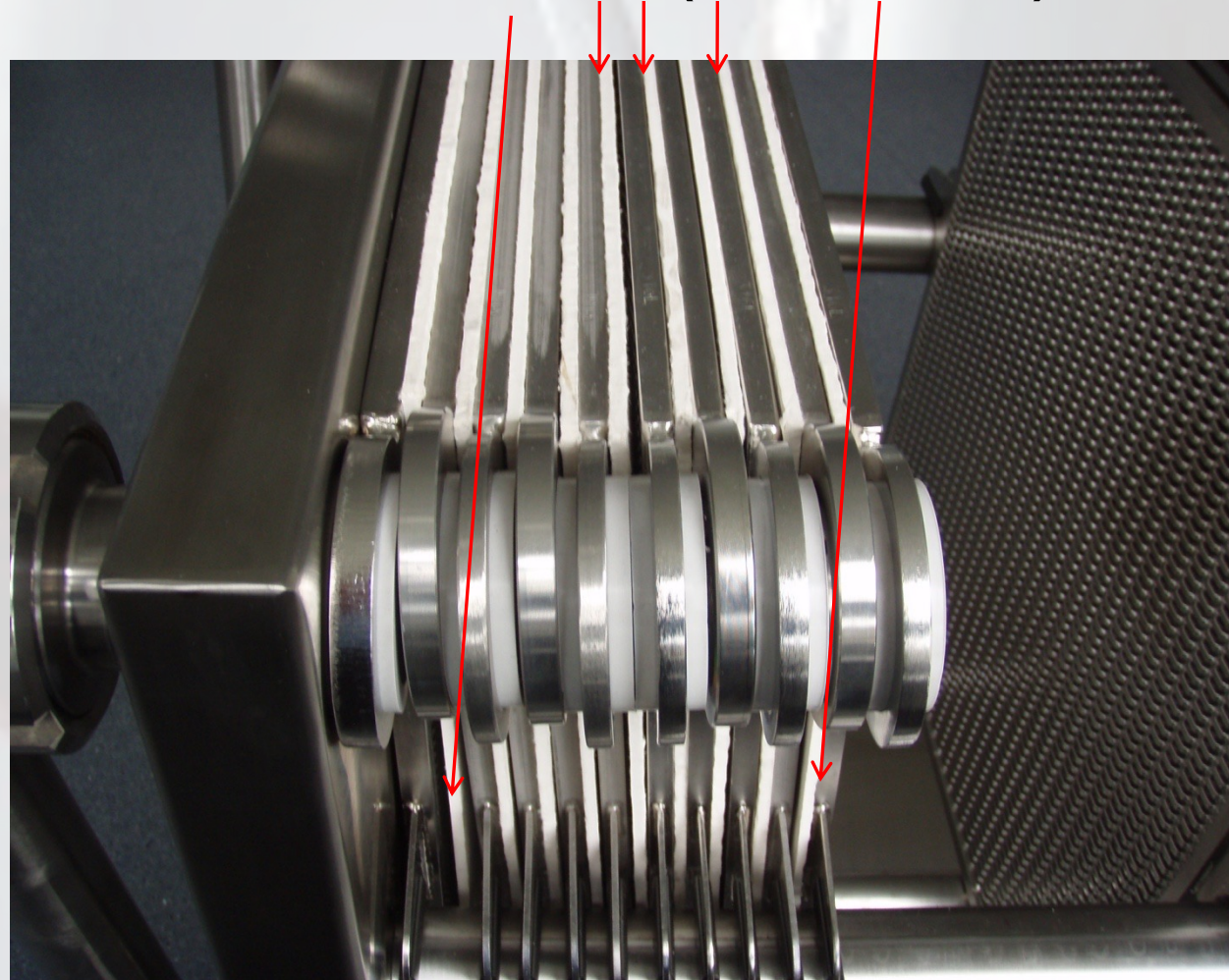
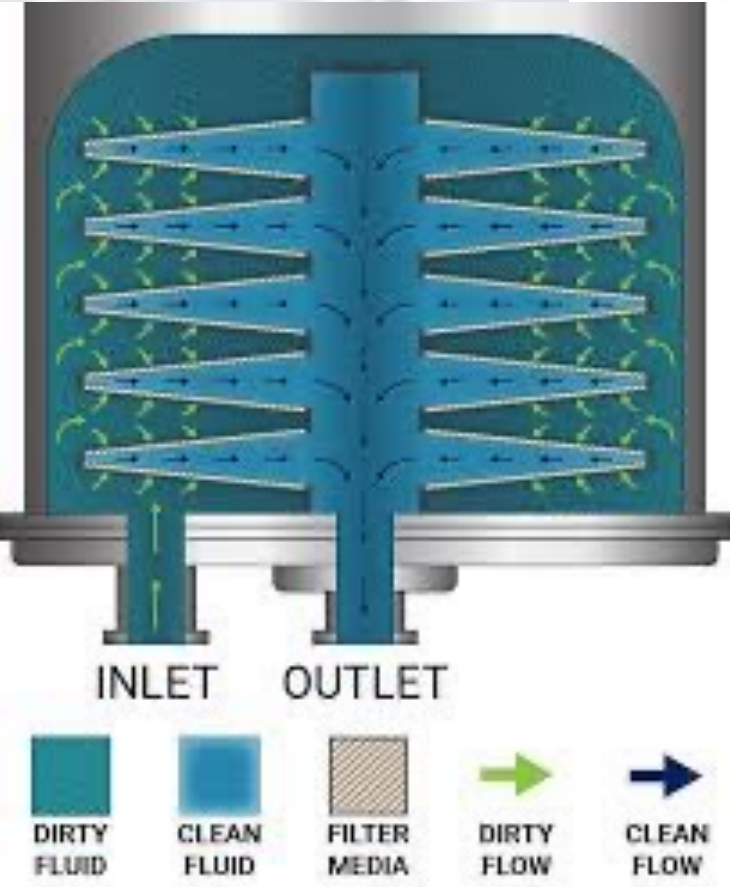


Plate & Frame Filter

Before closing the filter, wet the pressure section of the filter sheets (from outside)



LENTICULAR FILTER



LENTICULAR FILTER



MEMBRANE FILTER



Checks during filtration / critical figures

1. Max. flow rates
2. Max. differential pressure
3. Permanent flow (no stop and go)

FibraFix Grades

Standard version	High capacity version*	Retention rate (µm)	
Filtrodur 900			Supporting sheet
AF 6		35 - 15	Coarse filtration
AF 9		30 - 10	
AF 15		20 - 8.0	
AF 20	AF 21H	15 - 6.0	Clarifying filtration
→ AF 30	AF 31H	12 - 5.0	
x AF 40	AF 41H	9.0 - 4.0	
x AF 50		6.0 - 3.0	
→ AF 70	AF 71H	3.0 - 1.5	Fine filtration
x AF 100	AF 101H	1.5 - 0.6	Germ reducing filtration
x AF ST 110		0.8 - 0.5	Sterile filtration
→ AF ST 130		0.6 - 0.4	
AF ST 140		0.4 - 0.2	
AF ST 150		0.2 - 0.04	

* Provides increased dirt holding capacity for longer service life

→ Spec Sheets:

<http://www.filtrox.com/downloads/technical-data-sheets/index.en.html>

Flow Rates for Wine Filtration

Prefiltration

Sheet grade	Module grade	Rec. flow rate (L/m ² hr)	Max. differential pressure (bar)
AF 20, AF 30, AF 31H	AF 23, AF 33	700	2.5
AF 40, AF 50	AF 43, AF 53	700	2.5
AF 70, AF 100	AF 73, AF 103	500 – 700	1.5 - 2

Final filtration /
Bottling filtration

Sheet grade	Module grade	Rec. flow rate (L/m ² hr)	Max. differential pressure (bar)
AF 100	AF 103	500	1.5
AF ST 110	AF 113	350	1.5
AF ST 130	AF 133	350	1.2
AF ST 140	AF 143	300	1.2

Filter area sheets:

40x40cm sheet → 0.14 m²

60x60cm sheet → 0.33 m²

Filter area modules:

12" module → 1.8 m²

16" module → 3.6 m²



Calculation Example:

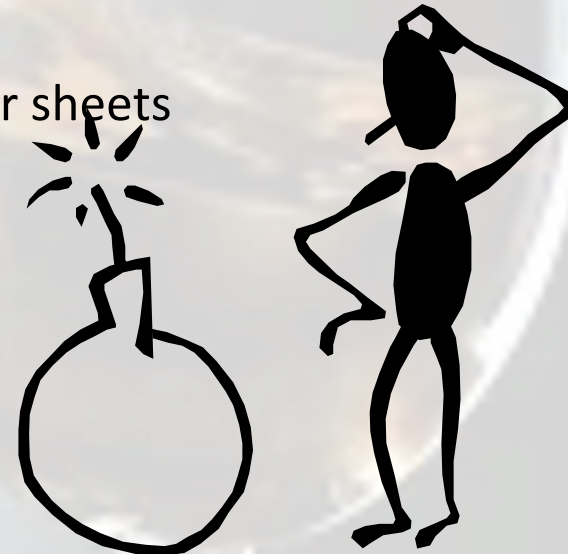
Actual flow rate = Rec. flow rate * m² of sheet or module used * number of sheets or modules used

Filtration with AF ST 130 in a 40x40cm filter with 35 sheets:

350 L/m²hr * 0.14 m² * 35 = **1715 L/hr**

TROUBLESHOOTING

- The filtered product looks good but the process is not profitable due to premature blinding of the filter sheets:
 - Filter was not vented properly
 - Filter sheets inserted the wrong way around
 - Filter sheet grade is too tight
 - No or not the right prefiltration
 - Isolated reasons unrelated to the filter sheets



TROUBLESHOOTING

- The filtered product is cloudy or out of specification:
 - Filtration flow is too fast
 - Filter sheet grade is too coarse
 - Pressure shocks in the filter during filtration
 - Isolated reasons unrelated to the filter sheets



The image features two wine glasses against a dark, gradient background. The glass on the left is filled with a deep red wine, while the glass on the right is filled with a golden white wine. The lighting highlights the curves of the glasses and the liquid within. The text 'ACKNOWLEDGEMENTS' is centered in the upper half of the image in a white, sans-serif font.

ACKNOWLEDGEMENTS

THANK YOU

QUESTIONS