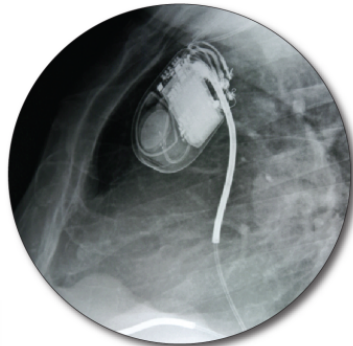


# Choosing the Right Cleaner



Providing Assembly and Cleaning Solutions since 1923

# Company Overview

International Products Corporation (IPC), incorporated in 1923, manufactures specialty chemicals. IPC has over 30 years experience making and selling specialty cleaners and formulated lubricants to industry.

IPC is the proud recipient of the 2013 Environmental Innovation award by the Suppliers Partnership for the Environment.

All products are manufactured in the New Jersey headquarters and are available worldwide.

International Products Corporation is an ISO 9001:2008 certified company



**Company Headquarters**

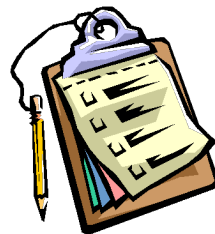


**Distributor Locations**

# Today's Agenda

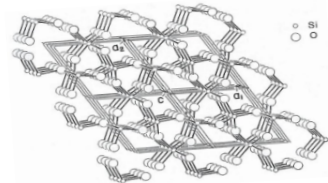
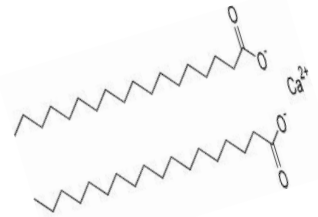
## Choosing the Right Cleaner

- Fouling Mechanism
- Cleaning Mechanism
- Chemistry of Cleaners
- Detergency Variables
- Matching
- Specialty Cleaners
- Validation Techniques
- Samples, Laboratory Assistance, Technical Documents
- Thank You!!



# Fouling Mechanism

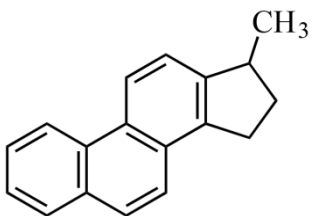
- Mechanisms – Materials are negatively charged
  - Hydrophobic Attraction
    - Van der Waal forces of high MW soils create a hydrophobic attraction to negative surface
      - 12 to 1 rule
        - » C12 or higher and maximum of one functional group
          - Proteins, Biofilm, Natural Organic Matter (NOM), polymers
    - Electrostatic repulsion overcome by hydrophobic attraction
  - Multivalent cations attraction



$\text{Ca}^{2+}$ ,  $\text{Fe}^{2+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Al}^{3+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Si}^{2+}$  . . . .

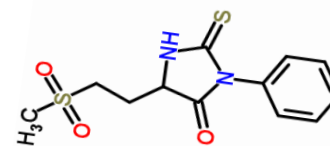
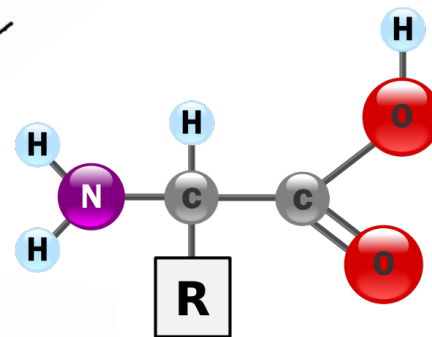
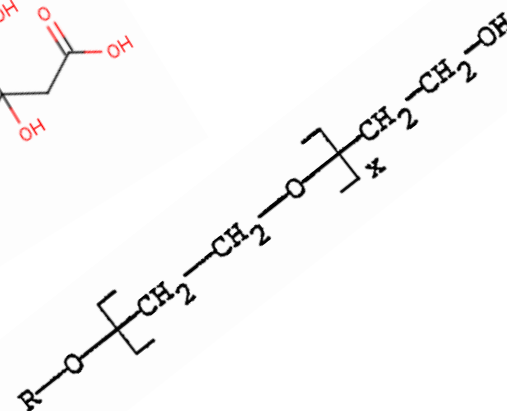
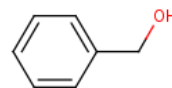
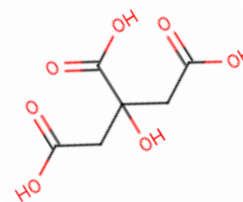
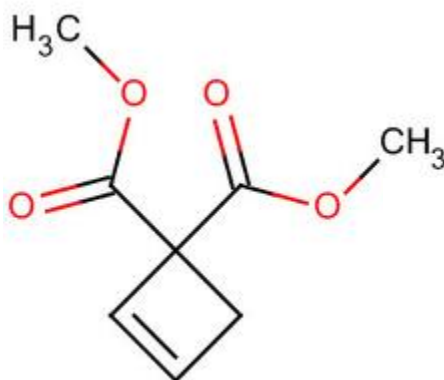
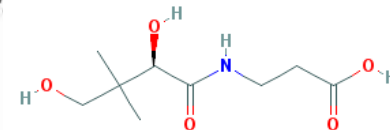
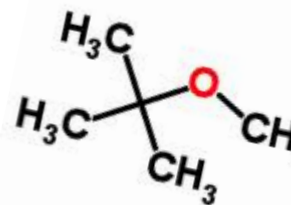
- Salt bridges – multivalent cations allow for a denser soil layer to coat the surface
  - » Carbonates, Silica, Oxides, Sulfates, Inorganics

- Fouling begets fouling



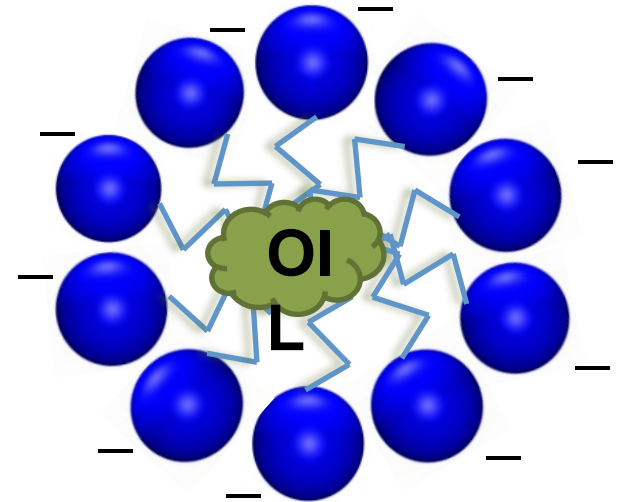
# Functional Groups

- Polar, charges
  - Combination of different atoms
    - Esters
    - Ethers
    - Amides
    - Amines
    - Alcohols
    - Sulfone
    - Acids
  - Combination of functional groups
- 
- The chemical structure shows a cyclobutane ring with two geminal methoxy groups (-OCH<sub>3</sub>) and a methyl group (-CH<sub>3</sub>) attached to one carbon, and a phenyl group (-C<sub>6</sub>H<sub>5</sub>) attached to the adjacent carbon. The oxygen atoms in the methoxy groups are highlighted in red.



# Cleaning Mechanism

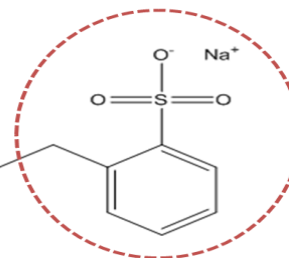
- Introduce functional groups to the fouling layer
  - Creates an electrostatic repulsion
    - Strong enough to displace hydrophobic attraction
  - Hydrophilic in nature
  - Polarity



# Surfactant Types

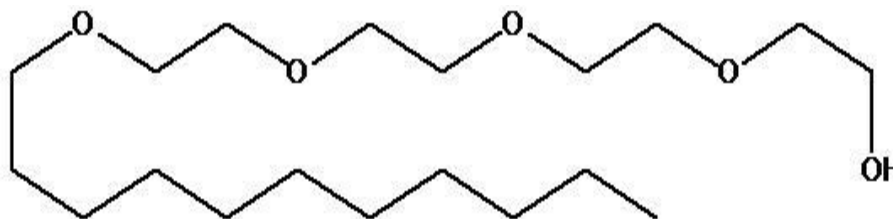
- Anionic:

“An appropriate choice



- Nonionic:

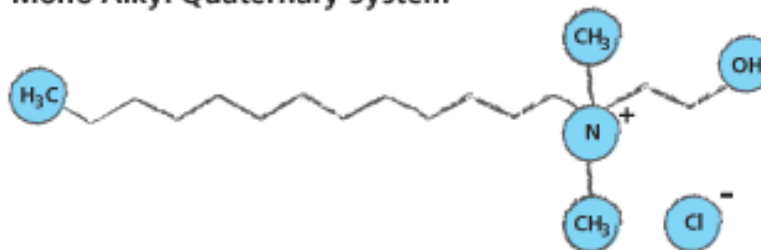
“No Problem”



- Cationic:

“Catastrophe!”

Mono Alkyl Quaternary System

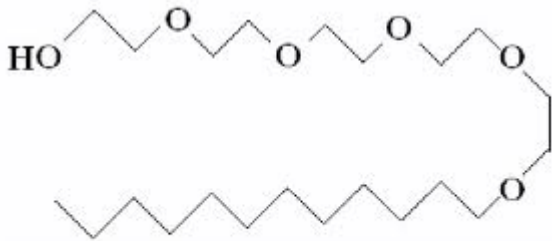




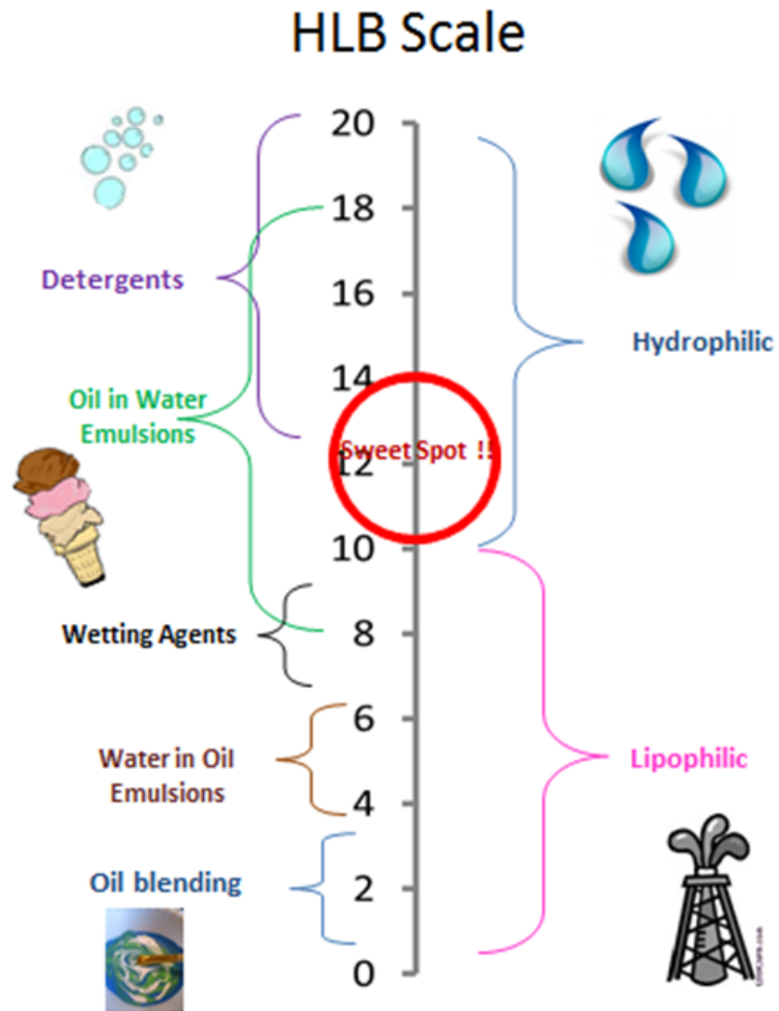
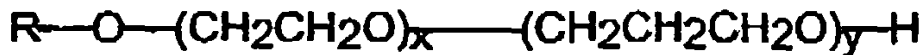
# Nonionics

- No formal charge
- EO vs PO
- Hydrophilic – Lipophilic Balance

$$\text{HLB} = 20 * (\text{MW}_{\text{Hydro}} / \text{MW}_{\text{Total}})$$



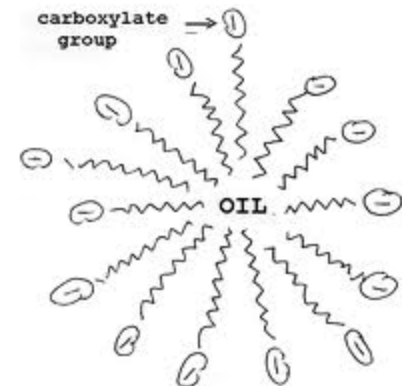
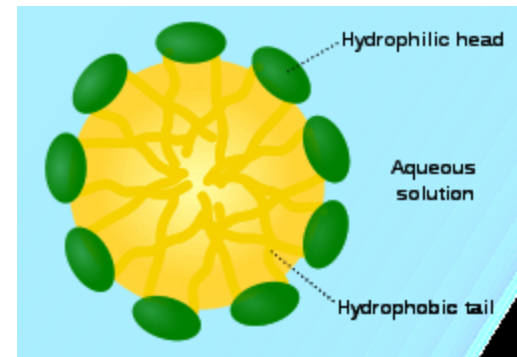
Polyoxyethylene (5) lauryl ether





# Micelles

- Orientation of surfactant around an oil droplet
- Suspends oil in water
- Different types
  - o/w
  - w/o
  - o/w/o
- CMC threshold
  - Lowest surface tension



# Typical Cleaner Formulation

- Carrier / Fillers
  - Water, sodium carbonate / sodium bicarbonate
- Builder
  - Keeps pH buffered
  - NaOH, KOH, EDTA, citric, etc.
- Anionic Surfactants
- Nonionic Surfactants
- Rust inhibitor
  - Phosphates, silicates, amines, azoles, nitrites
- Chelants, dispersants, anti-scalants
- Enzymes
- Hydrotropes



# Ingredients

| INGREDIENT  | PURPOSE                                                                    | EXAMPLE                                                                                                                                                                | COMMENTS                                                                          |
|-------------|----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Carrier     | Filler                                                                     | Water<br>Sodium Carbonate / Sodium Bicarbonate                                                                                                                         | Reduce hazard<br>Reduce Cost<br>Stability                                         |
| Builders    | Keep pH at a certain value<br>Ties up metals in water<br>High pH<br>Low pH | Sodium Hydroxide, Sodium citrate, sodium borate, potassium hydroxide, silicates, phosphates<br>Citric acid, nitric acid, lactic acid, glycolic acid, hydrochloric acid | High pH – target foulants: organics<br>Low pH – inorganics, metals, oxides, scale |
| Surfactants | Responsible for the cleaning<br>Functional groups<br>Lower surface tension | Anionic<br>Nonionic<br>(Cationic)                                                                                                                                      | Unlimited choices<br>Synergy                                                      |
| Hydrotropes | Allows builders and surfactants to coexist                                 | Sodium xylene sulfonate<br>Imidazolines                                                                                                                                | Single purpose only<br>Some claim multi-functionality                             |

# Ingredients (cont.)

| INGREDIENT | Purpose             | Example                                             | Comments                                                                                                      |
|------------|---------------------|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Enzymes    | Catalyze soil       | Protease<br>Amylase<br>Lipase<br>Cellulase          | Time-consuming<br>Delicate – need other ingredients<br>Expensive<br>“Green” but GHS Exploding Chest Pictogram |
| Solvents   | Solubility of soil  | Glycol ethers<br>Ethanol<br>IPA                     | Compatibility Issues<br>Environmental Issues<br>Health Issues<br>Not common in membrane cleaners              |
| Additives  | Additional benefits | Preservatives<br>Corrosion inhibitors<br>Anti-Stats |                                                                                                               |

# Detergency Variables

- Water Quality
- Cleaning Time
- Concentration
- **Temperature**
- Agitation
- Sequence
- Match cleaner to soil



# Cleaners

- Acid
  - $\text{pH} < 4$
- Alkaline
  - $\text{pH} > 9$
- Neutral
  - $\text{pH} = 7$  ( $\text{pH} 5 - 7$ )
- Others
  - Bleaches
  - Disinfectants

| pH | Examples of solutions                        |
|----|----------------------------------------------|
| 0  | Battery acid, strong hydrofluoric acid       |
| 1  | Hydrochloric acid secreted by stomach lining |
| 2  | Lemon juice, gastric acid, vinegar           |
| 3  | Grapefruit juice, orange juice, soda         |
| 4  | Tomato juice, acid rain                      |
| 5  | Soft drinking water, black coffee            |
| 6  | Urine, saliva                                |
| 7  | "Pure" water                                 |
| 8  | Sea water                                    |
| 9  | Baking soda                                  |
| 10 | Great Salt Lake, milk of magnesia            |
| 11 | Ammonia solution                             |
| 12 | Soapy water                                  |
| 13 | Bleach, oven cleaner                         |
| 14 | Liquid drain cleaner                         |

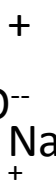
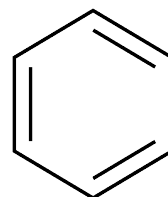
# Alkaline and Acid

## Alkaline Cleaners

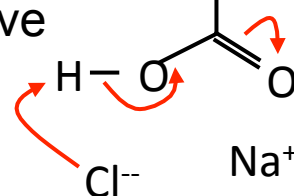
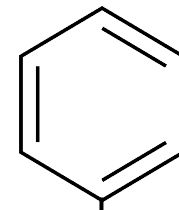
- pH > 9
- Effective against oils and greases
- Surfactants and Builders
  - Anionic and nonionic surfactants
    - Dissolve/emulsify oils and greases
  - Builders and alkalinity
    - Improves detergency
    - Improves water quality
    - Allows surfactants to work better
    - Contributes to carbonate scale

## Acid Cleaners

- pH < 4
- Effective against metals (*iron, calcium, magnesium*), oxides, inorganics, scale
- Citric Acid
  - Safe choice of acid



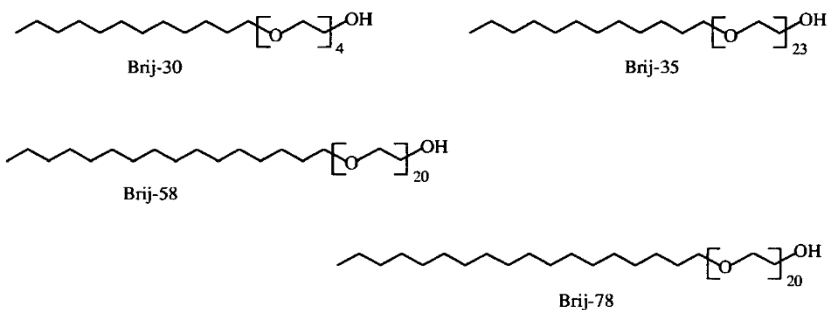
H<sub>2</sub>O; NaCl





# Neutral Cleaners

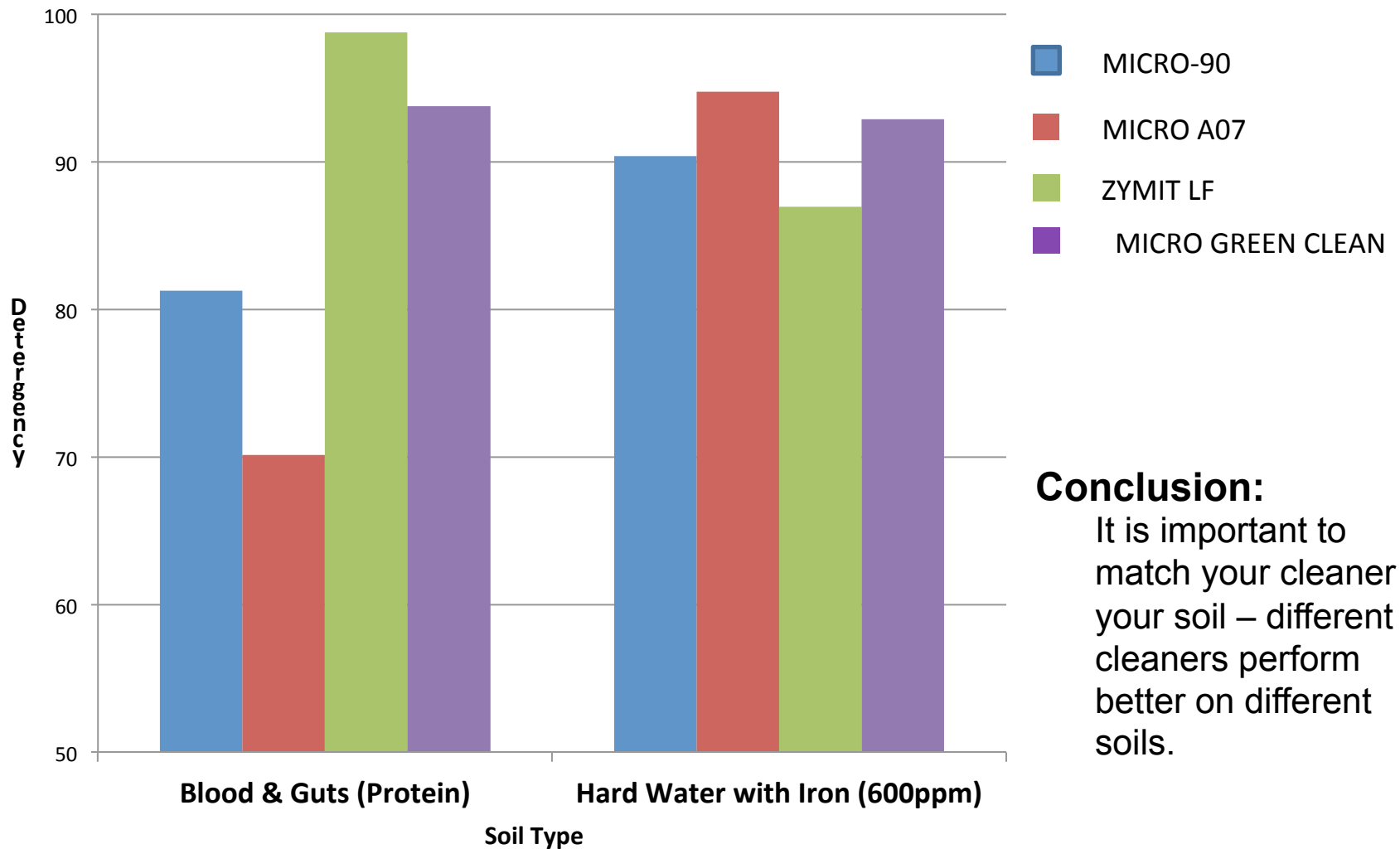
- pH range: 5 to 8
- Delicate Parts
  - Soft metals
- Nonionic Surfactants (& Solvents)
  - Dissolve/emulsify oils and greases
- Highly Concentrated
  - No Builders
  - No Hydrotropes
- Unaffected by water hardness
- Cloud Point



# Match Cleaner to Soil

| MATCH CLEANER TO TYPICAL COSMETIC SOILS                             |     |                                                                                               |                                                                 |
|---------------------------------------------------------------------|-----|-----------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| IPC CLEANERS                                                        | pH  | TYPICAL SOILS REMOVED                                                                         | CLEANING METHOD                                                 |
| <b>Micro-90<sup>®</sup></b><br>Alkaline Cleaning Solution           | 9.7 | Gels, Emulsifiers, Oils, Titanium Dioxides, Dyes, Silicons, Fragrances, Petrolatum, Paraffins | Manual, Ultrasonic, CIP, Immersion                              |
| <b>Micro<sup>®</sup> Green Clean</b><br>Biodegradable Cleaner       | 9.8 | Gels, Emulsifiers, Oils, Titanium Dioxides, Dyes, Silicons, Fragrances, Petrolatum, Paraffins | Manual, Ultrasonic, CIP, Immersion                              |
| <b>Micro<sup>®</sup> A07</b><br>Citric Acid Biodegradable Cleaner   | 3.0 | Insoluble salts, Oxides                                                                       | Manual, Ultrasonic, CIP, Immersion                              |
| <b>Surface-Cleanse/930<sup>®</sup></b><br>Neutral Cleaner           | 6.5 | Emulsifiers, Gels, Oils, Dyes, Fragrances, Petrolatum, Paraffins                              | Manual, Ultrasonic, CIP, Immersion                              |
| <b>LF2100<sup>®</sup></b><br>Liquid Low-Foam Cleaner                | 9.7 | Gels, Emulsifiers, Oils, Titanium Dioxides, Dyes, Silicons, Fragrances, Petrolatum, Paraffins | Manual, Ultrasonic, CIP, Immersion, High-Agitation, Power Spray |
| <b>Zymit<sup>®</sup> Low-Foam</b><br>Liquid Low-Foam Enzyme Cleaner | 7.5 | Gels, Protein Stains, Starch, Carbohydrate Stains                                             | Manual, Ultrasonic, CIP, Immersion, High-Agitation, Power Spray |
| <b>Zymit<sup>®</sup> Pro</b><br>Liquid Enzyme Cleaner               | 7.5 | Gels, Protein Stains, Oils, Greases                                                           | Manual, Ultrasonic, CIP, Immersion                              |

# Match Cleaner to Soil



## Conclusion:

It is important to match your cleaner to your soil – different cleaners perform better on different soils.

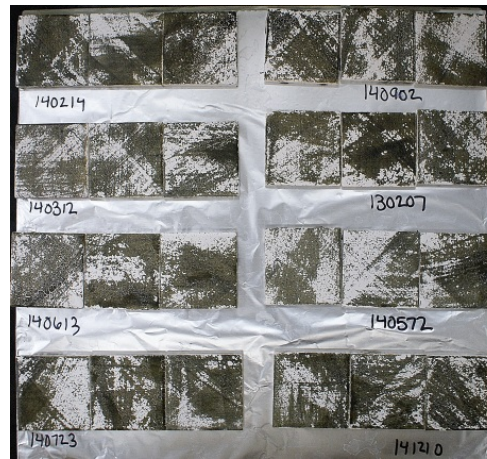
# Match Cleaner to Soil

## Laboratory Evaluation

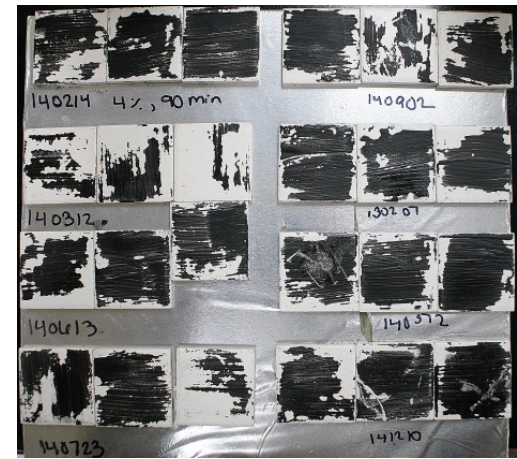
- ASTM Soils
- Modified ASTM Procedures
- Control samples critical



Inorganic



Bathroom Soil

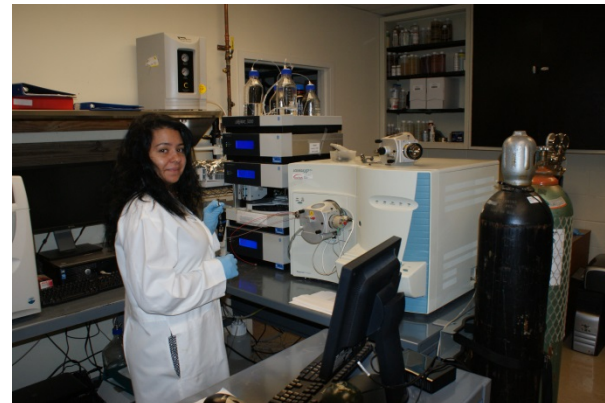


Kitchen Soil

# IPC's Laboratory Evaluation



- Customer's Soil
  - Excipients, APIs, grease, unknown, etc.
- Characterize
  - FTIR, HPLC, MS, IC
- Solubility Profiles
- Develop Cleaning Procedure
  - Time, Temperature, Sonication, Concentration, etc.
- Trials at Customer's Site





## Micro-90® Concentrated Cleaning Solution

- Chemistry: Chelants, ionic and non-ionic surfactants, builders
- Wash systems: CIP, ultrasonic, immersion, mild-agitation
- Target soils: Oil, grease, flux, wax, metal fines, particulates, biological
- Uses: Filter membranes, metal, glass, equipment, labware, etc.
- Typical pH: 9.5
- Shelf life: 5 years



## LF2100® Low-Foam Alkaline Cleaning Solution

- Chemistry: Chelant, non-ionic and amphoteric surfactants, builders
- Wash systems: CIP, ultrasonic, high-pressure spray, automatic washers
- Target soils: Oil, grease, flux, wax, metal fines, particulates, biological
- Uses: Metal, glass, fabric, process equipment
- Typical pH: 9.7
- Shelf life: 5 years



## Micro® Green Clean Biodegradable Cleaner

- Chemistry: Biodegradable chelant, ionic and non-ionic surfactants, builders
- Wash systems: CIP, ultrasonic, immersion, mild-agitation
- Target soils: Oil, grease, flux, wax, metal fines, particulates, biological
- Uses: Filter membranes, metal, glass, equipment, labware, etc.
- Typical pH: 9.7
- Shelf life: 4 years



## Micro® A07 Citric Acid Cleaner

- Chemistry: Citric acid, anionic surfactants, builders
- Wash systems: CIP, ultrasonic, immersion, mild-agitation
- Target soils: Scale, rust, mineral deposits
- Uses: Filter membranes, metal, process equipment
- Typical pH: 2.5
- Shelf life: 4 years



## Zymit® Low-Foam Enzyme Cleaner

- Chemistry: Dual-action protease and amylase enzymes, detergents, builders
- Wash systems: CIP, immersion, ultrasonic, high-pressure spray, automatic washers
- Target soils: Proteins & starches (biological, grass and food stains, photosensitive gels)
- Uses: Medical devices, glass, metal, fabric
- Typical pH: 7.7
- Shelf life: 2 years



## Zymit® Pro Enzyme Cleaner

- Chemistry: Protease enzymes, detergents, builders
- Wash systems: CIP, ultrasonic, immersion, mild-agitation
- Target soils: Proteins (biological, food debris)
- Uses: Filter membranes, glass, metal, medical devices
- Typical pH: 7.7
- Shelf life: 2 years



## Surface-Cleanse 930® Neutral Cleaner

- Chemistry: Nonionic surfactants
- Wash systems: CIP, ultrasonic, immersion, mild-agitation
- Target soils: Oil, ink, flux, adhesive
- Uses: Delicate metal, electronic components
- Typical pH: 7.0
- Shelf life: 5 years



# **Cleaning Validation Techniques**

- 1. Visual Inspection**
- 2. Foam Test**
- 3. Titration**
- 4. Refractive Index**
- 5. Conductivity**
- 6. Methylene Blue**
- 7. Methylene Blue w/ UV-visible Spectrophotometer**
- 8. Black Light**
- 9. TOC**
- 10. GC/LC/IC**







# International Products CORPORATION

Contact us to request  
**free** samples, product information  
or a copy of this presentation

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**Thank you!**