Food Science and Technology Notes

Extension Division Department of Food Science and Technology Virginia Polytechnic Institute Blacksburg, Virginia

The advantages and disadvantages of various sanitizers along with their properties and functions are of interest to all food processors. It is important that the proper sanitizer be selected for a particular job since improper use of a sanitizer could be ineffective in reducing contamination and also result in serious damage to processing equipment. The following article should be helpful in helping decide what type chemical to use. George J. Flick, Seafood Technologist, State Technical Services.

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THE PROPERTIES AND FUNCTIONS OF COMMONLY USED SANITIZERS

Edmund A. Zottola
Extension Food Microbiologist
Department of Food Science and Industries
Agricultural Extension Service
University of Minnesota

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Table I
SANITIZING MATERIALS

Characteristic	Liquid Sodium Hypo. Cl.	Pdr. Sod. Hypo. Cl.	Calcium Hypo. Cl. (Powder)	Chlor-amines (Powder)	Dichloro DiMethyl Hydantoin	Sodium Dichloroiso-cyanurate	Quaternaries (Liquid and Powder)	Iodophors
Germicidal Efficiency	Good	Varies with water hardness	Good to poor	Questionable and varied	Rate Between Hypochlorites & Chloramines	Good	More effec-tive against gram-positive organisms	Very rapid on Vegetative Cells
Use Dilution Toxicity-200 ppm	No	No	No	No	No	No	Moderate	Depends on the Wetting Agent
Toxicity -- Shelf Strength	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stability -- Stock	Good to Poor	Good to Poor	Good to Poor	Good	Good	Good	Excellent	Varies with temperature
Stability--Use	Good	Good	Good	Good	Poor	Moderate	Excellent	Varies with temperature
Speed	Fast	Moderate	Moderate	Slow	Moderate	Fast	Moderate	Fast
Penetration	Same as Water	Same as Water	Same as Water	Same as Water	Same as Water	Same as Water	Good	Good
Film (hardness Forming effect)	None	Much	Much	Varies	None	None	Varied	None to slight
Affected by Organic Matter	Yes	Yes	Yes	Yes	Yes	Yes	Moderately	Yes

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Affected by other Water Constituents	No	No (?)	No (?)	High Alk. only	High Alk. waters adverse	Yes No	Yes	High Alka-linity only
Ease of Measurement	Good	Good	Good	Good (?)	Good	Good (Same as hypo.)	Varied (?)	Good
Odor (use Dilution)	High	High	High	Low	High	High	None	Slight Iodine
Taste	Object.	Object.	Object.	Object.	Object.	Object.	Bitter	Iodine
Effect on skin (Use Dilution)	Possible	Possible	Possible	Possible	Possible	Possible	Beneficial	Apparently None
Corrosiveness (Use Dilutions)	Slight Depends	Slight Depends	Moderate Depends	Slight	Worst of the Chlorines	Very Slight	None	Non-Corrosive to Stainless Steel
Cost of Active Ingredients	Low	High	Low	High	High	High	Moderate	Somewhat higher than Liquid Sodium Hypochlorites based on 25 ppm available iodine vs. 200 ppm available chlorine.

TABLE 2

Liquid Sodium Hypochlorites

Advantages	Disadvantages
1. Fast germicidal action--is non-selective.	1. Characteristic odor.
2. No dissolving problems since it is liquid.	2. Spillage or breakage may cause staining or bleaching.
3. Easily dispensed in controlled amounts.	3. Should be kept in cool, dark storage area to insure stability. Comparatively short shelf-life.
4. Uniform--entire contents of container have some strength.	4. Must be protected from freezing in very severe climatic conditions.
5. Non-film forming--little effect by hardness or other water constituents.	5. High rate of activity with organic matter decreases strength if soil is carried into sanitizing solution.
6. Economical.	6. Variations in product alkalinity can affect germicidal action.
7. No caking or dustiness in container.	7. Misuse can cause rusting, pitting, and corrosion.
8. No "pinpoint burning" of use-solution vats.	8. Possible adverse effect on skin tissues.
9. Use-dilution non-toxic.	9. Not acceptable because of precipitation problems in iron water supplies.
10. Use concentration easily measured by convenient field tests.	
11. Reasonably high percentage of active ingredient provided, according to formulation and use requirements. (1% to 15%.)	

TABLE 3

Powdered Sodium Hypochlorites

Advantages	Disadvantages
1. Moderately fast, though variable germicidal action.	1. Germicidal efficiency varies with hardness of water supply used.
2. Non-selective against organisms.	2. Amount of available chlorine (if blended) in different layers of shipping drum may vary due to storage and handling conditions.
3. Storage and handling not critical in cold water.	3. Must be dissolved to release chlorine to liquid solution.
4. Minimum problems from spillage or breakage of shipping containers.	4. Caking or dustiness in container complicate use.
5. Use dilution non-toxic.	5. Accurate measurement for use-dosage difficult.
6. Use dilution easily measured by field test.	6. Normal methods of application cause "pinpoint burning" of vat bottom.
	7. Use-solution very cloudy. Severe reaction with water hardness constituents results in gross formation of film on surfaces being sanitized.
	8. Encourages corrosive action due to film formation.
	9. Active ingredients are high in cost
	10. Characteristic odor.
	11. Strength reduced by addition of organic matter.
	12. High alkalinity in use-dilution slows germicidal activity.
	13. Low percentage of active ingredient inherent in this type formulation. (3.25% only).
	14. Cool dark covered storage important.

TABLE 4

Powdered Calcium Hypochlorites

Advantages	Disadvantages
1. Non-selective against organisms.	1. Germicidal efficiency varies from good to poor depending upon individual water supply used and amount of powder added to it.
2. Storage and handling not critical in cold weather.	2. Amount of available chlorine (if blended) varies somewhat in different layers in shipping drum according to storage and handling conditions.
3. Minimum problems from spillage or container breakage.	3. Dissolving a problem - also, must be dissolved before it can function as a sanitizer.
4. Relatively stable.	4. Dustiness in container complicates use.
5. Use-dilution non-toxic.	5. Accurate measurement of use-dosage difficult.
6. Use-dilution easily measured by field test.	6. Normal methods of application cause "pinpoint burning" of vats.
7. High percentage of active ingredient in usual formulations (15%-70%.)	7. Accelerates and promotes gross film-formation on surfaces being sanitized; add hardness mineral to solution; use-solution very cloudy.
	8. Slow germicidal action compared to other hypochlorites.
	9. Encourages corrosive action due to film-formation.
	10. Characteristic odor.
	11. Strength reduced by addition of organic matter.
	12. Cool dark covered storage important.

TABLE 5

Chloramine-T

Advantages	Disadvantages
1. Stability of powdered stock material good.	1. Germicidal efficiency adversely affected by high-alkaline waters, alkaline detergent "carry-over" and in some cases by the amount of this material being used.
2. Moderate effect by organic matter.	2. Releases chlorine at too slow a rate for most utensil sanitizing operations.
3. Low odor characteristics.	3. Germicidal action very slow in usual application methods.
4. Use-dilution non-toxic.	4. Must be dissolved before it can function as a sanitizer.
5. Use-dilutions can be measured.	5. Dustiness in containers may complicate use.
	6. Accurate measurement of use-dosage difficult.
	7. Normal methods of application cause "pinpoint burning" of vats.
	8. Cost of active ingredients high.
	9. Strong concentrations with high alkalinity are very irritating to skin.
	10. Adjustment to reduce pH in order to insure germicidal efficiency may make material very corrosive and unstable so that it loses strength by "gassing off" onto air.
	11. Organic matter quickly uses up active chlorine that is present.

TABLE 6

Liquid Quaternary Ammonium Compounds

Advantages	Disadvantages
1. No objectionable odor.	1. Germicidal efficiency varied and selective, especially against "gram-negative" organisms. Different (sometimes slower) type of kill.
2. Very mild to skin, eyes, and clothing.	2. Moderate toxicity in use dilution (?).
3. Non-corrosive. (This factor the same as the water in which it is used.)	3. Incompatibility with common detergent components complicates use: Germicidal efficiency may be reduced. Objectionable films may be formed on surfaces treated.
4. Ease of accurate measurement and dispensing.	4. Affected by various natural water constituents.
5. Use-dilution readily measured by practical field test.	5. Different members of the broad quaternary ammonium group vary widely in germicidal effectiveness; therefore, acceptance by official agencies is limited and varied.
6. Dissolved solutions "go to work" instantly.	6. Adversely affect rubber on repeated or prolonged exposure at normal use-dilutions.
7. Very stable to temperature changes.	7. Comparatively higher in cost.
8. Very stable under storage.	8. Slow to dissipate - residual problem.
9. Good penetration qualities.	9. Foam problem in mechanical (CIP) applications.
10. Provides a residual bacteriostatic film which is highly desirable.	
11. Abilities to eliminate and prevent odors are outstanding.	
12. One of the best ingredients for incorporation of "germicidal detergent" formulations.	

TABLE 7

Liquid Iodophors

Advantages	Disadvantages
1. Fast germicidal action.	1. Not as effective against spores and phage as hypochlorites.
2. Non-selective.	2. Should not be used at temperatures about 110^0F. (rapid loss of strength, objectionable odor, and staining properties caused by "gassing off.")
3. Well-established germicidal efficiency against vegetative cells.	3. Germicidal action adversely affected by highly alkaline water or "carry over" of highly alkaline detergent solutions (depending on acid content.)
4. Ease of accurate measurement and dispensing.	4. Corrosive to several metals commonly used in food and beverage operations.
5. Conveneint field test available.	5. Current use-cost is comparatively high.
6. Solutions "go to work instantly" because they are dissolved.	6. Germicidal efficiency reduced by addition of organic matter (to solution being used.)
7. Good penetration qualities.	7. Spillage or breakage of containers may cause staining and/or corrosion.
8. Pale amber color of use-solution serves as visual control.	8. Possible residual problem.
9. Acid nature helps "condition" hard waters -- prevents film formations.	9. Foam problem in mechanical (CIP) applications.
10. Wetting agents ingredient promotes fast spot-free drying.	10. Not effective for removal of certain milk soils. (i.e., fats and greases.)
11. Is useful as a "germicidal detergent" for selected light soil applications.	
12. Stable under normal storage conditions.	
13. Easy on skin tissues in use-dilution. Best for cow preparation.	

TABLE 8

Detergent Sanitizers

Characteristic	Chlor.	Quat.	Iodophor
Germicidal Efficiency	Variable with formulae and use conditions		
Toxicity - Use Dilution	Depends on Formulation	Varies	Depends on the Wetting Agent
Toxicity - Shelf str.	Yes	Yes	Yes
Stability - Stock	Varied	Good	Good
Speed		Variable with formulae and use conditions	
Penetration	Varied	Good	Good
Film Forming (Hardness effect)	Varied	Varied	None to Slight
Affected by Organic Matter	Yes	Limited Extent	Yes
Affected by other Water Constituents	None	Limited to None	High Alkalinity Only
Ease of Measurement	Good	Varied	Good
Odor (Use Dilution)	High	None	Slight Iodine
Taste	Object.	Bitter	Iodine
Effect of Skin (Use Dilution)	Possible	Depends on Formula	Possible
Corrosiveness (Use Dilution)	Variable	Possible Slight	Slight
Cost of Active Ingredient		Does Not Apply	