Penn State Extension

Good Agricultural Practices (GAP) Farm Food Safety

Using Chlorine Sanitizers in Produce Wash Tanks

The use of diluted chlorine bleach solutions in fresh produce wash water is a common and inexpensive practice among small scale growers and packers. To use this sanitizer safely and effectively, it's important to understand why we should add a sanitizer to wash water, the different kinds of chlorine sanitizers available, and what factors influence their effectiveness.

Why add a sanitizer to produce wash water?

It's important to understand that if produce becomes contaminated with harmful microorganisms in the field, we can never assume that sanitizer wash treatments can make the product completely safe to eat. The few cells that survive may still be enough to make someone sick. This is why it is critically important to follow Good Agricultural Principles (GAP) that *prevent* contamination from occurring.

Then why should we add a sanitizer to wash water? One reason is to make sure that the water source cannot be a source of contamination. Another reason is to prevent the transfer of harmful microbes present on a few fruits or vegetables to an entire produce lot, therefore magnifying a single isolated contamination incident into one that could affect many people. A continuous presence of a sanitizer also prevents small amounts of harmful microbes from growing in the wash water or on equipment surfaces and eventually getting on the product.

What do we mean by the term "chlorine sanitizer"?

When we discuss chlorine sanitizers we usually are referring to a class of antimicrobial chemicals known as "hypochlorites." There are two common forms of hypochlorite disinfectants.

Sodium hypochlorite. You may recognize this form as common liquid bleach used to whiten or disinfect clothes in the laundry. Bleach can be purchased with varying concentrations of this active ingredient written on the label, usually between 5 and 12% sodium hypochlorite. Concentrated sodium hypochlorite solutions are sold as a highly alkaline product so that it remains stable over time. Therefore, they are very caustic and should be handled with care to avoid splashing that can damage the skin and eyes.

Calcium hypochlorite. This form of hypochlorite is sold as a dry granular material. It is used most commonly in the home as a disinfectant for swimming pools. For water disinfection, it is available as pellets than slowly dissolve under a stream of water. Because calcium hypochlorite it is in a non-liquid form, it is easier to measure out and therefore less hazardous to use.

All sanitizers are regulated by the U.S. Environmental Protection Agency (EPA) and the Food and Drug Administration (FDA). It is a violation of federal law to use ordinary liquid bleach or dry powders that are not specifically labeled for disinfection purposes. Make sure the label of the container indicates that it is approved for microbial disinfection.

What factors influence the effectiveness of chlorine sanitizers?

The two most common factors are the acidity of the wash water solution and the amount of organic matter present.

Organic matter. Hypochlorite molecules are chemically converted by organic matter into chlorine forms that have little or no microbial killing ability. Organic matter includes soil, dust, plant surfaces, and juices from cuts or wounds. For this reason, make sure to remove as much soil and debris as possible before washing by shaking, brushing, or by using water sprays. Use skimmer screens in the tank to remove larger debris. Organic matter can quickly accumulate in a sanitizing tank, as evidenced by a rise in turbidity or muddiness. You should therefore monitor free chlorine levels periodically to make sure they are at adequate levels during the sanitizing process.

Acidity. The hypochlorite molecule changes when the pH the solution changes. pH is a measure of the acidity of the water. The most active form is at or about pH 4. As the pH rises (more alkaline) or decreases (more acid) above or below this value, the ability to kill microorganisms decreases. Usually a pH 4 solution is difficult to maintain and can be corrosive to metal containers and tools. Therefore a compromise pH range of 6.5 to 7.5 is acceptable. This is within the range of most municipal and private well water sources and is still adequate to kill most microorganisms. pH test strips are available at scientific supply houses, or at swimming pool supply stores. Most of the time, no pH adjustment is needed. However, in rare cases when the water is from a limestone source, the pH may be higher than 7.5 and it may be necessary to add muriatic, citric, or other acid to bring the pH down to about 7. Monitor your pH level while doing this though. Adding too much acid can drop the pH well below 4 which can result in the formation of dangerous chlorine gas.

How should chlorine levels be monitored?

There are a variety of test strips or measuring kits you can use to determine how much chlorine is in your wash solution. It's important to understand though that there are two types of chlorine and two methods to determine levels of each. Total chlorine is a measure of active hypochlorite and its more inactive forms that combined with organic matter. Free (also called available) chlorine measures only the amount of active hypochlorite that has not reacted with organic matter and therefore is capable of killing microorganism. As organic matter accumulates in your wash tank, free chlorine levels will decrease with time until the solution has no antimicrobial properties left. Therefore when purchasing test strips or kits, make sure you select one that measures free chlorine levels.

What is an effective level of chlorine to maintain?

The amount of total chlorine used in produce wash tanks is generally between 50 and 200 ppm (mg/L). In your operation, the amount you initially add will vary depending on what levels may blemish produce or create unpleasant flavors, and of course how much free chlorine remains after repeated use. Guidelines are available for maximum amounts of total chlorine that individual produce crops will tolerate. It is generally recommended that free chlorine levels remain between 50 and 100 ppm to assure continuous antimicrobial activity. With a little experimentation, you can use these levels as a starting point. During the washing process monitor free chlorine levels to determine how many batches you can run through the tank before more chlorine should be added or if the solution should be discarded and a fresh one made. Remember, results are likely to be different for each commodity type you run through your wash tank.