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Comments:

MIXING CHLORINE SOLUTIONS

Desired ppm of Free Chlorine	Pints of 5.25% NaOCl solution per 100 gal. of water	Pints of 12.75% NaOCl solution per 100 gal. of water	Ounces of 65% $Ca(OCl)_2$ per 100 gal. of water
25	0.4	0.2	0.5
50	0.8	0.3	1.0
75	1.1	0.5	1.5
100	1.5	0.6	2.1
125	1.9	0.8	2.6
150	2.3	0.9	3.1
175	2.7	1.1	3.6
200	3.0	1.3	4.1

To prepare a specific free chlorine solution (ppm) using sodium hypochlorite (NaOCl), use the following formula.

1) **Determine amount of sodium hypochlorite (NaOCl) concentrate to be added to the total volume of water** (units for NaOCl concentrate to add and total volume must be the same):

$$\text{Volume of NaOCl to add} = \frac{\text{Desired ppm of free chlorine} \times \text{total volume in tank}}{(\%\ \text{NaOCl in concentrate}) \times 10{,}000}$$

2) **Add calculated amount of NaOCl concentrate to tank and bring up to final volume with water.**

Example

To achieve a 150 ppm free chlorine concentration in a 1,000 gallon dump tank using a 12.75% sodium hypochlorite solution.

1) NaOCl concentrate to add (gallons) $= \frac{150 \text{ ppm} \times 1{,}000 \text{ gallons}}{(12.75 \times 10{,}000) \text{ ppm}} =$ **1.18 gallons.**

2) Add 1.18 gallons of 12.75% sodium hypochlorite to 998.82 gallons of water. Adjust pH to between 6.5 & 7.5.

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CHLORINE USE IN PRODUCE PACKING LINES

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INTRODUCTION

Many postharvest decay problems result from the ineffective sanitizing of packinghouse dump tanks, flumes and hydrocoolers. Even healthy looking products from the field can harbor large populations of pathogens, particularly during warm, rainy weather. Pathogens present on freshly harvested fruits and vegetables accumulate in recirculated water handling systems. When fruits and vegetables contact water containing pathogens, they often become infected and subsequently decay during shipping and handling.

Although many packers routinely add chlorine to their water handling systems, failure to follow the IFAS guidelines for packinghouse water sanitation may greatly reduce the effectiveness of this treatment in reducing postharvest decay. **IFAS recommends constantly maintaining 100 to 150 parts per million (ppm) of free chlorine and a pH in the range of 6.5 to 7.5 for all recirculated water.** There is a good possibility that decay problems will arise during handling and shipping whenever product contacts recirculated water that is not maintained under these conditions. In this article, we outline principles for effectively using chlorine for water sanitation.

FORMS OF CHLORINE

The main forms of chlorine used include sodium hypochlorite (NaOCl), calcium hypochlorite ($Ca(OCl)_2$) and chlorine gas (Cl_2). Sodium hypochlorite is often sold as 12 to 15 % solutions. Calcium hypochlorite usually is sold as a powder or tablets in formulations of 65%. However, it does not dissolve readily (especially in cold water) and undissolved particles can injury fruits and vegetables. To prevent this, first dissolve the powder or granules in a small amount of warm water before adding it to the tank. If using tablets for continuous, slow release of chlorine, ensure that the tablets are placed where water circulates well around them. Chlorine gas comes in pressurized gas cylinders and should be handled cautiously according to label instructions.

FACTORS INFLUENCING CHLORINE ACTIVITY

Water pH: When sodium hypochlorite is added to water, it forms sodium hydroxide (NaOH) and hypochlorous acid (HOCl). All three forms of chlorine produce hypochlorous acid (also called available chlorine or active chlorine). **Hypochlorous acid is what kills pathogens.** In high pH solutions, most of the hypochlorous acid disassociates to form hypochlorite ion (OCl-) which is not an effective sanitizer. Testing kits for free chlorine measure both hypochlorous acid and hypochlorite ion and alone do not indicate the quantity of available chlorine that kills pathogens. Chlorine solutions with pH above 8 are relatively ineffective against pathogens. Below pH 6, chlorine is more corrosive to equipment and activity is rapidly lost. **A pH of around 7 will maintain about 80% of the chlorine in the available (hypochlorous acid) form with very**