Tartrate Stability

Mavrik North America

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Tartrate Stability

- Potassium bitartrate = KHT
- Tartrate Stability: Absence of visible crystals (precipitation) after extended time at a reference temperature

Common Applications

- Sparkling Wine
- White Wine
- Rose Wine

Red Wine

- Not typically held cold (below 10c) for extended periods
- Pigment-Tannin-KHT complexes result in as much 40% greater solubility than in comparable white wine

Vineyard Factors

- UV Radiation
- Soil
- Rootstock
- Irrigation
- Other more important quality vectors to manage in vineyard

Juice vs. Wine

- Alcohol decrease solubility of KHT
- Significant KHT precipitation occurs during and following fermentation
- Wine becomes ~KHT stable at cellar temperature over time
- Increasing presence of colloidal structures increases solubility

Solubility of KHT in Wine (g/l)

	ETHANOL CONTENT (%v/v)				
TEMP (c)	**0**	**10**	**12**	**14**	**20**
0	2.25	1.26	1.11	0.98	0.68
5	2.66	1.58	1.49	1.24	0.86
10	3.42	2.02	1.81	1.63	1.1
15	4.17	2.45	2.25	2.03	1.51
20	4.92	3.08	2.77	2.51	1.82

*From Berg & Keefer (1958) & Principles and Practice of Winemaking, Boulton, et al. (1996), p. 321

Relationship of KHT to pH

Fraction of tartaric acid in the ion forms at various pH values

pH	% Undissociated	% Bitartrate	% Tartrate
2.80	66.60	32.80	0.55
3.00	55.50	43.30	1.15
3.20	43.70	54.00	2.28
3.40	32.40	63.40	4.24
3.60	22.60	70.00	7.43
3.80	14.80	72.90	12.26
4.00	9.19	71.70	19.10
4.20	5.38	66.50	28.10

*From Principles and Practice of Winemaking, Boulton, et al. (1996), p. 321

Crystallization Factors

- the concentration of KHT
- Presence of crystalline nuclei
- Impedimentory complexing factors
- Supersaturation necessary for nucleation
- Once nucleation has occurred, further crystal growth results in precipitation

Complexing Factors

- Proteins & tartaric acid (White-Red)
- Polyphenols & tartaric acid (Red)
- Also inhibitory may be complexes with metals, sulfates & gums

Potassium Additions

- Potassium sorbate
- Potassium metabisulfite
- Potassium bicarbonate

Potassium Bicarbonate

- Deacidification should be done prior to tartrate stabilization
- Take into account likely effects of tartrate stabilization on TA (ie, -1 to -2 g/l TA

Potassium Sorbate

- Sorbate will add up to 70 mg/l K
- These can compromise cold stability
- In controlled methods (RCS, ED, etc), overshoot by 1% conductivity change
- In uncontrolled (chilling) methods add sorbate before KHT stabilization?

Potassium Metabisulfite

- May add up to 30 mg/l K
- Make addition (if necessary) right before measuring KHT stability
- Perform KHT stabilization
- Make final adjustment prior to bottling

Fining

- Fining removes complexing factors (polyphenols, proteins, etc.)
- Fining should be completed prior to determination of and treatment for KHT stability
- Bentonite fining often done concurrently w/ chilling methods

Filtering

- Filtration will remove colloids and condensed polyphenols (yes, white too)
- Wines ideally bottling line ready prior to determination of and treatment for KHT stability
- Where this is not possible, overshoot or consider stabilizing additives

Methods to Determine KHT Stability

- Solubility Product
- Concentration Product
- Freeze Test
- Conductivity Change Test

Solubility & Concentration Products

- Equations utilizing known variables (k-, HT+)
- Rapidly declining use to favor of faster, easier, less expensive methods

Freeze Test (or Hold Cold)

- Freeze and thaw a wine sample quickly (freezer)
- Or hold cold (refrigerator) for extended period
- Freezer too cold; Refrigerator too warm
- Confounding effects of other solutes
- Difficult to interpret results

Conductivity Change

- Chill small sample to desired temperature
- Seed w/ KHT
- Measure drop in conductivity after KHT precipitates
- <5% change at target temp is considered KHT stable

Conductivity Change Benefits

- Fast (10-30 minutes)
- Accurate (true simulation)
- Inexpensive
- Easy to do on-site
- However, understates stability, especially at lower pH levels

Methods to Achieve KHT Stability

- Chilling
- Contact Seeding
- Ion Exchange
- Metatartaric Acid
- Carboxymethylcellulose (not approved)
- Electrodialysis
- Nanofiltration + Microfiltration
- Glycoprotein addition (not approved)
- Mavrik Rapid Cold Stabilization (RCS)

Chilling

- Hold at or below target temperature until KHT precipitates
- 1-6 weeks
- Lowers TA
- Raises pH (if initial is >3.65)
- Lowers pH (if initial is <3.65)
- Bentonite or other fining concurrent

Effects of Chilling

- Oxidation due to increased O2 solubility
- Loss of colloids
- Loss of tartaric acid (up to 2 g/l)
- Wine loss of 1-3%
- Heavy electricity use (as much as 1kW/h per gallon or more)

Contact Process

- Combines chilling w/ addition of KHT
- 4g/l (33lbs/1000gal) of 40 µm ideal
- Cost $0.05 to $0.10/ gallon
- Cons=Same as chilling, may decrease TA even more
- Time: 1-2 days + time to chill

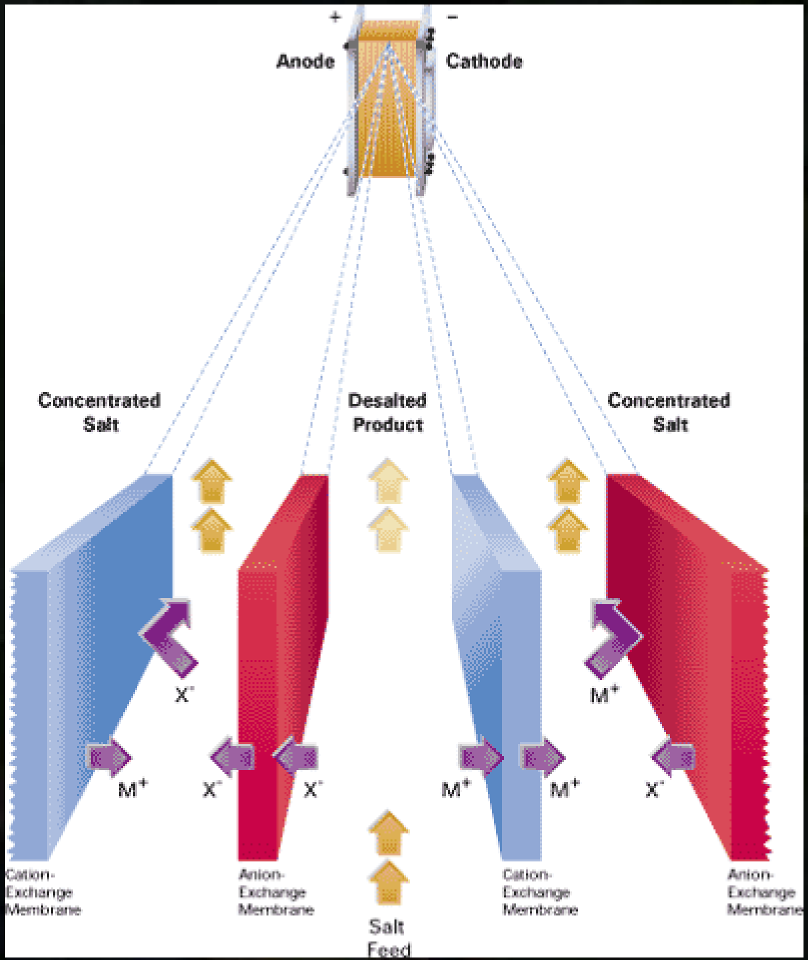
Note on Colloids

- Colloids are complex structures which incorporate anthocyanins, tannins, polysaccharides, proteins, & sulfur compounds as well as KHT
- Chilling/seeding removes colloids
- Colloids serve a number of functions, from mouthfeel to aroma and their loss is typically considered a quality detriment

Electrodialysis

- Uses electrical current to remove k+ and HT-- ions into a water stream
- Does not remove colloids
- Lowers TA significantly

Electrodialysis Cell



Electrodialysis Cons

- Uses water = 15% of wine volume or 5% w/ addition of high-energy recovery
- Very expensive machinery/consumables
- Lowers TA (but not pH)
- Batch process requires 2-3 tanks w/ risk of DO pickup
- Requires preclarification by centrifuge or high polish filtration

Mannoprotein

- EU approved addition of select mannoproteins
- Can render wine KHT stable
- Mannoprotein = glycoprotein
- Glycoproteins recently associated w/ headaches & allergies

Metatartaric Acid

- Short-term KHT stability
- Lasts 2-18 months
- Then wine will precipitate crystals

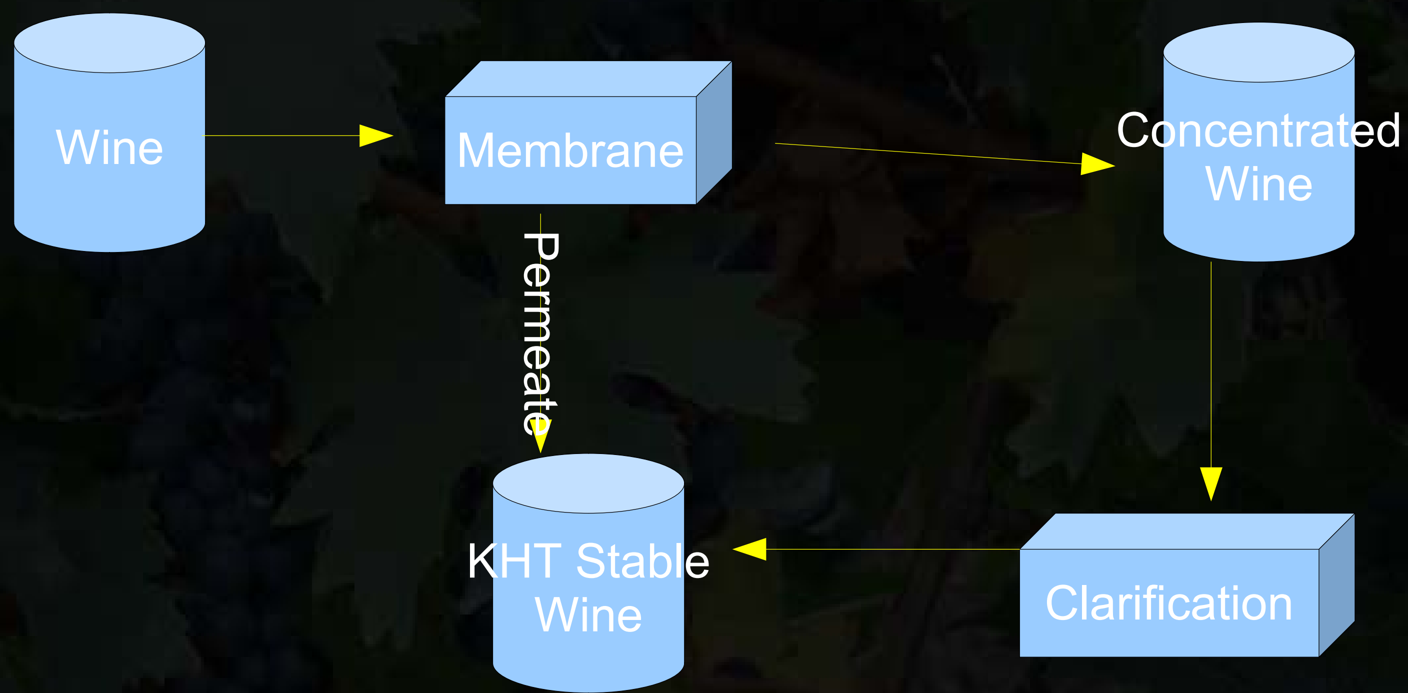
Nanofiltration + Clarification

- Concentrates wine under 500+ psi until KHT spontaneously precipitates
- Then concentrate is clarified to remove crystals
- Then wine reconstituted

Note On Crossflow

- PERMEATE: what passes through membrane
- RETENTATE: what does not pass through membrane
- Microfiltration, Ultrafiltration, Nanofiltration, Reverse Osmosis

Nanofiltration + Clarification



Nanofiltration Cons

- Complicated, multi-step, multi-tank
- Only saves 60% of energy use
- High-pressure exposure
- Expensive equipment

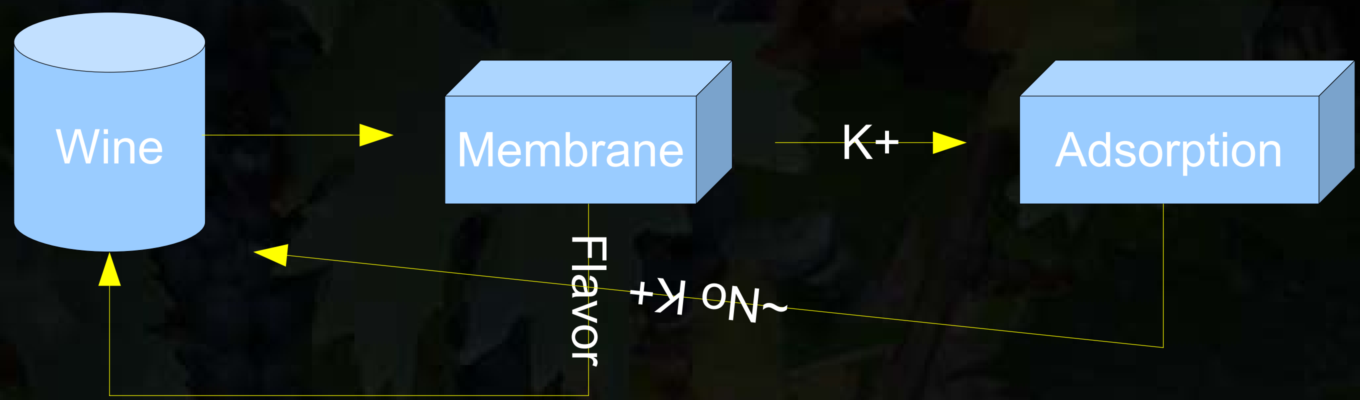
Ion Exchange

- Puts wine through ion exchange resins
- Cation exchange (k+, Ca++, Mg++, etc)
- and/or anion exchange (HT-- and other acids)
- Adsorbs colloids, and other flavor/ aromatic components
- 2+ tanks w/ DO pickup risk
- Originally patented by . . . Mogen David

Mavrik RCS

- Ultraselective membrane separation permeates K+, but not other cations
- Resin adsorbs K+ from permeate
- No acid or colloids or other flavor/aromatic compounds removed
- Only traces of Ca++ and Mg++ removed
- 0 to negligible pH shift downward
- One tank, no headspace management

Mavrik RCS



Comparison of Methods

Compared to Chilling

	ED	Nano	RCS
Energy Use	**80%**	**60%**	*40%*
Time	**22%**	**23%**	*20%*
Labor	**125%**	**120%**	*80%*
Loss	**100%**	**100%**	*25%*
Water Use	**500%**	**180%**	*125%*

BOLD: Adapted from Low, L.L., et al. (2008)

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