Types of Microorganisms

Types of Organisms

Viruses
Bacteria
Molds
Yeast
Protozoa
Detergents and Sanitizers

- Temperature
- Chemical
- Time
- Action

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<table>
<thead>
<tr>
<th>External Changing Factors Affecting Plant Sanitation &amp; CIP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1965</strong></td>
</tr>
<tr>
<td>Plant Technology</td>
</tr>
<tr>
<td>Hand Cleaning → Beginning of CIP → Manual CIP Hook-ups → Valving &amp; Proximity Switches</td>
</tr>
<tr>
<td># of Food Plants</td>
</tr>
<tr>
<td>Chemical Usage</td>
</tr>
<tr>
<td>Rationalisation of chemical supply → Many suppliers → Global Supplier(s)</td>
</tr>
<tr>
<td>Process Development</td>
</tr>
<tr>
<td>Safety</td>
</tr>
<tr>
<td>Environmental</td>
</tr>
<tr>
<td>Internal &amp; External Quality Drivers</td>
</tr>
<tr>
<td>Quality by inspection</td>
</tr>
<tr>
<td>Fragmented standards</td>
</tr>
</tbody>
</table>
Factors Influencing the CIP Result

**Plant design:**
- materials, surface finish
- equipment design
- geometry
- hygienic design

**Process**
- quantity & type of soil
- age of soil
- temperature profile
- degree of automation
- environmental conditions

**Cleaning parameters:**
- T - time
- A - action
- C - concentration
- T - temperature
- W - H₂O
- I - individual
- N - nature of soil
- S - surface

**Organizational**
- Good manufacturing practices (GMPs)
- Standard operating procedures (SOPs)
- HACCP
- personnel training
1st Cleaning

Detergents modify the nature of water so that it may efficiently penetrate, dislodge, disperse, and carry away surface soils.
First, What is a Clean Surface?

Free from residual film or soil.

Free from harmful microorganisms

- Pathogenic
- Spoilage

*Strict application of these criteria may mean clean surface is never achieved*

Criteria for defining an acceptable surface is required

- e.g. <100 microorganisms per 100 sq. cm
- Uniform water sheeting, no breaks.
Major Components in All Cleaning Systems

1st Cleaning (Detergents)
- Removal of Soil

2nd Sanitizing (Sanitizers)
- Treatment of the surface to kill remaining microorganisms
## I. Cleaning Fundamentals: TACT WINS

<table>
<thead>
<tr>
<th>T</th>
<th>Time</th>
<th>Contact time on the surface being cleaned</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Action</td>
<td>Physical force exerted onto the surface</td>
</tr>
<tr>
<td>C</td>
<td>Concentration</td>
<td>Type &amp; amount of detergent used</td>
</tr>
<tr>
<td>T</td>
<td>Temperature</td>
<td>Amount of energy as heat used in the cleaning solution</td>
</tr>
<tr>
<td>W</td>
<td>Water</td>
<td>Used to prepare cleaning solution</td>
</tr>
<tr>
<td>I</td>
<td>Individual</td>
<td>Worker performing clean-up operation</td>
</tr>
<tr>
<td>N</td>
<td>Nature of Soil</td>
<td>Composition of the soil</td>
</tr>
<tr>
<td>S</td>
<td>Surface</td>
<td>Composition of material is being cleaned</td>
</tr>
</tbody>
</table>
Cleaning Fundamentals – TACT

**Time** is determined by:

- Equipment size
- Nature of soil: i.e. protein, mineral, etc.
- Thermal degradation of soil on the surface being cleaned

\[
\text{Time} = \text{Equipment size} \times \text{Nature of soil} \times \text{Thermal degradation}
\]
Cleaning Fundamentals – TACT

Action -- Several Choices:

- Manual
  - Brushing
- Foaming
- High Pressure
- Clean in Place (CIP)
- Clean out of Place (COP)
Cleaning Fundamentals – TACT

In CIP for moving a liquid over a surface. We can identify three areas --

- Boundary or streamline zone
- Transition zone
- Turbulent zone

An what’s the velocity we’re seeking?

- Lines
- Tank
Cleaning Fundamentals – TACT

Cleaning is influenced by the:

Concentration of detergent

Properties of the detergent used:

- **pH** (acidic, alkaline or neutral)
- **surfactants** for wetting and soil suspension
- **sequestrants and chelants** to match water conditions and break calcium bonds
- foam free
- compatible with process material gaskets, metals and resin coatings
- minimal impact on effluent
pH & Detergent Chemicals

<table>
<thead>
<tr>
<th>Acid</th>
<th>pH Scale</th>
<th>Base</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>10</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>13</td>
<td>14</td>
<td></td>
</tr>
</tbody>
</table>

<<Foaming Acids>>

Attack Minerals

<<<<Household Detergents>>>>

<<Beverages>>>

<<<<<<Molds>>>>>>>>>>>>>>>>>>>>>>>>>

<<<<Yeast>>>>>>>>>>>>>

<<<<<<Bacteria>>>>>>>>>

<<<<Lactobacillus>>>>>

pH is a log scale. Incremental changes in concentrations are factors of 10. Industrial Detergents are strong acids and bases.
Alkaline Detergent Components

**ALKALIS**
- Caustic soda
- Sodium carbonate
- Trisodium phosphate
- Sodium metasilicate

**SURFACANTS**
- LAS (Linear Alkyl Benzene Sulfonate)
- Known as wetting agents
- Increase soil penetration and dispersion
- Improve rinsing and control foaming

**CHELATING AGENTS**
- EDTA (Ethylene Diamine Tetraacetic Acid)
- Gluconates
- Complex phosphates
- Used for water softening
- Mineral control
- Function by combining with minerals

**CHLORINE**
- Sodium hypochlorite
- Used as additive in alkaline cleaners
- Aids in protein film removal
- Can be approved for food contact surfaces
- Ether or alcohol type material

**SOLVENTS**
- Dipropylene glycol-methyl ether
- Butyl cellosolve
- Used for grease cutting
- Can be approved for food contact surfaces
- Ether or alcohol type material
Sequestrants are substances that engulf (chelant) Ca\(^{++}\) & Mg\(^{++}\) ions and keep them in solution.

Sequestrants usually react in 1:1 stoichiometry.

Examples of Sequestrants are:

- EDTA
- Gluconates
- Phosphates
- Polymers

Sequestrants remove scale or beerstone deposits by pulling the Ca\(^{++}\) right out of the soil matrix.
1 = After Pre-Rinse

2 = After 3% NaOH CIP

3 = Strong Chelant Added to NaOH

4 = Again, After CIP with Strong Chelant Added to NaOH. Why is this Important?

What the Sequestrant Does
TACT – Oxidizing Agents. Role of Sodium Hypochlorite (NaOCl)

In Detergents, NaOCl is a oxidizer -- Cuts Films

In Sanitizers, NaOCl kills microbes. Why?

NaOCl + 2 H2O $\rightleftharpoons$ HOCl + NaOH

(Hypochlorous Acid)

![Graph showing the relationship between pH and the percentage of HOCl and OCl⁻](image-url)
**Acid Detergent Components**

**ACIDS**
- used for removal of inorganic soils such as mineral films
- remove soil by dissolving
- mineral
- phosphoric
- nitric/sulfuric
- organic
- citric
- acetic
- halogen
- hydrochloric
- hydrofluoric

**SURFACTANTS**
- known as wetting agents
- increase soil penetration and dispersion
- improve rinsing and control foaming
- nonionic
- alkylphenols
- anionic
- alcohol ethoxylates

**WATER**
- component of most liquid cleaners
- primary component of all cleaning use solutions
- H2O
A surfactant (surface active compound) is a substance that lowers the surface tension of a solution. A surfactant makes water wetter. Surfactants also foam, control foam, emulsify and disperse soils in solution.

Chemically surfactants have anionic, cationic or nonionic (neutral) structures.

Water

Water + Surfactant
Surfactant (SURFace ACTive AgeNT) molecules are composed of both a water loving (hydrophilic) and water hating/oil loving (hydrophobic) group.

Surfactants enhance wetting, emulsify fats and oily materials.

Bonus Question: What was the first surfactant?
A surfactant (a surface active compound) is a substance that lowers the surface tension of a solution. A surfactant makes water wetter.

Surfactants increase detergency, wetting, emulsification, solubilization & dispersion of soils.
Water forms beads which have minimal contact with surface and soils and do not penetrate crevices in surface.
Surfactant solution spreads across surface, thoroughly wetting soil particles and penetrating crevices.
TACT -- Surfactants -- Wetting Penetration

Without surfactants

Proteins, debris etc. - microbes can grow

With surfactants

Protein, debris and microbes out of crevices
<table>
<thead>
<tr>
<th>Detergent</th>
<th>Soil/Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkaline/Caustic Detergent</td>
<td>Heavy Burnt on Soils on Heated Surfaces</td>
</tr>
<tr>
<td>▪ Defoamed</td>
<td>▪ Brewkettles</td>
</tr>
<tr>
<td>Chlorinated Alkaline Detergent</td>
<td>▪ HTST</td>
</tr>
<tr>
<td>Acidic detergents</td>
<td>Light Soiling/Films/Micro</td>
</tr>
<tr>
<td>▪ Defoamed</td>
<td>▪ Tanks</td>
</tr>
<tr>
<td></td>
<td>▪ Fillers, Valves &amp; lines</td>
</tr>
<tr>
<td></td>
<td>Descaling/Acid Washing</td>
</tr>
<tr>
<td></td>
<td>Fermenters, Applications Under CO₂</td>
</tr>
</tbody>
</table>
TACT -- Typical CIP Detergent Composition for a Heated Surface

HD Liquid Caustic Detergent

- H₂O
- 40 – 45 % NaOH
- 0.4 – 1.0% Defoaming Surfactant
- 2 – 4 % Water Conditioner

Usage Profile

- Conc. = 2 – 4 %
- pH = 12.8
- Temp: 180 °F
Synergy gives a cleaning result greater than the sum of the individual components.
Temperature is determined by the:

Soil characteristics: i.e. Melting of resin or aromatic flavor component

Processing temperature

The detergent. For example the cloud point (de-foaming point) of a surfactant is 120 °F. That detergent needs to be used at temps >120 °F.

Condition of soil on the surface being cleaned.

Remember…..

For every 10°C rise the rate of chemical attack on a soil doubles

In CIP the diffusion processes increase with temperature and hence cross the boundary layer faster
Water Functions to:

- pre-rinse to remove gross soils
- soften soils left on the surface
- carry detergent to the surface to be cleaned
- carry wastes away from the surface being cleaned
- rinse detergent off of the surface
- carry sanitizer to the surface after cleaning

Hardness Classification

- **SOFT:** 0 - 60 PPM or 0 - 3.5 grains
- **MODERATE:** 60 - 120 PPM 3.5 - 7 grains
- **HARD:** 120 - 180 PPM 7 - 10.5 grains
- **VERY HARD:** > 180 PPM >10.5 grains
## WINS -- Typical H₂O Analysis

**What does it mean?**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.52</td>
</tr>
<tr>
<td>Specific Conductance</td>
<td>586 µmhm</td>
</tr>
<tr>
<td>Color (Visual)</td>
<td>colorless</td>
</tr>
<tr>
<td>Clarity (Visual)</td>
<td>clear</td>
</tr>
<tr>
<td>P Alkalinity (CaCO₃)</td>
<td>0 PPM</td>
</tr>
<tr>
<td>M Alkalinity (CaCO₃)</td>
<td>96 PPM</td>
</tr>
<tr>
<td>Total Hardness CaCO₃</td>
<td>190 PPM</td>
</tr>
<tr>
<td>Calcium Hardness CaCO₃</td>
<td>136 PPM</td>
</tr>
<tr>
<td>Magnesium Hardness CaCO₃</td>
<td>54 PPM</td>
</tr>
<tr>
<td>Iron, Total</td>
<td>0.32 PPM</td>
</tr>
<tr>
<td>Silica SiO₂</td>
<td>5.66 PPM</td>
</tr>
<tr>
<td>Nitrate NO₃</td>
<td>5 PPM</td>
</tr>
<tr>
<td>Chloride Cl</td>
<td>93 PPM</td>
</tr>
<tr>
<td>Sulfate SO₄</td>
<td>58 PPM</td>
</tr>
<tr>
<td>Phosphate PO₄</td>
<td>0.03 PPM</td>
</tr>
</tbody>
</table>

**Source:** Akron, OH
WINS -- Individual

Changes in Our Workforce

- More Diverse
  - Blue/White Collar ⇒ Business Casual
  - Gender Lines Dropping
- Single to Multi-Task
  - Line Worker ⇒ Area Technician
  - (Production/Maintenance/Quality/Sanitation)
  - Skill Sets: O/Is; Equipment & Tests
  - Empowerment of Workers

Challenges

- Multi-Lingual
- Reading Levels
- Turnover

Training /Knowledge is the key!

“Management is nothing more than motivating other people.”
Lee Iacocca
## WINS – ‘Typical’ Soils

<table>
<thead>
<tr>
<th>Type of Soil</th>
<th>Appearance</th>
<th>Cause</th>
<th>Removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oils (Flavor)</td>
<td>greasy/ white</td>
<td>-low cleaning temperature</td>
<td>-hot alkaline wash</td>
</tr>
<tr>
<td></td>
<td>hanging water</td>
<td>-improper detergent</td>
<td></td>
</tr>
<tr>
<td></td>
<td>droplets</td>
<td>concentration</td>
<td></td>
</tr>
<tr>
<td>Hop</td>
<td>blue/rainbow</td>
<td>-using non-chlorinated cleaner</td>
<td>-thorough pre-rinse,</td>
</tr>
<tr>
<td></td>
<td>hue</td>
<td>-inadequate pre-rinse</td>
<td>chlorinated alkaline</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>detergent wash</td>
</tr>
<tr>
<td>Proteins/Pectins</td>
<td>clear to brown</td>
<td>- sugars and starches</td>
<td>-hot alkaline wash</td>
</tr>
<tr>
<td>(And Like Substances)</td>
<td>film, sticky</td>
<td>precipitated or burned on</td>
<td></td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>white/gray chalky</td>
<td>-mineral drop-out from water</td>
<td>-acid wash</td>
</tr>
<tr>
<td></td>
<td>film</td>
<td>-inadequate chelant level in detergent</td>
<td>-properly built detergent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-lack of acidified rinse</td>
<td></td>
</tr>
</tbody>
</table>

*Diversey* for a cleaner, healthier future
## WINS -- ‘Atypical’ Soils

<table>
<thead>
<tr>
<th>Type of Soil</th>
<th>Appearance</th>
<th>Cause</th>
<th>Removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silica, Fe, Mn</td>
<td>“permanent” white films, reddish residues</td>
<td>-process H2O -allowing soft metal safe (silicated detergents) to dry</td>
<td>-special mixed acids</td>
</tr>
<tr>
<td>Hydrocarbons</td>
<td>Hanging H2O droplets</td>
<td>-leaks from equipment -over greasing</td>
<td>-hot, emulsifying detergent</td>
</tr>
<tr>
<td>Greases</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment By-Products</td>
<td>black residues</td>
<td>-normal wear &amp; tear</td>
<td>-acid washes -emulsifying detergents</td>
</tr>
<tr>
<td>(Tire tracks, Gasket inking)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>