NC State University
Fresh Produce Safety Laboratory
Supporting Farm to Fork Produce Safety

Choosing and Using a Chlorine-Based Disinfectant During Postharvest Handling of Fruits and Vegetables

Important Considerations

Please keep in mind that the **only realistic goal** of using a disinfectant in water is to prevent the introduction and re-distribution of plant and human pathogens to Fresh Produce during pre and postharvest operations.

1-All chlorine- based products in contact with fruits and vegetables must be **food grade** and registered for agricultural uses (Code of Federal regulations chapter 21 CFR Part 173). **Household bleach is not food grade** and is not to be used when disinfecting Produce.

Food Grade Chlorine-Based Products

Sodium Hypochlorite (12.5% concentration)	Calcium Hypochlorite (68% concentration)
AGCLOR-310	ECR Calcium hypochlorite AST
FRESHGARD 72	ECR Calcium hypochlorite, granules
FRESHCLOR	DRYTEC, granules (65% concentration)
DIXICHLOR	Hydrology Calcium hypochlorite, briquettes
PAC-CHLOR	INDUCLOR, granules

Examples of food grade chlorine compounds used in fresh Produce disinfection (EPA registered).

2- Read labels to ensure that any soaps or other water treatments, such as flotation aides or salts, are food grade and compatible with your chlorine formulation.

3-**Incompatible soaps (non-food grade) react and use up the chlorine intended to kill pathogens and produce carcinogenic compounds.**

4-The chlorine-treated water should ideally have a **pH between 6.5 and 7.0. Water clarity** also called **water turbidity;** is often related to the amount of suspended solids in solution. **Turbidity** in **flumes** is commonly maintained below 350 FAU (units of turbidity) to provide adequate chlorine levels without excessive water dumping in multiple use systems.

5-Measure, control and adjust the concentration of **FREE Chlorine** in your tank or disinfection system using chlorine meters or strips.

6-The are 3 forms of chlorine in solution: Total, combined and free chlorine. **Total chlorine** refers to the total amount of chlorine in solution. **Combined chlorine** refers to the chlorine that has already reacted with the organic matter, including product, within your tank or disinfection system. **Free chlorine** refers to the form of chlorine available to disinfect the water or product (It's achieved at a pH 6.5-7.0).

7- Adjust the pH of the chlorine solution by adding **a food grade acid**. **Examples:** Citric acid, Muriatic acid, or Phosphoric acid **Always add the acid of choice to the chlorine solution once it was been thoroughly mixed to prevent noxious and deadly chlorine gas formation.**

8-Calcium hypochlorite is more stable than liquid sodium hypochlorite during storage.

9-When handling these chemicals make sure you understand / **follow all the guidelines listed on the label and MSDS** of the product.

For more information please contact, Dr. Eduardo Gutierrez-Rodriguez, email egutier2@ncsu.edu

Practical Guide for Chlorination of Water used for Fresh Produce Disinfection

Sodium Hypochlorite (SH) liquid solution (12.5% concentration)							
Total Chlorine Concentration (ppm)	Gallons (G) of water in Tank - ***Amount of SH to be added***						
	100 G	200G	400 G	600 G	800 G	1000 G	1200 G
25	76 ml	152 ml	304 ml	456 ml	608 ml	760 ml	912 ml
50	152 ml	304 ml	608 ml	912 ml	1216 ml	1520 ml	1824 ml
100	304 ml	608 ml	1216 ml	1824 ml	2432 ml	3040 ml	3648 ml
150	456 ml	912 ml	1824 ml	2736 ml	3648 ml	4560 ml	5472 ml
200	608 ml	1216 ml	2432 ml	3648 ml	4864 ml	6080 ml	7296 ml
Calcium Hypochlorite (CH) powder* (68% Concentration)							
Total Chlorine Concentration (ppm)	Gallons (G) of water in Tank - ***Amount of stock solution to be added***						
	100 G	200 G	400 G	600 G	800 G	1000 G	1200 G
25	70 ml	140 ml	279 ml	419 ml	559 ml	699 ml	838 ml
50	140 ml	279 ml	559 ml	838 ml	1118 ml	1397 ml	1676 ml
100	279 ml	559 ml	1118 ml	1676 ml	2235 ml	2794 ml	3353 ml
150	419 ml	838 ml	1676 ml	2515 ml	3353 ml	4191 ml	5029 ml
200	559 ml	1118 ml	2235 ml	3353 ml	4471 ml	5588 ml	6706 ml

*** BEST PRATICE: First prepare a stock solution at 20% M/V.** This means 1000 g of calcium hypochlorite is added to 4000 ml of clean water (Final volume 5L). Mix well to ensure full solubility. From this stock solution use the necessary ml (milliliters) to prepare the chlorine solution of choice. Example: to prepare 100 G at a concentration of 25 ppm (total chlorine), add 70 ml of the stock solution to 100 G of clean water. **ppm= refers to parts per million.** When measuring the concentration of chlorine **remember; measuring total chlorine is different than free chlorine**

Recommended concentrations of FREE chlorine:

1- Squash (all types)= 75-100ppm, 2-Spinach-Lettuce= 75-150ppm, 3- Cucumber, Broccoli, Melons, Sweet Potatoes= 100-150ppm.

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