Washing and Sanitizing Home Winemaking and Brewing Equipment

It's About The Best Ways To Break Chemical Bonds of Organic Contaminants – Not Your Equipment –

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INTRODUCTION

These days, washing the dishes after dinner can be as simple as loading a dishwasher, adding a little packet of chemicals, and pushing a button. Chemists and engineers have figured out how to make the various technologies work smoothly, effectively, and safely; without our having to know much, if anything, about how everything works. It is a completely different story when it comes to washing home winemaking or brewing equipment, most of which cannot be washed in a dishwasher. Choices regarding washing/sanitizing agents and technique, can literally be *make or break*. A wrong choice can result in spoiled wine or beer, damaged equipment, or even injury.

This article will review basic information regarding the washing and sanitizing of metal, glass, rubber, and plastic equipment with special attention to the washing of carboys.

TERMS

Certain terms and abbreviations are commonly used when discussing the washing and sanitizing of home winemaking and brewing equipment and it helps to be familiar with them.

Amphiphilic is a term describing chemicals that possess both hydrophilic (water-loving, polar) and lipophilic (fat-loving, no polar) branches (See Surfactants). Examples are soaps and detergents.

Catalysis is the change in rate of a chemical reaction due to the participation of a substance called a catalyst. Unlike other substances that participate in the chemical reaction, a catalyst is not consumed by the reaction taking place.

CIP refers to Cleaning In Place

COP refers to Cleaning Out of Place

Detergent is a term used to describe amphiphilic chemicals (surfactants) that remain surface active in the presence of atoms of dissolved salts that have multiple charges (multivalent ions), such as calcium (Ca^{++}) or magnesium (Mg^{++}) in hard water (see Hard Water).

Disinfection refers to any process intended to kill microorganisms. Disinfection does not necessarily kill all microorganisms, especially resistant spores, and is not equivalent to sterilization.

Enzymes are proteins that catalyze chemical reactions by lowering the activation energy of a reaction; thereby, increasing the rate of the reaction dramatically. In the context of washing agents, the purpose of enzymes is to break insoluble organic materials down to smaller more soluble components, thus greatly improving washing efficiency and reducing washing times.

Protease enzymes break down proteins.
Amylases break down starches.
Lipases break down fats.
Cellulases break down cellulose.

Most enzymes function best at neutral pH and are likely to be damaged by acidic or caustic conditions. Enzymes are also damaged by oxidizing agents and sanitizers.

Flavor/Odor Scalping refers to the movement of flavors/odors between foods and beverages and packaging or equipment.

Glass is a term that in its most common refers to soft glass (soda lime glass) and hard glass (borosilicate glass). Borosilicate glass is most commonly used to manufacture cook ware and laboratory ware, because its coefficient of thermal expansion is only about 1/3 that of soft glass, making it much less likely to crack when heated. The great majority of larger pieces of glass equipment used in home winemaking and brewing, carboys for instance, are made of soft glass, because soft glass is so much less expensive than hard glass.

As a technical/scientific term *glass* has a much more broad meaning and refers to every solid that can exist in a non-crystalline (amorphous) form that exhibits a reversible transition to a soft state (glass transition) when heated. Many different materials are glasses in this broader sense. Some examples are: water solutions, salt melts, metallic alloys, and organic polymers. Acrylic plastic, polycarbonate plastic, and alkene polymers (e.g., polyethylene, polypropylene, and co-polymers of polyethylene terephthalate [PET]) are examples of organic polymer glasses.

Hard Water is a term used to describe water that contains significant concentrations of multivalent ions such as calcium (C^{++}), magnesium (Mg^{++}), iron (ferrous Fe^{++} and ferric Fe^{+++}), and manganese (Mn^{++}), to react with soaps to form soap scum (see Soap Scum).Water that causes sinks to develop reddish-brown stains probably contains significant concentrations of iron salts and possibly iron bacteria. Water that produces brownish-black stains, probably contains significant concentrations manganese salts. Calcium and magnesium salts tend to form whitish scales. Some washing agents are designed to work better in hard water.

Sanitization refers to the reduction of microorganisms to levels considered safe from a public health viewpoint. In winemaking terms, it is the process of reducing microorganism (e.g. yeasts and bacteria) and enzyme contamination to levels that have no significant effect on the making of excellent wine.

Saponification is a process of splitting the ester bonds (fatty acid -alcohol bonds) of water insoluble fatty substances with a caustic, such as sodium hydroxide (lye), to create water-soluble, amphiphilic salts of the fatty acids (soaps).

Soap Scum forms when the mulitvalent ions in water react with the amphiphilic salts of fatty acids to displace sodium ions and join fatty acids together head to head, resulting in substances that are essentially insoluble in water.

Sterilization refers to any process that kills or otherwise eliminates all forms of microbial life, including dormant forms.

Surfactants (short for surface-active agents) are amphiphilic compounds that lower the surface tension between liquids or between liquids and solids; thereby, facilitating mixing. Examples of surfactants would be detergents, foaming agents, and wetting agents.

AN IMPORTANT WARNING

With regard to comments and suggestions made in this article, it is the responsibility of the user to take all necessary steps to prevent injury and property damage and recommendations made herein do not relieve the user of this ultimate responsibility.

Glass carboys have played a significant role in home winemaking over the years. However, no responsible discussion involving washing and sanitizing of winemaking equipment can fail to mention that glass carboys, especially the soft-glass carboys commonly available to home winemakers and brewers, are potentially dangerous and must be handled with **extreme caution** and nothing stated in this article should be interpreted otherwise. Major manufacturers of glass laboratory equipment and home winemaking and brewing forums warn of the potential hazards, and a brief search of the Internet for, “glass carboy injury” will turn up seemingly endless reports of accidents.[1,2,3,4,5,6]

Glass, soft glass in particular, is slightly soluble in water and more soluble if the water contains caustics, which are common ingredients in washing agents. As glass dissolves from the surface of glass objects, micro cracks form and the strength of the object becomes increasingly compromised. With continued use, glass carboys become more and more fragile. Thus, a mode of handling that you may have executed many times with a given carboy can result in an unexpected breakage. Never carry glass carboys by their necks and be aware that even lifting a full glass carboy off a counter by placing your hands around its base can cause it to crack wide open. Carboy carrying harnesses are not an ideal solution, as they do not provide protection from flying glass shards. Carrying bags and crates offer greater protection. Washing glass carboys is especially dangerous, because they will be, of necessity, uncovered and likely to be slippery – always wear protective gloves and clothing.

WASHING VS. SANITIZING

Washing is the process of removing organic and inorganic contaminants to a level of insignificance. Washing agents are designed to facilitate this process by breaking down, solubilizing, and dispersing contaminants into water, so the contaminants can be washed away. It goes without saying that significant contamination is likely to affect the quality of a wine. What is not always appreciated is that microorganisms build biofilm communities [7], capable of collecting nutrients and defending against attack by sanitizing agents. For this reason, it is important that the washing process is effective and adequately applied.

Sanitization and sterilization are not equivalent. Sterilization is the process of eradicating all living microorganisms; whereas, sanitization involves reducing the number or types of microorganisms to levels that are harmless for practical purposes. Sterilization requires very aggressive conditions, such as autoclaving, which involves exposing items to high-pressure, saturated steam at 121 °C for around 15 to 20 minutes. Clearly, autoclaving is not a practical option for home winemaking and brewing, and it is unnecessary. Pouring boiling water on, or into, winemaking equipment is not the same as autoclaving and doing so: 1) Will not sterilize the equipment, 2) Is unlikely to be as effective as using chemical sanitizing agents, 3) Is potentially dangerous, and 4) Is likely to damage the equipment.

WASHING AND SANITIZING AGENTS

Strong caustics break the chemical bonds of large, insoluble, organic molecules to produce smaller more soluble molecules. Some of these smaller molecules will have surfactant qualities; thereby, helping to break down deposits and removing greasy residues from the walls of tanks. The following list of some strong caustics, listed in descending order of aggressiveness, are used individually or as combinations in many washing agents:

Sodium hydroxide (Lye or Caustic Soda)

Potasium hydroxide (Caustic Potash)

Sodium metasilicate (Sodium silicate)

Trisodium phosphate (Sodium phosphate or TSP)

Sodium percarbonate (Sometimes referred to as sodium carbonate peroxyhydrate)
It is an adduct (joined molecules) of sodium carbonate and hydrogen peroxide. In water, sodium percarbonate dissolves to release sodium carbonate and hydrogen peroxide, an effective disinfectant and bleaching agent.

Sodium carbonate (Soda Ash)

By contrast, enzyme-based washing agents use combinations of enzymes to break down large organic molecules under relatively mild conditions in a neutral pH range.

It is important to bear in mind that not all washing or sanitizing agents are compatible with every type of material used to fabricate home winemaking and brewing equipment (Table1 & 2). Thus, an agent that is suitable for use with stainless steel equipment may severely damage copper, aluminum, oak, glass, PET (polyethylene terephthalate), acetal, nylon, rubber etc., while agents that may not damage some of the latter can damage stainless steel. It is also important to understand that mixing or storing certain agents together can be dangerous.[8] Read the product instructions and warnings and take them seriously. As a general rule, store harsh washing and sanitizing agents in a dry, cool, ventilated, location – away from sunlight. Keep the agents tightly sealed in their original containers and from time to time, check to see that the containers are not leaking.

Regrettably, most washing and sanitizing agents do not come with sufficient information to enable most of us to make truly informed decisions about which to use with what materials and under what conditions. Seventh Generation Detergents are exceptional in this regard, because their labels list essentially all of the ingredients.[9] The information on the material safety data sheet (MSDS) of most washing and sanitizing agents is intended primarily as a warning regarding personal safety, not equipment safety, and is unlikely to be of much help, unless you have a chemical engineering background. Furthermore, an MSDS is not required to list everything in an agent.

Materials that are not considered hazardous and that do not exceed 1% concentration or that a manufacturer considers to be proprietary, either individually or by virtue of their combination, may not be listed on an MSDS.[10]

TABLE #1 Resistance Scale A – Good D – Poor Materials		Acids					Bases													Sanitizers						
		5-6% Acetic Acid	10% Phosphoric Acid	10% Hydrochloric Acid	20% Hydrochloric Acid	25% Hydrochloric Acid	6% Ammonium- Hydroxide	1% Potassium Hydroxide	10% Potassium Hydroxide	25% Potassium Hydroxide	1% Sodium Hydroxide	10% Sodium Hydroxide	15% Sodium Hydroxide	20% Sodium Hydroxide	30% Sodium Hydroxide	10% Sodium Silicate	10%Trisodium Phosphate	2% Sodium Carbonate	30% Sodium Carbonate	5% Hydrogen Peroxide	10% Hydrogen Peroxide	5-6% Bleach	10%Sodium Bisulfite	10%Iodine Water	0.2% Peroxyacetic acid	<15% Chlorine Dioxide
Soda Lime Glass		As soft glass is exposed to acids or caustics, even water, it becomes increasingly fragile.																								
Metals	304 SS	A	C	D	D	D	A		B	B			B	B	B	B	B		B	B	B	D	B	D		D
	316 SS	A	A	C	D	D	A		A	A	A	A	A	B	B	A	B		B	A	B	B	B	D		D
	Aluminum	D	D	D	D	D	B		D	D		D	D	D	D						A	D				
	Brass	D	D	D	D	D	D							B								D				
	Copper	B	D	D	D	D	D							A							D					
Elastomers	Nat. Rubber	B			A									A							B	C				
	Buna-N	B	C	B	C	C	C		B	B			B	B	B						D	D		C		D
	Santoprene	B	A		B		A							A								A				
	Silicone	C	A	D	D	D	B	D	D	D	B	B	B	C	D	D	C	B	D	C	A	B	D	D	D	D
	Viton	C	A	A	A	A	C		B	D			D	C	D	C	A		B	B	B	B	B	B		D
Plastics	Acetyl (Delrin)	C	D		C	D				D			D	D	D	D			C		D	D	D			
	Polycarbonate	A	A	B	B		C	C	D		D	D			D	D		B			A	C	A	A	D	D
	Polyethylene LD	A	A	A	A		A	A	A		A	A		B	B	B		A			A	B	A	A	D	D
	Polyethylene HD	A	A	B	B	C	A	C	B	C		A	B	B	C	C		A			C	C	A	A	D	D
	PET-Crystalline	B	B	C			C	C	D		C	D		D	D	D		B			A	B	A	A		
	PET-Amorphous	B		C			C	C	D		C	D		D	D	D		B			B	B	A	A	D	
	Polypropylene	A	A	A	B	B	A	A	A	B	A	A	A	A	B	B	C	A	C	B	C	C	C	D	D	D
	PVC - Rigid	C	B	B		C	C	A	B	B	A	B	B	B	B	C	C	A	D	C	B	B	B	D	D	C
	PVC - Tubing	C	B	B	B	C	C	B	B	C	B	C	C	D	D	D		B			B	B	B	D	D	D
	Nylon	D	D	D			A	B	B		B	B		B	B	D		C			D	D	C	C	D	D
	Teflon - FEP	A	A	A		A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
	Teflon - PTFE	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A

Note – Table #1 combines chemical resistance data from a variety of sources that are not all matched in terms of test conditions.[11, 12, 13, 14] Because temperature and many other factors, including the mixing of chemicals, can dramatically affect how materials react, this table is intended only to demonstrate that selecting washing and sanitizing chemicals poses serious logistical challenges. BetterBottle assumes no liability for the completeness of the information contained in the table. There is no warranty expressed or implied and the final determination of material or washing/sanitizing agents suitability is the responsibility of the user.

	TABLE #2 Product	Enzymes	Acetic Acid	Phosphoric Acid	Surfactants	Hydrochloric Acid	Ammonium- Hydroxide	Potassium Hydroxide	Sodium Hydroxide	Sodium Silicate	Trisodium Phosphate	Sodium Carbonate	Sodium Percarbonate	Hydrogen Peroxide	Sodium Hypochlorite	Sodium Bisulfite	Sodium Bromide	Iodophor butoxy polypropoxy polyethoxy ethanol-iodine	Peroxyacetic acid	Sodium Chlorite (Releases Chlorine Dioxide)
FiveStar	PBW									X			X							
FiveStar	CMC				X						X	X			X					
FiveStar	Saniclean			X	X															
FiveStar	IO Star																	X		
FiveStar	Star San			X	X															
	B-Brite Crosby & Baker Ltd.												X							
	BTF National Chemicals, Inc																	X		
	Diversol BX/A Johnson Diversy Canada, Inc.										X				X		X			
	Free & Clear Natural 2X Seventh Generation	X			X															
	OneStep Logic, Inc.												X					?		
	Oxysan ZS EcoLab		X											X					X	
	Oxiclean Orange Glo International											X	X							
	SelectiveMicro Clean 2L500 Selective Micro Technologies, LLC																			X
	Straight-A Logic, Inc.												X							
	Sun Oxygen Sun Products Corp.												X							

RECOMENDATIONS FOR WASHING AND SANIZITING

Water

Water that is not provided by a municipal water company or that has not been tested for potability should probably not be used to wash equipment or to make wine or beer, because the water may contain microorganisms and other contaminants that can spoil a wine or beer.

Hard water can make washing more difficult and, if used as an ingredient, can result in chemical instabilities and insoluble precipitates. Softened water is fine for washing and sanitizing; however, it is not recommended for mixing the actual ingredients of a wine or beer, because the ion-exchange softening process increases the salt concentration of the water by exchanging multiple monovalent ions of sodium (Na^+) for each multivalent ion that is exchanged; thereby increasing the saltiness of the water.

As an ingredient, water that has been purified by reverse osmosis or distillation is preferable to softened water.

Pre-rinsing

As soon as you finish using a piece of equipment and while any organic material remains wet, rinse the equipment with a jet of warm tap water to dislodge the bulk of the material and finish with a jet of hot tap water. The hot water should not be above 52°C (125°F). Water above this temperature is generally considered to be dangerously hot and is not necessary for effective pre-rinsing.[15] Furthermore, excessively hot water can damage many types of plastic equipment and is likely to cause soft glass carboys to expand unevenly and crack. Keep rinsed equipment wet until you wash it and start washing it promptly.

Preparing Washing/Sanitizing Agents For Use

Select washing/sanitizing agents that are compatible with your equipment and follow these general rules:

1. Use hot water that is not more than 52°C (125°F).

2. Do not use higher concentrations than recommended by the manufacturers of the agents or your equipment.

3. In the case of aggressive agents that can cause damage to your equipment, make up working solutions in a container that is made of a material known to be especially resistant to attack by the agents. **Always fill the container with water before adding the agent** and when adding the concentrated agent, stir the water vigorously to insure that the agent is quickly diluted and uniformly mixed. Adding a concentrated liquid or powdered agent to a container before adding water is a worst case situation in terms of damaging the container. The concentration of a powdered agent will be extraordinarily high adjacent to a mound of dissolving powder and considerable heat is likely to be released as the powder dissolves.

Figure 1
A BetterBottle PET carboy with caustic stress cracking in the bottom, which resulted from over 8 hours of exposure to what may have been an excessively concentrated solution of PBW.

Washing Basics

How you wash will depend very much on what you are washing; however, certain generalizations can be made:

1. Do not soak your equipment for long periods in solutions of chemicals that are known to attack the materials from which the equipment is made. Short exposure may be acceptable, even recommended, but prolonged soaking is just asking for trouble (see Table 1 and Figure 1). BetterBottle has tested two enzyme-enhanced, environmentally friendly detergents as a safe washing agents for home winemaking and brewing equipment

   Free & Clear Natural 2X Seventh Generation [16] & **Super Pro-zyme Enzymatic Cleaner** [17]

   These detergents do not appear to damage any of the materials listed in Table 1, excluding glass, even after many weeks of exposure. And the enzymes are effective at breaking down and solubilizing the organic deposits produced by fermentation.

2. Agitation and cautious rubbing will greatly facilitate the washing process. However, whatever you use for rubbing should be sufficiently non-abrasive so that it will not scratch the surface of your equipment. Scratches will just make the equipment more difficult to wash the next time and can harbor contamination, including microorganisms.

3. It is better to use your working solution of washing agent in modest, repeated doses, rather than all in one time. The washing power of fresh working solution will be stronger and more effective than it will be for a solution that is significantly contaminated with the dissolved and suspended materials you want to wash away.

Easily accessible surfaces are generally pretty easy to wash. Inaccessible or difficult to access surfaces are the real challenge and require ingenuity, sometimes a great deal of ingenuity. Pumps, hoses, and tubing can be especially difficult to wash. When possible, it is helpful to use peristaltic pumps or pumps that have heads that can be easily disassembled. And it is much easier to tell if the inside of flexible tubing is degraded or dirty when the tubing is made of transparent or translucent material; however, be aware that not all such tubing is rated for contact with food and some types may scalp flavors.

Washing BetterBottle Carboys

The nature of BetterBottle carboys makes them much easier to wash than other types of fermentation carboys. And the BetterBottle technical team has developed an approach that uses the safe and environmentally friendly enzyme-enhanced detergents referenced above; however, the general approach can also be used with other washing agents. The following instructions apply to 6 gallon (22.7L) carboys, but can be scaled down for smaller sizes.

1. Pour about 6 liters (~1.6 gallons) of hot water (50°C/122°F) and 30 ml (2+ tablespoons or ~1 fluid ounce) of the enzyme-enhanced detergent into a 22.7 L (6 gallon) carboy.

2. Inserting a 12” (30 cm) square piece of old bath towel, or similar rag, into the carboy will speed washing.

3. Close the carboy with a stopper that has an easily removable vent plug and roll/slosh vigorously on a soft surface, such as a piece of rug, for a few minutes. Remove the closure plug frequently to release the suction that develops as the result of the cooling water vapor.

4. Let the carboy sit for 10-15 minutes and roll/slosh again for a few more minutes.

5. After a few such cycles, this approach will usually remove all the organic deposits, with the possible exception of the ring of deposit that forms at the top of the fermenting wine or beer.

6. If a ring of deposit persists, dump out the dirty detergent water, leaving the piece of towel in the carboy, and add another 16 liters (1.6 gallons) of hot tap water (50°C/122°F) and 25 ml (2+ tablespoons) the detergent. Then, close the carboy and invert it on a small plastic bucket to soak the ring of deposit. If the ring of deposit is not submerged, add a little more hot water. Again, remove the closure plug frequently to release the suction that develops as the result of the cooling water vapor.

7. Swirl the carboy, neck down, so the piece of towel rubs away the ring of deposit. If parts of the deposit do not wash loose, it is safe to leave the carboy to soak overnight, once the water has cooled enough so as not to cause a vacuum within the carboy.

8. If parts of a deposit are stubborn, dump out almost all of the water, add another 25 ml (2+ tablespoons) of the detergent to the wet piece of towel and swirl the rag vigorously around on the deposits.

9. Let the carboy sit for a while and repeat the swirling as needed. It should not take long to remove all of the deposits.

10. Finally, rinse the carboy, neck down, with a jet of warm water.

The practicality of using the enzyme-enhanced detergent approach to washing BetterBottle carboys has been tested by washing carboys that were sent to BetterBottle by home brewers, who volunteered to participate in the study. As soon as a brewer finished his fermentation, he rinsed the carboy with plain water, stuffed paper towel in the neck to keep the interior damp, and shipped the carboy to BetterBottle, along with its history. Shipping took two days on average. BetterBottle staff began washing the carboys within 5 hours of arrival. The results are pictured in the following series of *before* and *after* photographs.

Enzyme-Enhanced Detergent Washing of BetterBottle Carboys
Study Results

Carboy 1A – This Beer was an American Style Stout (7.2% ABV). The temperature of wort before fermentation was 55°-62° F. Fermentation lasted approximately three weeks. Washing was done with Free & Clear Natural 2X Seventh Generation detergent.The carboy had been used to make **10-20 batches of beer**.

Carboy 1B – This Beer was a German Style Oktoberfest (5.2% ABV). The temperature of the wort before fermentation was 55°-62° F. Fermentation lasted approximately three weeks. Washing was done with Free & Clear Natural 2X Seventh Generation detergent. The carboy had been used to make **10-20 batches of beer**.

Carboy 2A – This Beer was a Doppelbock. The temperature of the wort before fermentation was 50° F. Fermentation lasted approximately four weeks. Washing was done with Free & Clear Natural 2X Seventh Generation detergent. The carboy had been used to make about **25 batches of beer**.

Carboy 2B – This beer was an American Wheat, using White Lab 001 yeast. The temperature of the wort before fermentation was 65° F. Fermentation lasted approximately two weeks. Washing was done with Free & Clear Natural 2X Seventh Generation detergent. The carboy had been used to make about **20 batches of beer**.

Carboy 3A – This beer was a Belgian Blonde Ale. The temperature of the wort before fermentation was 80° F. Fermentation lasted approximately three weeks. Washing was done with Free & Clear Natural 2X Seventh Generation detergent. The carboy had been used to make about **6 batches of beer**.

Carboy 4A – This beer was a Kölsch. The temperature of the wort before fermentation was 50° F. Fermentation lasted approximately four weeks. Washing was done with Free & Clear Natural 2X Seventh Generation detergent. The carboy had been used to make about 20 batches of beer.

Carboy 4B – This beer was an American Pale Ale. The temperature of the wort before fermentation was 60° F. Fermentation lasted approximately three weeks. Washing was done with Free & Clear Natural 2X Seventh Generation detergent. The carboy had been used to make one batch of beer.

Carboy 5A – This beer was Pale Ale. The temperature of the wort before fermentation was 63°- 65° F. Fermentation lasted approximately two weeks. Washing was done with Free & Clear Natural 2X Seventh Generation detergent. The carboy had been used to make about 45 batches of beer.

Carboy 5B – This beer was Pale Ale. The temperature of the wort before fermentation was 63°- 65° F. Fermentation lasted approximately two weeks. Washing was done with Free & Clear Natural 2X Seventh Generation detergent. The carboy had been used to make about 45 batches of beer.

Carboy 6A – This beer was Roggenbier. Washing was done with Super Pro-zyme Enzymatic Cleaner detergent. The carboy had been used to make 5-12 batches of beer.

Carboy 6B – This beer was Pale Ale. Washing was done with Super Pro-zyme Enzymatic Cleaner detergent. The carboy had been used to make 5-12 batches of beer.

Transition Rinse

It is important that surfaces are thoroughly rinsed before they are sanitized. Mixing washing agent chemicals with sanitizing agent chemicals may damage equipment and may be unsafe.

Sanitizing Basics

Sanitize using an agent that is least likely to damage your equipment (see Tables1 & 2) and be sure to dilute the agent as recommended by the manufacturers of the agent and equipment. Not all microorganisms are equally susceptible to sanitizers and not all sanitizers are equally effective (Tables 3 & 4).[18] In general, disinfectants of intermediate-level strength have served home winemakers and brewers very well. Bisulfites and phosphoric acid are often used as no-rinse sanitizers; however, they are not actually sanitizers in a strict sense. They inhibit the growth of microorganisms, but many types of microorganisms are resistant.[19]

Chemical sanitizers of intermdiate-level and high-level strength consist of very aggressive oxidizing agents that should effectively sanitize clean surfaces in about ten minutes. When practical, sloshing a solution of these sanitizing agents around on the surface of equipment, as opposed to filling the equipment with the solution, will save on water and sanitizer. Soaking equipment in these sanitizers for hours or days is unnecessary and will certainly increase the likelihood of damaging many types of equipment. The effectiveness of enzyme-enhanced detergents as sanitizers has not been extensively tested for home winemaking or brewing as of this writing, but may prove to be effective.

TABLE #3

Sanitizer strengths required to deal with different classes of microorganisms

SANITIZER STRENGTH	TYPE OF ORGANISM
Chemical Sterilant	• Bacteria with Spores
High-Level Disinfectant	• Mycobacteria • Non-Enveloped Viruses
Intermediate-Level Disinfectant	• Fungii
Low-Level Disinfectant	• Vegetative Bacteria • Enveloped Viruses

TABLE #4

Strength of Sanitizers

SANITIZER STRENGTH	SANITIZER
Chemical Sterilant	• Ethylene Oxide • Ozone
High-Level Disinfectant	• 6% Hydrogen Peroxide • 0.5% Hydrogen Peroxide (acid-stabilized) • Peroxyacetic Acid
Intermediate-Level Disinfectant	• Chlorine (Bleach and Chlorine dioxide) • Iodophors
Low-Level Disinfectant	• 3% Hydrogen Peroxide • Quaternary Ammonium Compounds (QUATS)

Chlorine-based sanitizers are shunned by many home winemakers and brewers, because of their concern for producing chlorinated phenols, which filamentous fungi and Streptomyces biomethylate to chorinated anisoles. [20] The 2,4,6-trichloroanisole (TCA) is known to cause a musty, mold taint at very low concentrations. However, a great many home winemakers and brewers have been using 0.1% bleach solutions for years without problems. If equipment has been well washed, there should be negligible levels of phenols to chlorinate.

Cautionary Note – It is widely known and frequently mentioned in home winemaking and brewing discussions that mixing an acid, even a weak acid such as vinegar, with bleach will release chlorine gas, a potent killer of living cells. However, mentioning this fact is most definitely not the same as recommending that home winemakers and brewers do this in order to *boost* the sanitizing effect of bleach. In point of fact, this approach is definitely <u>not recommended</u> because it is unnecessary, dangerous, and can damage equipment.

Final Rinse

Some non-toxic sanitizing agents may not require a water rinse; however, a final water rinse is generally a good idea, provided the rinse water is sanitary and does not contain significant concentrations of chlorine. If your municipal water contains more chlorine that is desirable, an inexpensive carbon water filter can be use to remove the chlorine; however, bear in mind that once the chlorine has been removed, there is nothing to prevent microorganisms from proliferating downstream from the carbon filter and on the filter itself. Keep that part of your plumbing short and clean. Alternative approaches for removing chlorine from water are to boil the water for a few minutes or to add a little metabibisulfite or bisulfite.[21]

- Boiling works if the water is treated with hypochlorite, but not if it is treated with chloramine. Let the water cool to 52°C (125°F), or less, before using it to rinse.

- According to the World Health Organization, chlorine is present in treated tap water at concentrations of about 0.2–1 mg/L.[22] Assuming a chlorine concentration of 1mg/L, the dechlorination of either hypochlorite or chloramine treated water requires 1.34mg of sodium metabisulfite or 1.46 of sodium bisulfite per liter.[23] The chlorine of both hypochlorite and chloramine is converted to harmless chloride ions and the bisulfite is converted to harmless sulfate ions. The reaction occurs very quickly and should be complete within minutes after the salt has dissolved.

After the final rinse, drain and dry your equipment, unless you plan on using it right away. Carboys are likely to dry faster if they are placed on their sides in a warm area. Of course, the area should be clean.

Once rinsed, your equipment should be free of odors; however, bear in mind that smells can linger in partially closed spaces, such at a carboy, even when odor causing substances are only present as traces of gas that are mixed with the air inside the space. Without a substantial forced air flow, it can take a surprisingly long time for an odor to dissipate, even though the amount of odor causing substance is truly negligible.

DID IT ALL WORK?

The proof of effective washing and sanitizing is in the pudding or, more specifically, the wine or beer. However, it is important to keep an open mind when considering why a wine or beer did not turn out as hoped. Inadequate washing or sanitizing are not the only reasons for a poor result. There are many reasons for *off* flavors or odors that are not related to washing or sanitizing.[24,25]

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