BASIC CHEMISTRY OF CLEANING

Prepared by:

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Definition of Relevant Terms:

Sequestering or Chelating:	The process wherein minerals associated with water hardness (such as calcium, magnesium or iron) are combined with certain substances to form water soluble combinations that will not precipitate out of solution or interfere with the cleaning capacity of a solution.
Suspension:	The retention of insoluble materials in a dispersed state.
Wetting Action:	The enhanced ability of the cleaning solution to come into intimate contact with soil, or the surface being treated, by lowering the surface tension.
Acids:	Chemical compounds which in solution produce free hydrogen ions and thus have pH below 7.0.
Alkalis:	Chemical compounds which in solution produce free hydroxyl ions and thus have a pH above 7.0.

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Table of Contents

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I. Four Basic Types of Cleaning Compounds

A. Alkaline Detergents - pH 9 and Above

1. Contain one or more of the following:

		Functions & Characteristics
a.	Caustic Soda or Potash	Germicidal Action Dissolving Action Saponification Most Corrosive Lacks Deflocculating & Emulsifying Power
b.	Soda Ash	Fair Deflocculating & Emulsifying Good Buffer Poor Water Softener In Hard Water Conditions, Helps Develop Mineral Deposits
c.	Phosphates	Water-Softening Emulsification Dispersion Protein Peptizing Prevention of Soil Redeposition
d.	Silicates	Soil Suspension Non-Corrosive to Most Metals Protects Metals Against Corrosion from Other Alkalis
e.	Chlorine	Peptization Rinse-Aid Germicidal Below pH 10
f.	Wetting Agents	Improve Wetting & Penetrating Action of Cleaner; Improves Rinsing; High or Low Foam or Defoaming, Depending Upon Application
g.	Chelating Agents	Water - Softening Heat - Stable

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B. Acid Detergents - pH 3 and Below

1. Contain one or more of the following:

	Functions & Characteristics
a. **Inorganic Acids**	
Muriatic - Most corrosive to stainless steel	Dissolves Alkaline, Mineral, Milkstone & Protein Films
Sulfuric - Most corrosive to people	
Nitric - Passivates stainless steel	
Phosphoric - Non-corrosive to stainless steel	
b. **Organic Acids**	
Citric > Mild	Dissolves Alkaline, Mineral, Milkstone & Protein Films.
Acetic > Less	Not so effective as inorganic acids.
Gluconic > Corrosive	
c. **Wetting Agents**	Improved Wetting & Rinsing Acids are poor Wetters High-Foam, Low-Foam or Defoaming Characteristics

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I. Four Basic Types of Cleaning Compounds (Continued)

C. Synthetic Detergents (soap) pH 5 to 9

1. Contain one or more of the following:

		Functions & Characteristics
a.	**Anionic Detergents**	Moderate - to high-foaming Unstable with cationic detergents (quats) Non so effective as nonionics as cleaners.
b.	**Nonionic Detergents**	Low - to high-foaming Stable with either anionic or cationic detergents
c.	**Cationic Detergents**	Poor wetters as compared with nonionic & anionic detergents Primarily used as germicides
d.	**Additional Additives** Phosphates Silicates Chelating Compounds	

D. Sanitizers

1.

	Advantages	Disadvantages
a. Liquid	Active against all microorganisms Unaffected by hard water salt Non-Film-Forming Spot-Free Drying Easy to test concentrations Active against spores	Short shelf life Non heat-stable Corrosive to skin & all metals Most effective pH 6.5 to 9.5 Any carryover of acid or alkaline detergent decreases effectiveness

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D. Sanitizer

		Advantages	Disadvantages
2.	Iodophors	Active against all microorganisms except sporses and bacteriophage Effective in hard water Easy to test concentration Good penetration properties	Can stain porous and plastic surfaces Readily absorbed through the skin Should not be used above 120°F. Germicidal action affected by alkaline residues Non-residual
3.	Quats (Cationic Detergents)	Indefinite shelf life Effective against wide range or organisms Prevents & eliminates odors Non-corrosive Non-irritating to skin (in use dilution) Temperature-stable Forms bacteriostatic film Good penetration properties	May be neutralized by anionic detergent residues May foam in CIP applications Not effective against spores or phage

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II. Product Descriptions

Troy 1131 Foam - Add	Synthetic detergent blend. High foaming. Acid and alkaline stable. Neutral detergent, its primary function to produce a rich, stable foam when mixed with acid or alkaline detergents and applied with foaming equipment. Contains nonionic and anionic wetting agents. Residue will neutralize quat sanitizers. Dilution ration: 1:50 to 1:100.
Troy 1137 FP Chlorinated Self-Foaming Alkaline Cleaner	Caustic potash - vs. Caustic soda - type alkaline cleaner. Makes a potassium soap vs. a sodium soap which is more soluble in water. Rinses better than a sodium type product (TROY 1129). Also contains chlorine for protein peptization, phosphates for water softening and emulsification of fats; silicates to prevent both soil redeposition and corrosion. Dilution ration: 1:20 -hand scrubbing; 1:30 to 1:50 -foam cleaning.
TROY 1152 Lo-Foam Detergent for Automatic Scrubbers	Controlled foam; moderately alkaline. Contains water-soluble solvents to help remove petroleum grease & black tire marks. Also contains corrosion inhibitors to protect machine parts. Dilution: 1:20 to 1:40.
TROY 2033 FP General Cleaner	Chlorinated Alaline: phosphate based detergent to soften water, emulsify, chlorine for protein peptization. Excellent for hand scrubbing. Dilution : 1:20 hand scrubbing' 1:30 to 1:30 foaming.

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II. Product Descriptions (continued)

Troy 1412 One Step Hand Sanitizer	Quaternary Ammonium - type hand sanitizer; leaves a bacteriostatic film, which iodines do not. Not absorbed through the skin. (Iodines are.)
Troy 1651 Sanitizer	Concentrated Quarternary ammonium - type sanitizer; new, twin - chain type quat as effective at 150 ppm as the old quats are at 200 ppm. One oz. per 2 gallons of water. (150 ppm) meets the no-rinse specifications. Leaves a residual film that other types of sanitizers do not. Effective to 1,000 ppm hardness.
Troy 2118 FP Self Foaming Acid Cleaner	Phosphoric-nitric blended acid for general acid cleaning, scale removal, etc. Contains nitric acid, which will passivate stainless steel.
Troy1133 Pasteurizer Cleaner	A heavy duty glucanted caustic cleaner for cleaning pasteurizers and heat exchangers. Use at 2-6%

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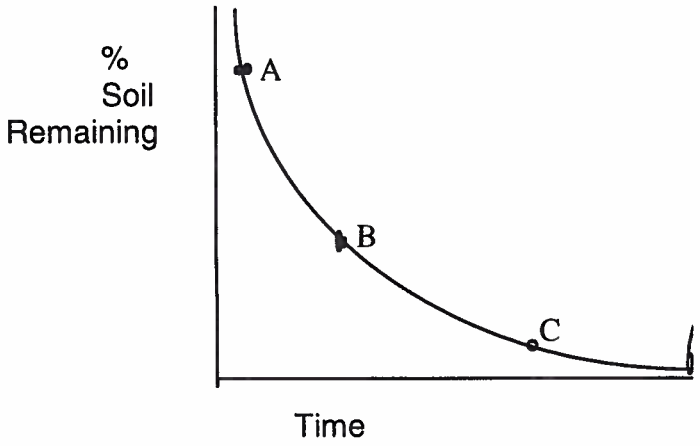
III. Factors Affecting Cleaning Efficiency

A. Time

1. 

2. Lower temperature, more time; higher temperature (within limits) less time.

3. Lower concentration (within limits) more time; higher concentration (within limits) less time.

4. Lower velocity, more time. Higher velocity, less time.

5. It is expensive (equipment, labor and materials) to reduce time..

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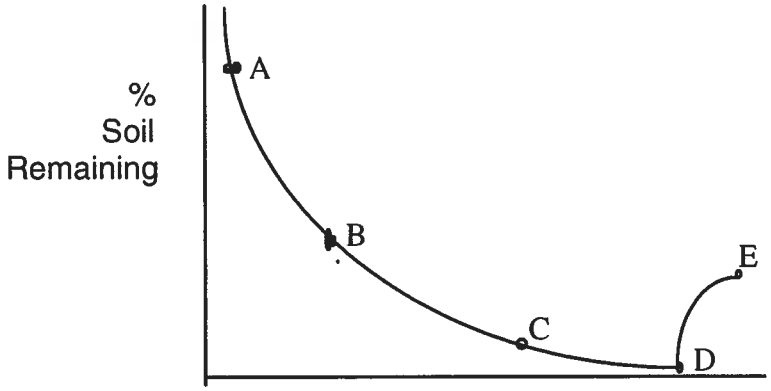
B. Concentration

1.



2. Higher temperature, less concentration
   Lower temperature, more concentration

3. Longer time, less concentration
   Less time, higher concentration

4. Higher velocity, less concentration
   Lower velocity, higher concentration

5. In most cases, it is less expensive to increase velocity, time (as long as no labor is involved) than to increase concentration.

   In most cases, it is more expensive to increase temperature, time (if labor is involved) than concentration.

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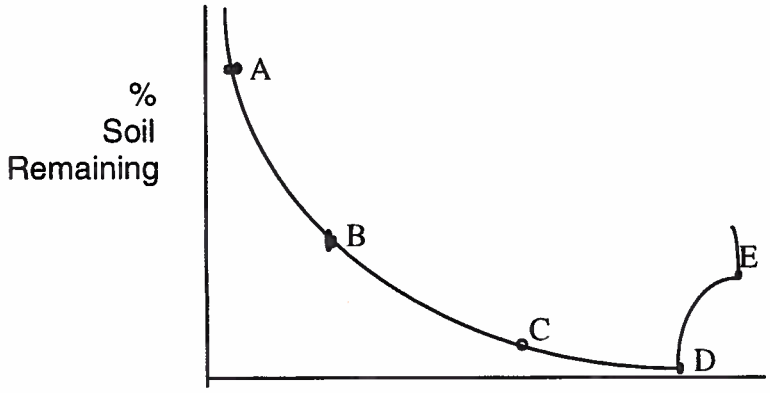
C. Temperature

1.



2. As temperature increases:

   a. The strength of bonds between the soil and the surface decrease

   b. Viscosity decreases and turbulent action increases.

   c. The solubility of soluble materials increases.

   d. The chemical reaction rates increase.

3. "Rules of Thumb"

   a. For products with a temperature range between the melting point of fat (90° F) and the burn point of protein (185° F) an increase of 18° F will double the efficiency of the cleaning operation.

   b. Above 185° F, heat-induced reactions bind animal protein more tightly.

   c. Minimum effective temperature is 5° F. higher than the melting point of the fat (90° F).

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C. Temperature (continued)

4. Type of cleaner affects temperature.

   a. Straight caustic-chelated-type cleaners (TROY 2501 FPC) require higher temperatures.

   b. Caustic-phosphate-type cleaners (TROY 2507 FP, 1138 FP) require lower temperatures.

5. In most cases, it is less expensive to increase time (if no labor is involved) velocity, concentration, than to increase temperature.

6. In most cases, it is more expensive to increase time (if labor is involved) than to increase temperature..

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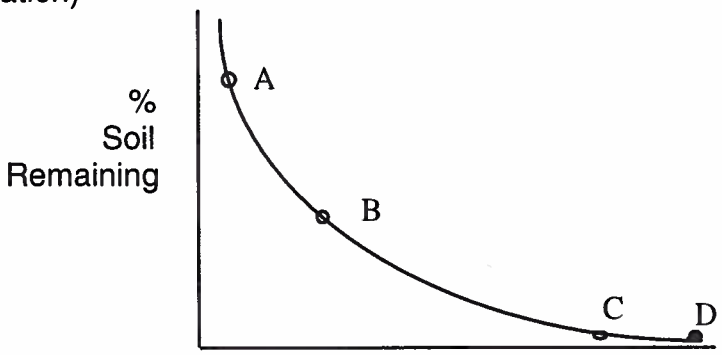
D. Velocity (Agitation)

1.



2. All other factors being equal, an increase in velocity (agitation) will decrease time, temperature and concentration requirements.

3. Increasing velocity (agitation) is the least expensive means of improving cleaning effectiveness.

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IV. Fundamental Cleaning Procedures

A. Effective Plant Sanitation will consist of a variety of different cleaning procedures. Factors affecting efficiency will apply, and most procedures will include:

1. Pre-Rinse
2. Wash
3. Post-Rinse
4. Sanitize

B. Foam Cleaning

1. Foam-cleaning has been utilized for years as the main procedure for general plant sanitation. If performed properly, it is both cost and labor efficient. Although foam cleaning is effective, light hand cleaning may still be required. Foam cleaning can also produce adverse effects when proper procedures are not followed. When foaming follow these steps:

a. Cover or remove water sensitive materials.

b. Perform dry pick-up, placing trash and meat scraps in proper containers.

c. Pre-rinse all equipment, walls and floors.

d. Adjust air and solution mixture to provide proper foam texture.

e. On walls and vertical surfaces, foam the entire area. Do not depend on foam run-off to clean!

f. Do not foam too large an area at one time. Foam allowed to dry will create problems. (Heavily soiled areas normally can be hand-cleaned with foam and a nylon pad.)

g. Give a thorough final rinse.
h. Sanitize.

B. Foam-Cleaning

2. Common Error in Foam-Cleaning
(Foam Top, Across and Down)

a. Foaming too large an area at one time.

b. Foaming prior to break.

c. Improper foam texture. Extra dry foam does not penetrate soil, and extra wet foam does not have sufficient hang-time.

d. Improper coverage while foaming.

e. Poor final rinse.

f. Poor dry pick-up, leaving heavy piles of meat scraps to be moved with a pressure hose.

C. C.I.P.. Cleaning (Cleaned-In-Place)

1. C.I.P. cleaning is a labor efficient procedure used to automatically clean the interiors of vessels and connecting pipes. Although this is an automatic process, the basic cleaning steps will apply.
Concentration, temperature and time are critical to C.I.P. cleaning.
The following is a common C.I.P. procedure:

a. Pre-rinse through system. Add alkaline.

b. Pump cleaning solution through system.

c. Thoroughly rinse.

d. Acid phase for neutralization.

e. Final rinse.

f. Sanitize, if applicable.

IV. Fundamental Cleaning Procedures (continued)

C. C.I.P. Cleaning (continued)

2. Common Errors in C.I.P. Cleaning

a. Eliminating pre-rinse.

b. Shortening time cycle.

c. Eliminating acid phase.

d. Reducing solution volume.

3. Most shortcuts in C.I.P. cleaning are designed to save time. Most often, taking these shortcuts results in a poor job and increases cleaning time at a later date. Examples of C.I.P.:

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V. Sanitizers and Sanitizing Techniques

A. Sanitizing vs. Disinfection

1. Disinfection is a health care term.

   a. The same type of active ingredients are used, but at much higher levels, resulting in 100% kill.

   b. Not practical for food plants.--Residue would have to be rinsed off, thus re-contaminating.

2. Sanitizing is a food plant term.

   a. Refers to reducing bacteria to acceptable limits.

   b. Sanitizers, when used according to label directions, do not have to be rinsed, thus avoiding re-contaminating equipment.

   c. Minimum contact time: Two minutes.

B. Conditions Necessary for Sanitizing

1. Clean surface.

   a. Cannot sanitize dirt.

   b. Films should be removed; this fact emphasizes the importance of regular cleaning.

2. Smooth, non-porous surface.

   a. Badly scratched equipment is harder to sanitize

   b. Chemically attacked equipment is harder to sanitize

3. Suitable water supply

   a. Water above 1,000 ppm hardness reduces effectiveness of quat.

   b. Water with precipitate iron reduces the effectiveness of chlorine.

B. Conditions Necessary for Sanitizing (continued)

3c. Water above 120° F reduces the effectiveness of both chlorine and iodine.

d. Water with a pH of over 9 reduces the effectiveness of both chlorine and iodine.

4. Proper application equipment

a. Apply a pre-diluted solution, or meter accurately from a concentrate. Check concentration regularly.

b. The less favorable conditions (e.g., cutting boards) the longer the contact time.

c. Most effective means of sanitizing:

1) Soak

2) Spray or Wipe

3) Fogging--least effective, most hazardous to personnel.

C. Frequency of Sanitizing

1. Food contact surfaces

a. After cleaning.

b. Prior to start-up, if it does not immediately follow cleaning.

c. After "breaks."

d. After any maintenance is performed.

2. Non-food contact surfaces

a. As required, but on a schedule.
b. Use higher concentrations of the sanitizer (in case of quats, 400 ppm) will leave a residual film

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