The Differences Between Peracetic Acid High-level Disinfectants and Sterilants

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In the world of sterile processing, active ingredients tend to be the focus. Often, this leads to a belief that all products with the same active ingredient perform the same. Nothing can be further from the truth. Nothing illustrates this more than pain killer medications, such as acetaminophen. Acetaminophen can include ingredients to make it a solid pill, a gel pill, or a liquid. Some ingredients cause the acetaminophen to be slowly released extending the time that it controls pain. Other ingredients help reduce the possibility of upset stomach from ingesting the medication. Though the active ingredient is the same in all these medications, the formulation significantly affects how the medication will work. Imagine if an individual with a sensitive stomach got a normal pill or a patient recovering from a procedure did not get the extended-release version.

Many sterile processing (SP) professionals assume that products using peracetic acid are all the same. Of greater concern is that this belief can lead to improper selection and use. Understanding how formulations work can help in proper selection and reinforce the need to follow the product's instructions for use.

Why Does Composition Matter?

Peracetic acid is an oxidative chemistry. It kills organisms through destruction of bonds in proteins, enzymes, and other components necessary for cellular function. There are two key facts about peracetic acid. The first is that peracetic acid is made by a reaction between hydrogen peroxide and acetic acid within an aqueous environment. These compounds both make peracetic acid and are byproducts of the peracetic acid breaking down. This means that acetic acid and hydrogen peroxide will be found in every formulation.

By themselves, each chemical can kill microorganisms. Peracetic acid kills the fastest with acetic being the slowest. When combined, the concentration and ratio of each chemical within the high-level disinfectant or liquid chemical sterilant product will change the speed at which the product kills microorganisms. As table 1 shows, the chemical proportions vary between high-level disinfectants and liquid chemical sterilants

Learning Objectives

1. **Explain the effect that composition has on chemistry performance**
2. **Describe the impact of inactive ingredients on oxidative chemistry performance**

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Table 1: Reported exposure time needed to pass AOAC Sporicidal Activity Test.

Product	Component	% Formulation	Time to kill 105-106 endospores
S40™ Sterilant Concentrate	Acetic Acid	40%	6 minutes
	Peroxyacetic Acid	35%	
	Hydrogen Peroxide	6.5%	
Acecide®-C High-level Disinfectant and Sterilant	Acetic Acid	25-35%	120 minutes
	Peroxyacetic Acid	<9%	
	Hydrogen Peroxide	<9%	
Rapicide™ PA High-level Disinfectant	Acetic Acid	9%	300 minutes
	Peroxyacetic Acid	5%	
	Hydrogen Peroxide	22%	

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which affect the time needed to kill endospores.

The second fact is that oxidative chemistries are very reactive. They react to metals, minerals, and cellular components. Their corrosive nature can damage many materials. With all things equal, peracetic acid is more corrosive than acetic acid which is more corrosive than hydrogen peroxide. However, not all things are equal in oxidative chemistries. Different ratios between these chemicals can affect material compatibility. For example, a peracetic acid product with a high concentration of hydrogen peroxide may be more damaging than a formula with a lower level of hydrogen peroxide. Of course, increasing peracetic acid levels increases the solution's acidity causing the peracetic acid to be less effective against microorganisms.

The composition of these three key elements defines the microbial activity and material compatibility… or does it?

Balancing microbial efficacy and compatibility is the responsibility of the inactive ingredients. "Inactive ingredients" is a bit of a misnomer. Though they may not be killing microorganisms, they do have important jobs to do. Their functions include:

- Enhancing microbial activity of the active ingredient
- Increasing compatibility with instrumentation
- Promoting formula stability and shelf life

Aside from water, the inactive ingredients are typically found in the buffers. Buffers can be powders that dissolve into the water to create a solution. They can also be concentrated solutions added to the water. The buffers are designed to work with the specific composition of the active ingredients. This means that a buffer from one product does not work with any other product. Additionally, the composition of the buffer can vary widely between products creating different performance and compatibility profiles.

Surfactants are a chemical found in some formulations. Surfactants help the solution reach the surface of materials that would normally repel water. Often called wetting agents, surfactants help improve microbial activity by getting the active ingredient to the surface faster and more thoroughly.

pH buffer systems are composed of chemicals that can help balance the pH level to a more neutral level. Neutral solutions are gentler on materials. It also enhances the microbial activity of peracetic acid. Peracetic acid is most effective when at a more neutral pH.

Corrosive inhibiting agents are chemicals that help protect metals, especially soft metals like copper and brass, from being oxidized. Oxidization is the chemical process that causes metals to corrode or rust. Their job is to improve compatibility with instrumentation.

Some formulations have antifoaming agents. Foam can block the solution from reaching surfaces. These agents prevent or break up foam during processing.

Stabilizers are highly variable and dependent upon the formulation. Stabilizers help maintain the chemistries' effectivity and usability. Some stabilizers slow the natural decomposition of peracetic acid. Others help the inactive ingredients stay suspended.

With the right combination of inactive ingredients, a high-level disinfectant or liquid chemical sterilant can maximize the killing efficacy of peracetic acid, increase compatibility, and improve the penetration of the active ingredients to the device surfaces - even those that naturally repel water.

The Influencers

Formulation is key to performance but external influences from temperature and water can also impact the product's performance. In general, chemical reactions occur faster when the

Lesson:

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Quiz Answers:

1. C, 2. A, 3. B, 4. E, 5. C, 6. A, 7. C, 8. A, 9. B, 10. D

Figure 1: High-level disinfectant concentrate with a buffer system in solution. PHOTO COURTESY: STERIS

chemistries are heated. Oxidative chemistries follow this truth even as they kill microorganisms.

However, higher temperatures can damage temperature sensitive medical devices. Each high-level disinfectant and liquid chemical sterilant must balance the processing temperature for optimum performance against the temperature sensitive needs of the medical devices.

The opposite is also true. A processing temperature which is cooler will cause the chemistry to work slower, slowing the rate at which the microorganisms are killed. Effective high-level disinfection and liquid chemical sterilization can only be achieved when items are processed within the temperature range specified in the chemistry's instructions for use.

Figure 2: An LCS concentrate with powdered buffers that dissolve into water. PHOTO COURTESY: STERIS

Water is a key factor for chemistries with use dilutions made from concentrate. Though water supplied to healthcare facilities is safe to drink, it can contain metal ions, minerals, and dissolved organic material that can react with the active ingredients reducing their availability. This can interfere with high-level disinfection and liquid chemical sterilization.

Putting it into practice

Not all peracetic acid chemistries are the same

Each peracetic acid chemistry formulation has specific characteristics and performs differently. Ensure that the oxidative chemistry currently in use is a formulation that optimizes the effectiveness of peracetic acid, enhances penetration of the active ingredients, and helps protect instrumentation.

Processing temperature and water quality should be confirmed

Confirm that the processing temperatures meet the requirements of the peracetic acid chemistry. Manual processing may require periodically checking the solution and documenting the temperature. Temperature controls are built into automated processing systems. Ensure that the processor's cycle parameters meet those listed in the high-level disinfectant or liquid chemical sterilant's IFU.

Facilities should identify the water quality recommended by the oxidative chemistry manufacturer and ensure that the facility water meets these requirements.

Inspect the medical devices

Investigate discolorations, corrosion, blistering, bubbling, or other abnormalities thoroughly. These can be signs of incompatibility with the high-level disinfectant or liquid chemical sterilant.

It could also be signs of an interaction with residual chemicals used in the reprocessing cycle. Cleaning chemistries, point of use treatment products, and disinfectant wipes are composed of several chemicals which may be incompatible with the chosen high-level disinfectant or liquid chemical sterilant. Ensuring thorough rinsing to remove residuals prior to processing. Consider switching to products that are compatible with the high-level disinfectant or liquid chemical sterilant in use.

Conclusion

Not all peracetic acid high-level disinfectants and liquid chemical sterilants are the same. Be aware of these differences and implement policies and procedures that optimize the performance of the peracetic acid chemistry in use today. **HPN**

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The Differences Between Peracetic Acid High-level Disinfectants and Sterilants - Practice Quiz

1. **What type of chemical is Peracetic Acid?**
   A. Fixative
   B. Bonding
   C. Oxidative
   D. Reactive

2. **Which microbiocidal chemicals are always found with peracetic acid in high-level disinfectants and sterilant?**
   A. Acetic Acid and Hydrogen Peroxide
   B. Water and Acetic Acid
   C. Acetic Acid and Hydrogen
   D. Peroxide and Oxygen

3. **The chemical proportions between peracetic acid, acetic acid, and hydrogen peroxide are the same for all high-level disinfectants and sterilants.**
   A. True
   B. False

4. **What does the ratio of peracetic acid, acetic acid, and hydrogen peroxide affect?**
   A. Operating temperature
   B. Compatibility
   C. Microbial kill rate
   D. All of the above
   E. B and C only

5. **How can inactive ingredients help a high-level disinfectant or sterilant?**
   A. Lower the operating temperature
   B. Prevent off gassing
   C. Enhance microbial kill
   D. Speed drying of the device

6. **Why are antifoaming agents included in some high-level disinfectants and sterilants?**
   A. Foam can prevent surface contact of the solution
   B. Foam can prevent solution circulation
   C. Foam causes discoloration of devices
   D. Foam does not rinse off instruments

7. **How does cooler water affect the performance of the active ingredients?**
   A. Speeds up the degradation of active ingredients
   B. Increases the concentration corrosive inhibitors
   C. Slows the kill rate
   D. Slows dissolution of concentrates

8. **How do metal ions, minerals, and dissolved organic material normally found in tap water affect high-level disinfectant and sterilant use dilution made from concentrates?**
   A. They react with the active ingredients
   B. They enhance microbial kill
   C. They protect metals from corrosion
   D. They lower the operating temperature

9. **Automated high-level disinfection and liquid chemical sterilization processors should meet the cycle parameters listed in which instructions for use (IFU)?**
   A. Equipment IFU
   B. Chemistry IFU
   C. Medical device IFU
   D. Chemical Indicator IFU

10. **What can discolorations, corrosion, and blistering seen on medical devices processed through high-level disinfection mean?**
   A. Devices were steam sterilized
   B. Devices need further cleaning
   C. Devices were not cleaned
   D. Devices are incompatible with the disinfectant