

Fining Agents and Winery Sanitation

Wine 3
Introduction to Enology

4/8/2014

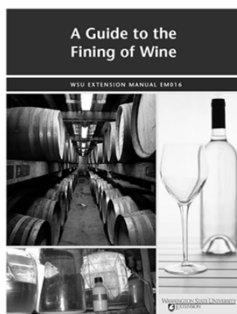
1

Tonight's Lecture

- *Review exam 2 and final project*
- *Particles that form haze in wine*
- *How fining agents work*
- *Bentonite*
- *Other fining agents*
- *Cleaning and sanitation methods*
- *Cleaning compounds*

2

New file on links page

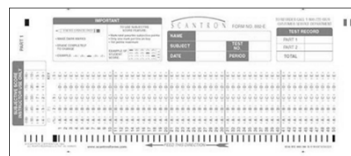


- There is a new link to a good article from Washington State University on the use of fining agents in wine.

3

Remember

- Next week is the second exam
- It will cover wine additives & sulfur dioxide up through tonight's lecture.
- You will need a Scantron form 882-E and a **calculator**.



4

Final Presentation

- A 5 to 10 minute oral presentation along with an written outline on any wine that is of interest to you.
- It cannot be a wine that you have made or one from where you work.
- If possible bring in a bottle to taste with the class, food to accompany your wine is also welcome.
- **Buy the wine before you start work!**

5

Final Presentation

- What to discuss:
 - Grape source, vineyard location, soil & climate, vineyard cultural practices, varieties, harvest criteria.
 - Grape crush and fermentation, what the vintage conditions were.
 - Processing, aging, blending and bottling of the wine.

6

- What to discuss:
 - The wine itself, the chemical statistics, flavors, textures and aromas of the finished product.
 - What you like/don't like about the wine, **why you chose it**, what you would do differently if you were the winemaker.

7

- Two most important things to address:
 - Tell me what the winery and winemaker did to make it taste the way it does.
 - The most important aspect is to select a wine that you think is significant.
 - Email Chris and I which wine you have selected before the final lab.

8

Guidelines for outline

- All you own words, **no cutting and pasting** text from internet.
- Bring a copy to hand in and one for yourself to use during your presentation. It should be about one single-spaced page.
- Be sure to start the outline with your name and the name of the wine that your are presenting.
- If you want to use Power Point slide or food to share talk/email me or Chris first.

9

Fining Agents

- Fining agents are materials added to wine that react with chemical constituents in the wine to affect its composition.
- Fining agents are not soluble (will not dissolve) so they settle or get filtered out so no residual fining agent is left behind.

10

Effects of Fining Agents

- **Clarity**, fining agents can facilitate the removal of suspended solids from a wine.
- **Color**, some fining agents will reduce color.
- **Stability**, fining agents are added to wine to insure that a brilliant wine remains so.
- **Sensory adjustment**, Fining agents can be added to remove or alter flavor components that are in the wine to affect flavor.

11

Commonly used fining agents

- There are a great number of fining agents that are available to winemakers to adjust a wine's flavor and chemistry.
- Tonight we will discuss the more common fining agents.
- Before discussing individual types we will go over how they function.

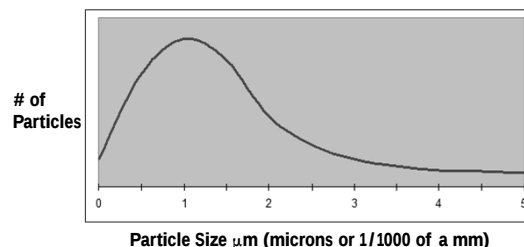
12

Particulate Matter in Wine

- Particles in wine are insoluble or semi-soluble solids that are suspended; these make a wine dull or hazy.
- Particles in wine include: yeast & bacteria, condensed tannins, proteins, bitartrate crystals, and polysaccharides.
- There are two properties that are important to settling, **size distribution** and **electrostatic charge**.

13

Size Distribution of Particulate Matter in Wine



- Notice: the large range of particle size and that the distribution is clustered around the smaller sizes.

14

Particulate Matter in Wine

- The rate of settling is influenced by:
 - Size of the particle, smaller particles settle out more slowly.
 - Protective colloids (*polysaccharides, gums, glucans and dextrans*). These envelop particles and prevent them from binding together; more pronounced with moldy grapes.

15

Particulate Matter in Wine

- The rate of settling is influenced by:
 - Height of the tank, taller tanks settle out more slowly.
 - When getting a lab sample the wine at the top of the tank is usually much cleaner than the wine from the base.

16

- When getting samples the cleanest wine is near the top.



17

Electrostatic charge

- Most particles in wine have a negative charge, except for proteins which are positively charged.
 - **Proteins positive +**
 - **Most other particles are negative -**
- Since like charges repel they must be neutralized before they can bind together, once particles are bound together they are heavier and settle out faster.

18

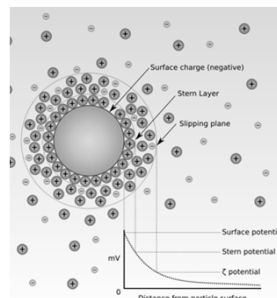
Electrostatic charge

- **Proteinaceous** (protein based) fining agents have a positive charge and they bind with negative particles in the wine and form particles with a heavier weight and a neutral charge that settle or filter out more easily.

19

Using fining agents

- Most fining agents do not dissolve in wine but remain as particles **in suspension**.
- Solid objects in wine are surrounded by a **boundary layer** of non-moving liquid.



20

Using fining agents

- The more turbulence during mixing the better the fining agents will react with the particles in the wine.
- This is why it is so important to mix the wine very well when adding fining agents.
- Several smaller additions of a fining agent work better than one large one (unlike SO_2).

21

Bentonite & Heat Stability

- Proteins are made out of chains of **Amino Acids**.
- A proteins shape is determined by its sequence of amino acids.
- A proteins function is determined by its shape.

22

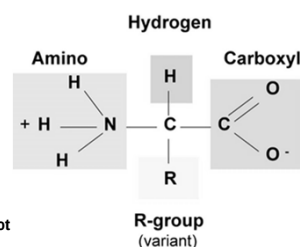
Protein Synthesis

- The sequence of amino acids in a protein is determined by the order of the base pairs in DNA.
- Although it is not directly relevant to winemaking we will briefly review how proteins are made.
- There are over 100,000 different proteins in the human body.

23

Amino acid structure

- Each amino acid has the following structure, each with a different "R" group attached. There are 20 different amino acids.



This slide will not
be on test

24

The 20 Amino Acids

This slide will not be on test

25

DNA Base Pairs

This slide will not be on test

26

RNA polymerase unwinds the DNA and attaches the complementary nucleotides to form messenger RNA.

This slide will not be on test

The Triplet Code

This slide will not be on test

28

Amino Acids

glycine (gly)

NCC(=O)O

isoleucine (ile)

CC(C)C(C)C(=O)O

Polypeptide chain: $H_2N^+ - \text{gly} - \text{ile} - \text{val} - \text{glu} - \text{gln} - \text{cys} - \text{cys} - \text{ala} - \text{ser} - \text{val} - \text{cys} - \text{ser} - \text{leu} - \text{tyr} - \text{gln} - \text{leu} - \text{glu} - \text{asn} - \text{tyr} - \text{cys} - \text{asn} - COO^-$

Protein

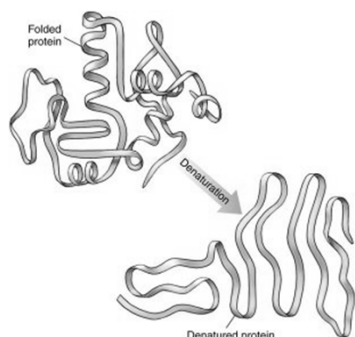
This slide will not be on test

Protein Stability

- So, why should you care?
- Proteins in wine can become unstable over time and denature (lose their structure) becoming insoluble. This leads to a cloudy precipitate in the wine.
- The denaturing is a very slow reaction and can make a wine that is brilliant to become cloudy after it has been bottled for several months.

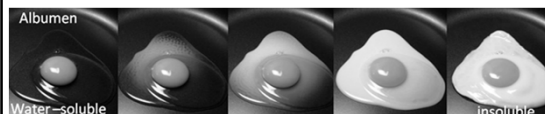
30

Protein Stability



31

Protein Stability



- This is the same reaction that takes place when an egg is cooked. Egg whites are made of albumen (egg protein) and when they are denatured by heat they become solid and turn white.

32

Bentonite Fining

- **Bentonite** is used in white, blush, and rosé wines to remove excess proteins and make the wines heat stable.
- Red wines do not require because they have much more tannins than white wine. Since tannin molecules are negatively charged, during ageing they react with protein in a similar manner as bentonite.

33

Bentonite

- Bentonite is a type of clay that is negatively charged and binds with positively charged proteins.
- The charges are neutralized and the protein/bentonite particles become insoluble and settle out.
- It is the most commonly used fining agent

34

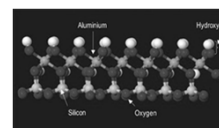
Bentonite

- There are two types:
 - **Sodium Bentonite** is more easily dissolvable, less of a respiratory irritant and more effective in fining wine. More common in US.
 - **Calcium bentonite** produces less lees, but is less effective so you use more. More common in Europe.

35

Bentonite Structure

- Bentonite particles form a planer structure with positive charges on the edge and negative charges on the flat surface.



36

Bentonite Fining

- The amount of bentonite required to make a wine protein stable is dependent on the variety, vineyard and vintage.
- Many Chardonnays don't need any bentonite, I have seen Sauvignon Blancs that needed more than 14# / 1000 Gal.

37

Bentonite Fining

- Like all fining agents it is best to do fining trials first to see how much is needed.
- Large additions of bentonite can strip a wines flavor, partially due to dilution.

38

Heat Stability Testing

- Heat accelerates the formation of protein hazes; to perform the lab test, add different concentrations of bentonite to wine samples.
 - Let settle, filter, and put in an oven at 125°F (50°C) for 48 hours and then look for haze under a high intensity lamp.
- You add the smallest amount that is clean.

39

Heat Stability Testing

- This is not an absolute test, so many wineries have variations on the temperature and time.
- **This is not done** to protect the wine against heat, but to use the high temperature to simulate the effects of long term aging.
- The terms protein stability and heat stability are used interchangeably.

40

Heat Stability Testing



Fined samples before filtering

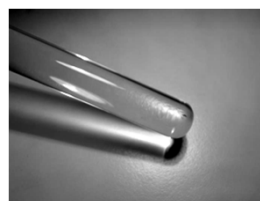


Oven for filtered samples

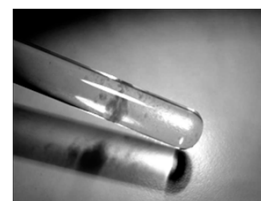
41

Heat Stability Testing

After heating the samples are checked for clarity



Stable @ 3# / 1000 gal.



Unstable @ 2# / 1000 gal.

42

Adding Bentonite

- Mix Bentonite at the rate of 1 gram/25 ml (1#/1.5 Gal) in hot water.
- Mix vigorously while bentonite is added to the water. Mix for one hour then let cool.
- Bentonite settles out in about two weeks leaving very loose lees that plug filters quickly.
- After fining is complete the wine can be filtered and tested for heat stability.

43

When to Add Bentonite?

- Bentonite can be added as juice or as wine.
- During the juice phase bentonite has less sensory effects but you do not know how much to add because it is alcohol that makes the protein unstable.
- As wine you can add just the amount that is needed after doing a stability test.

44

Mixing Bentonite

- To prevent clumping bentonite should be slowly added to well mixed hot water. After it is mixed allow it to cool before use.



45

Bentonite

- In **non-grape wine** like mead (honey wine) the proteins can be very stubborn so the must is sometimes boiled to denature the proteins prior to fermentation.
- If you're a home winemaker and you do not have the facilities to test wines, use 4#/1000 Gal for Sauv Blanc, and 2#/1000 Gal for other white varieties.

46

Other Fining Agents

- Bentonite is the most common fining agent used for wine.
- Now we will cover some of the many other fining agents that are available that affect a wines clarity or sensory properties.

47

Fining for Tannins

- Many fining agents react with tannin to make a wine softer and less astringent.
- It is better to not over extract the wine during fermentation so you do not need to fine the wine to make it taste right.

48

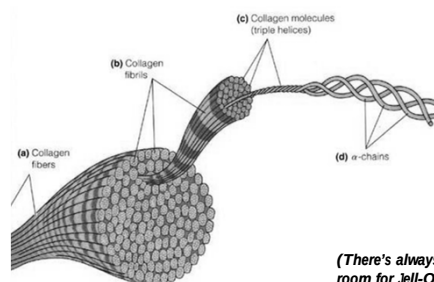
Counter-Fining

- Counter-fining is adding a second complimentary fining agent with a different charge a few days after the addition of the first fining agent.
- The one-two punch is very effective for clarifying wines.
- Example: bentonite followed by gelatin

49

Gelatin

- Collagen is isolated from the skin and connective tissue of animals during meat processing.



50

Gelatin

- Most common proteinaceous (protein based) agent, it is purified from collagen
- It has a positive charge at wine pH and it binds with both bentonite and phenolic groups.
- Used to settle bentonite in white wines and in reds it is used to remove the larger polymerized phenolics (tannins) to reduce astringency.

51

Gelatin

- **Note:** Astringency masks bitterness so gelatin fining may increase perceived bitterness.
- Rates of use for gelatin:
 - 100g to 250g ($\frac{1}{4}$ to $\frac{1}{2}$ #) per 1000 gal for clarity
 - 200g to 1000g ($\frac{1}{2}$ to 2#) per 1000 gal for tannin reduction

52

Gelatin

- Available in powder or liquid form.
- Very good for removing astringency from heavy press reds.
- Also useful for clarifying beer.



53

Isinglass

- Fish collagen from the air bladder of sturgeon, positive charge, used for clarity in white wines and as a riddling aid for sparkling wines. It removes less condensed tannins than gelatin or casein.



54

Isinglass

- Very useful when added after bentonite fining to help compact the lees. Isinglass can be very hard to dissolve and needs rinsed with fresh water before use.
- Very gentle and effective.
- Added at a rate of 50g to 250g (1/8 to 1/2 #) per 1000 Gallons.

55

Casein (potassium casinate)

- Milk protein it has a positive charge and it is used to remove phenolics, useful for excess oak, bitterness, or browning on white wines. Can be difficult to dissolve.
- Added at the rate of 100g to 1 Kg (1/8 to 2#) per 1000 Gallons.
- Present in some proprietary wine treatments like Catalasi (great for treating browning on whites).

56

Casein (potassium casinate)

- Some winemakers use non-fat milk as a fining agent so they do not have to bother with mixing it up.
 - (1 to 2 L/1000 Gal).
- Also used as a fining agent in coffee or tea.

57

Egg Whites (*Ovogel*)

- Contains the proteins **albumin** and **globulin**, positive charge. Used to remove tannins, goes after larger molecules than gelatin so it is gentler.
- Mix up the egg whites with 10% water, then into the wine. *Ovogel* is a trade name for freeze dried egg whites.
- Added at a rate of 1-4 egg whites per barrel. 100g to 1 Kg (1/4 to 2 #) / 1000 gallons for *Ovogel*.

58

Animal based fining agents

- Many of these are based on animal proteins and will make the wine non-vegan and could become an issue for allergen labeling in the future.
- There is little evidence to suggest that fining agents represent a risk to people with food sensitivities.

59

Silica Gel (*Kieselsof*)

- An aqueous suspension of silicon dioxide; it is used in conjunction with gelatin to clarify whites, its negative charge combines with gelatins positive charge to settle out and compact lees.
- It is added 24 hours after gelatin at the rate of 1/2 to 1 ml per gallon of wine. The legal limit is 2 gallons per 1000 gallons of wine.

60

Alginic Acid (*Sparkolloid*)

- Algin is a structural polymer of the cell wall of algae. Alginic acid is a high molecular weight, long-chained polymer.
- It is positively charged and usually is bound to some inert carrier such as diatomaceous earth to facilitate settling.

61

Alginic Acid (*Sparkolloid*)

- Works best if pH < 3.5, clarification may be accelerated with small additions of counter fining agents such as gelatin or bentonite.
- Some proprietary products include 5 to 10% gelatin. Useful in removing protective colloids, to improve settling.
- Dosage is 1-2# / 1000 Gallons.

62

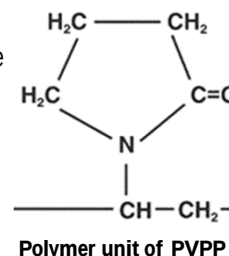
PVPP (Polyclar)

- PVPP (Polyvinylpolypyrrolidone) is a powderized plastic, used in white and blush wines to remove browning precursors (phenolics) also helps settle carbon. In light reds it can help remove bitterness.
- Can be used to absorb TCA, the compound found in cork taint. And as a preventive for **pinking**.

63

PVPP (Polyclar)

- Polyvinylpolypyrrolidone is a scary name but is relatively harmless
- Added at the rate of 1/2 to 3 # per 1000 gallons



64

Carbon (the nuclear option)

- Decolorizing or deodorizing forms available
- Can be used to remove color from wines, such as browning from oxidation or a white wine that has been contaminated with red wine.
- It can also be used to remove off aromas. At high levels (8#/1000) can be used to "Strip" a wine of all flavors, good & bad.

65

Carbon (the nuclear option)

- Added at a rate of: 100g to 500g (1/4 to 1#) per 1000 Gal for Browning
1Kg to 2 Kg (2 to 4 #) per 1000 Gal for off odors



66

Lab Trials

- With all fining additions, or any chemical addition for that matter, it is better to do a lab trial before adding the agent.
- In a lab trial, also called a bench trial, a small amount of the fining agent or additive is added to the wine in at the same ratio that you would in the cellar. The wine is then tasted and analyzed.

67

Lab Trials

- This can be done to an individual barrel or a bottle sample. Then taste and test the results to see the effects before you make the addition.

68

Lab Trials with Carbon



0 PPM through 200 PPM

69

Winery Sanitation

- We don't spend a lot of time covering this subject in class, but you sure spend a lot of time doing it in the cellar.



70

Winery Sanitation

- The easiest way to deal with spoilage is to prevent it from happening in the first place.
- The best way to prevent spoilage is to keep the number of spoilage microorganisms to a minimum around the cellar by keeping things clean.

71

Winery Sanitation

- Cleaning reduces wine residue that is an attractive habitat for spoilage microbes. Keeping a clean cellar is a time consuming practice but worth the effort.
- Cleaning is made much easier if you are careful to rinse all winery equipment with water as soon as you are done using it.

72

Winery Sanitation

- Winery Sanitation actually consists of three steps:
 - **Cleaning**, to remove soil (yeast cells, grape pulp, tartrates, etc.)
 - **Sanitizing**, to make sterile (kill live yeast and bacteria)
 - **Rinsing**, removing any residual soil as well as cleaning and sanitizing agents.

73

Cleaning

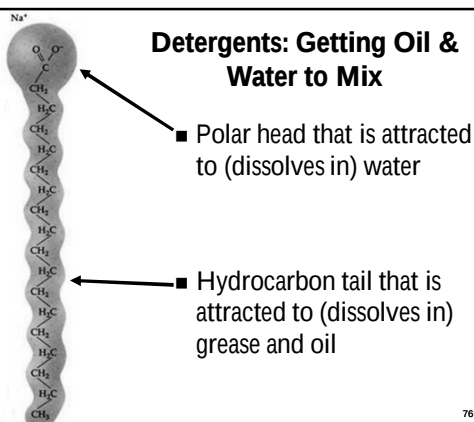
- Different materials are used to clean different surfaces. The most common type is an alkaline detergent. The alkali acts to remove greases and dissolve tartrates.
- **Strongly Alkali Materials:** caustic soda (NaOH), caustic potash (KOH)
- **Less Alkali Materials:** tri-sodium phosphate (TSP), soda ash (NaCO_3)

7

Detergents: Getting Oil & Water to Mix

- Detergents contain surfactants that act to make dirt soluble so it can be rinsed away by water.
- They also may contain hypochlorite (chlorine) to help disperse food soils, oxidize organic residues & brighten stainless steel.

75



i

Cleaning

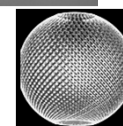
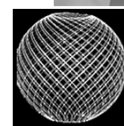
- Cleaning often requires some **mechanical action** to remove tough soils, such as a high-pressure spray or scrubbing with a brush.
- One can use a stronger solution of caustic and there will be less of a need for scrubbing, but the chemicals are more hazardous at a higher concentrations.

77

Tank Cleaners



Gamma-Jet



Neutralization

- **Neutralization** often follows cleaning; it consists of a citric acid rinse to neutralize residual alkali.
- After the rinse with citric acid rinse again with water.

79

Sodium Percarbonate (ProxyClean)

- **Sodium Percarbonate**, is a combination of soda ash and hydrogen peroxide. Hydrogen peroxide is a good biocide and soda ash is a mild caustic. Also called oxygen bleach.
- Good for BBLs, but I prefer ozone because residual is less of a problem. Useful for winemakers that wish to avoid chlorine to prevent the formation of TCA.

80

Sanitation

- With sanitation high temperature or chemicals are used to kill any residual microorganisms after cleaning is done.
- There are a number methods to sanitize:

■ Heat	■ Peracetic acid
■ Chlorine	■ Iodine
■ Chlorine dioxide	■ Sulfur Dioxide
■ Ozone	■ Ethanol

81

Sterilization

- To sterilize something means to remove or kill all microbiological life.
- No such thing as almost sterile (like being almost pregnant).
- For winemakers "wine sterile" killing any microbe that could grow in wine is good enough.

82

Hot Water or Steam

- Kills by denaturing enzymes and proteins. Effect is dependent on time and temperature.
- Most common winery method is 180°F for 30 min. Cooler temps take longer. A wet heat is also more effective than dry heat.
- For safety wear rubber boots & gloves as well as eye protection.

83

Hot Water or Steam

- There are many non-wine bacteria that can survive this treatment, such as *Bacillus*, but the alcohol in wine will kill them.
- Hotter temperatures work faster 212 °F steam only takes 15 minutes and uses less water. But high temperatures are more hazardous to work with, 180 degrees is a good compromise between effectiveness and safety.

84

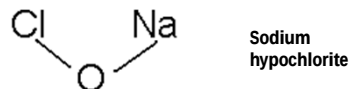
Chlorine

- Hypochlorites are more active in acid solutions than alkali solutions (But acid solutions are corrosive). Chlorinated alkalis clean and sanitize.
- Hypochlorite is an effective biocide and 200 ppm in contact for 15 minutes will sterilize.
- Chlorine also acts as a decolorizer to remove red stains on equipment before using it for whites.

85

Chlorine

- Household bleach (sodium hypochlorite) works well as a cleaning agent for home winemakers. A 1% solution of bleach is adequate for sterilizing clean equipment.



86

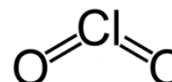
Chlorine

- Note: **NEVER** use chlorine on any porous material (like BBLs) that might absorb it.
- Chlorine can also deteriorate some plastic and rubber materials (such as press membranes) so be sure what you are cleaning can withstand exposure to chlorine.

87

Chlorine Dioxide

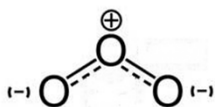
- Very powerful (reactive) cleaner/sanitizer. Does not have the potential to form TCA than hypochlorite does.
- Unstable so it requires expensive specialized equipment to produce it onsite.
- Corrosive, safety precautions apply and not suitable for all materials.



88

Ozone

- **Ozone** is a gas made from an oxygen molecule that has three oxygen atoms linked together (O_3 instead of O_2).
- It is very reactive with living cells. It is made by ozone generators that use electricity or UV light to excite oxygen to convert it to ozone.



89

Ozone

- The gas is dissolved into water to be used for cleaning.
- Ozone is unstable so it decomposes quickly eliminating the need for a final rinse.

90

Ozone

- Ozone works great for sanitizing equipment and Barrels but **only sanitizes does not clean**.
- Ozone harms membrane filters so it can't be used to sanitize them. Ozone gas is harmful, so caution must be used when working with it (like chlorine or SO₂).

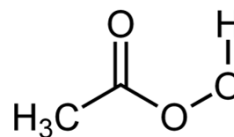


Ozone generator

91

Peracetic acid (PAA)

- Strong and quick acting antimicrobial agent. Also called Peroxyacetic acid.
- Most expensive sanitizer
- Rinsing not required
- Breaks down plastics



92

Iodine

- **Iodine**, also called iodophores. 25 ppm is effective as 200 ppm Cl. Residual is rinsed off with cold water, often used on bottling equipment



93

Sulfur Dioxide

- **SO₂**, Since it is food grade it can be used in porous material like barrels. 1000 ppm in an acid solution, very volatile (use a respirator).
- **Sodium** metabisulfite is preferable to potassium metabisulfite as a sanitizer, it is less expensive and dissolves easier, but both work fine.

94

Ethanol

- **Ethanol**, Good sanitizer, not as a cleaner, most important attribute is that it's food grade. You can buy high proof grape neutral spirits or cheap vodka.
- 70% ethanol is most effective strength.

95

Ethanol

- Useful on bottling equipment or in any situation that you cannot rinse the equipment after sanitizing. Great in a spray bottle for hitting corker jaws and filler valves.
- If using high proof grape neutral spirits the tax can be much more than the cost of the alcohol.

96

Cleaning / Sanitizing Procedure

- Rinse with hot water until tank is 150 F
- Circulate caustic chlorine (200ppm) for 15 minutes making sure tank is clean.
- Rinse with cold water until effluent doesn't feel slimy.
- Re-circulate with citric solution.
- Final rinse with cold water.

97

Cleaning / Sanitizing Procedure

- The same procedure can be used for other wine equipment such as pumps, fittings and non-porous materials.
- Remember some plastics cannot take high temperature and some materials (such as press membranes) are sensitive to chlorine.

98

Checking for sanitation

Simple method is to check for:

- **Does it look clean?**
- **Does it smell clean?**
- **Does it feel clean?**
- **Did all parts of the equipment that have contact with wine get clean?**
 - Buy equipment that is easy to clean (smooth surfaces and rounded corners)

99

Checking for sanitation

- ATP Swabs



Instant results

- Microbial plating



Results take 48+ hours

100

Safety First!

- Understand the cleaning chemicals you are working with, read MSDS
- Wear protective gear (goggles & gloves)
- Stronger chemicals work better but are more hazardous.



101

Next week

- **Second Exam**, bring a **Scantron** & a **calculator**.
- It covers the last five lectures, including:
 - Sulfur Dioxide & Additives
 - Tasting
 - Wine processing
 - Barrels
 - Fining & Sanitation
- Next weeks lecture, Blending & Bottling.

102