Troubleshooting Micro Problems in CIP Systems
Why Micro Problems?

System Problem
- Flow
- Dead Ends
- Non-Hygienic Design

Cleaning
- Chemical
- Program

Lack of Preventive Maintenance
- Gaskets
- Filters
AGAIN, CIP NEEDS VELOCITY!

MECHANICAL ACTION INSIDE OF PROCESS TUBING

* 5 FT/SEC MINIMUM REQUIREMENT

POOR, PARTIAL FLOW WITH ENTRAINED AIR

INADEQUATE LAMINAR FLOW DISTRIBUTION

GOOD TURBULENT FLOW DISTRIBUTION *
Dead Ends & Pockets

Great source of micro contamination in CIP systems. And, we don’t see it. We don’t realize a dead end in present.

Generally.......

- Flow into a dead leg is ‘better’ than flow away
- Vertical dead legs are always worse than horizontal
- L/D ratios > 1.5 are problematic
Dead Ends
Dead Ends

Recommendations:

Worse Case
Non-Hygienic Design

Corners/Welds

**Judging Unpolished Welds**

**Unacceptable**

*Weld badly sunken from the outside – heavy oxidation crusted in weld area.*

**Reason:** Inadequate gas (inert gas) purge.
Non-Hygienic Design

- Protruding into the Product Stream

- Surface Roughness/Unevenness

Pitting Corrosion
Pipe Interior Showing Pitting
Agitator Shaft Pitting
Other Examples, Non-Hygienic Design Problems....

Bacteria & debris adhering to an area around crack & pit from corrosion.

Drawing of Pseudomonas cells in the grain of a 180 grit stainless steel surface.
Cleaning Problems

Chemicals

CIP Program
Interior Tank Soils Remain
Vertical Tank Streaking – Protein Soils
What is a biofilm? A biofilm is a collection of microorganisms & debris, surrounded by the slime the microorganisms secrete, attached to a surface. Examples of biofilms we see everyday -- slime on a stone by a river; gel-like film inside a vase that held flowers for several days.
Why Are These Biofilms a Problem?

Biofilms grow to such an extent that they slough off a surface. This can contaminate the product. Why do we sometime get ‘spotty counts’?
A Biofilm *CANNOT* be Sanitized Away….

Biofilms evade antimicrobial challenges by multiple mechanisms, however, the most important mechanism is the failure of the antimicrobial to penetrate the biofilm.
Studying Biofilm Removal in CIP
Biofilms Removal in CIP: Effect of Time

Percentage of bacteria removed from stainless steel surfaces with circulation cleaning.
Flow = 5 ft/sec. Detergent concentration = 0.4%
Biofilm Removal in CIP: Effect of Action (Velocity) of a Detergent

Percentage of bacteria removed from stainless steel surfaces at various flow rates of a chlorinated detergent after 5 minutes in a circulation cleaning system.
Biofilm Removal in CIP: Effect of Concentration of Detergent

Percentage of bacteria removed from stainless steel surfaces with various concentrations of a chlorinated detergent in a circulation cleaning system.
Biofilms Removal in CIP: Effect of Temperature of Detergent

Percentage of bacteria removed from stainless steel surfaces at various temperatures of a chlorinated detergent in a circulation cleaning system. Detergent concentration = 0.4 % v/v.
PMs: First -- Gaskets

In every CIP system there needs to be a program of periodic gasket replacement.

Biofilms will harbor in gaskets & are nearly impossible to remove.

These biofilms then detach and contaminate our product.

Gasket Crack @ 20 X
Gaskets

Surface of Buna-N Gasket

Biofilm with extra-cellular matrix on Buna-N

S. typhimurium
PMs -- Air Blows

CHECK AIR BLOW ASSEMBLY FOR THE PROPER FILTERING MEDIA
SHOULD BE CHANGED AT LEAST WEEKLY
Now, Where do we Start?
Locating the Source(s) of Microbial Contamination

QC Lab
- Product Records
- Type of Contamination
- Patterns -- Graph it

Begin with.....
- System
- Cleaning
- PMs

Swabbing

Key = Be Systematic
Questions?