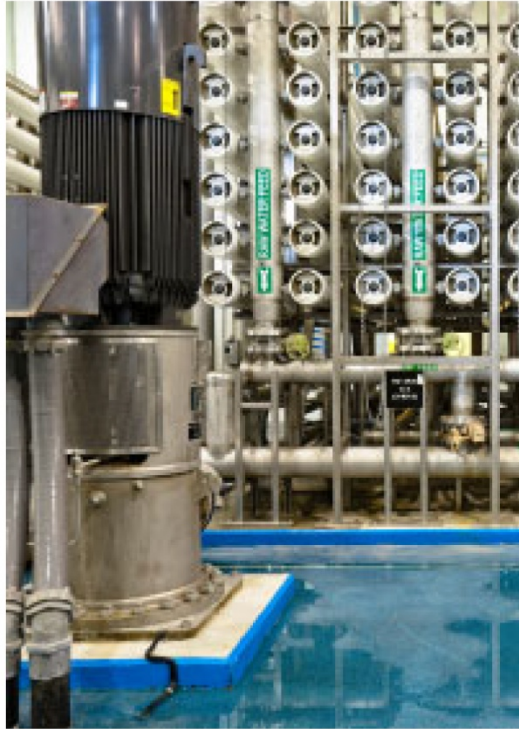


FILTER MEMBRANE CLEANING



FOOD & BEVERAGE — WASTEWATER — LABORATORY — PHARMACEUTICAL — CONTRACT MANUFACTURING



International Products
CORPORATION

201 Connecticut Drive, Burlington, NJ 08016 USA
Ph (609) 386-8770 Fax (609) 386-8438 www.ipcol.com
mkt@ipcol.com

Presenter Overview

International Products Corporation, incorporated in 1923, manufactures specialty cleaners and lubricants. The company has a history of over 30 years of successful selling to the filter membrane industry.

All products are manufactured in the U.S.A. in their New Jersey headquarters and are available worldwide.

An ISO 9001:2008 Certified Company

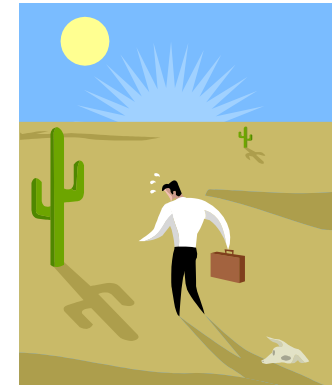


Today's Agenda

1. Global Water Supply Dilemma
2. Industries' Challenges
3. Industries' Alternatives
4. General Overview of Chemical Effects on Membranes
5. Cleaners
6. Laboratory Cleaning Trials / Case Scenario
7. Conclusions
8. Questions

Water, Water, Water

- Our most vital natural resource (after air)
- Fixed amount of water on earth
- Significant supply disparity worldwide
- Usage varies significantly
 - Gallons/capita/day/country: 1 – 145
- Need for potable water will continue to escalate
 - Increase in world population
 - 1900 – 1.65 b
 - 2000 – 6.1b
 - 2050 projection: 7.5b – 10.6b
 - Increase in agricultural products
 - 70% water for crops
 - Greater energy demands
 - Changes in lifestyle

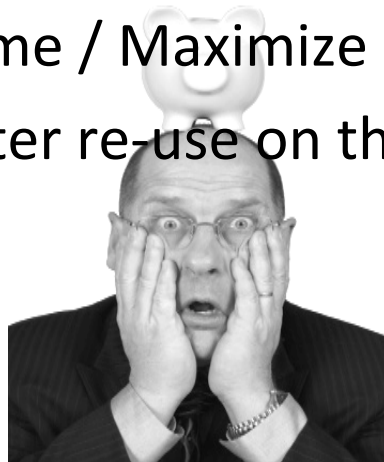


•Source: United Nations, NY 2004, Dept of Economic and Social Affairs. [World Populations to 2300](#)

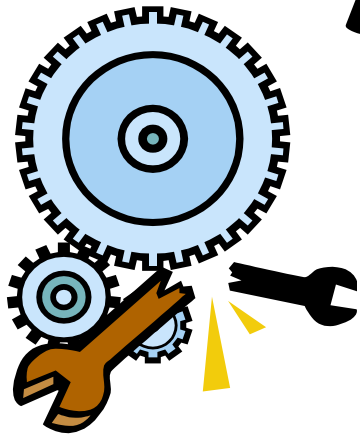
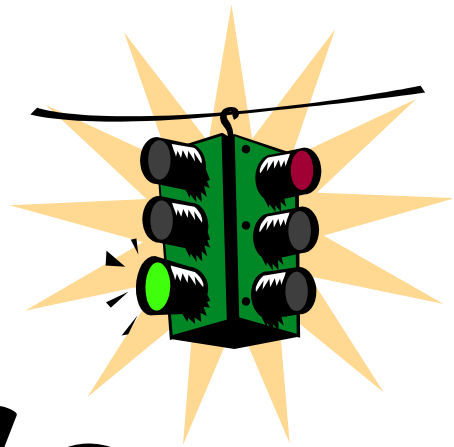
Industries' Challenges



- 20% water used in industries'
- Regulatory requirements
 - MARPOL Treaty, FDA, USDA, EPA, CEFAS, local regulations, etc.
- Economic Pressures
 - Reduced resources, staff, etc.
 - Minimize downtime / Maximize ROA
- Desalination and water re-use on the rise



KEEP THOSE
MEMBRANES
WORKING!!!

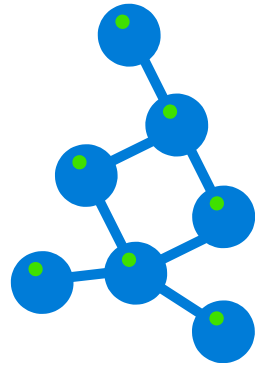
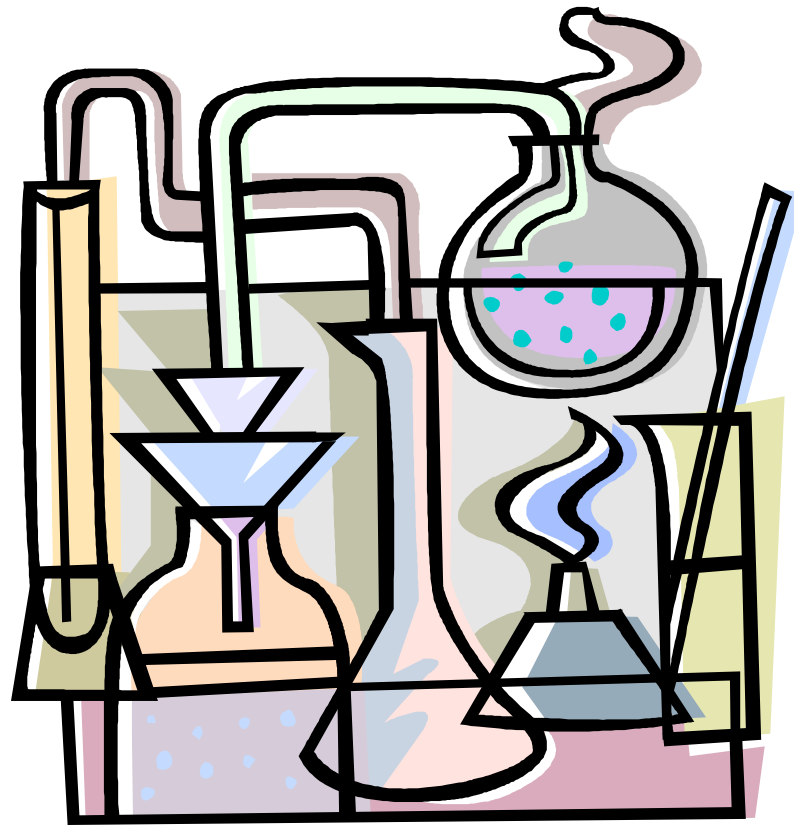
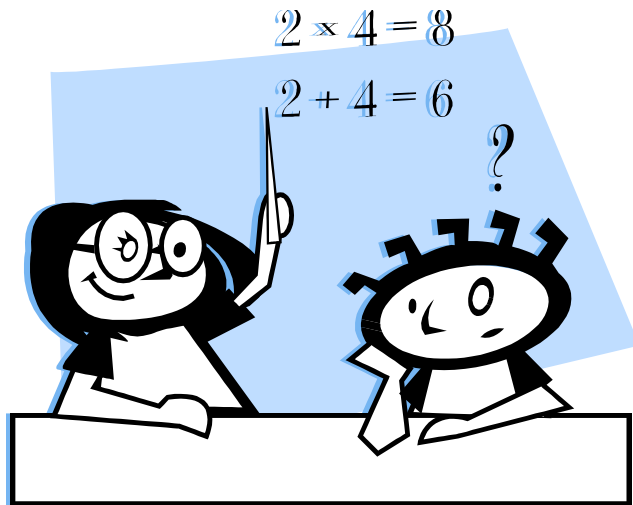


Decisions, Decisions, Decisions

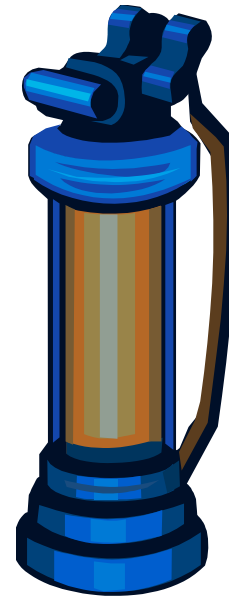
- Crisis control or preventive maintenance?
 - Sustainable?
- Trial and Error?
- Outsource?
 - “Let them worry about it”
 - Lose competency
 - Lose control
- Partnership with specialty chemical manufacturer?



There IS Help!!!

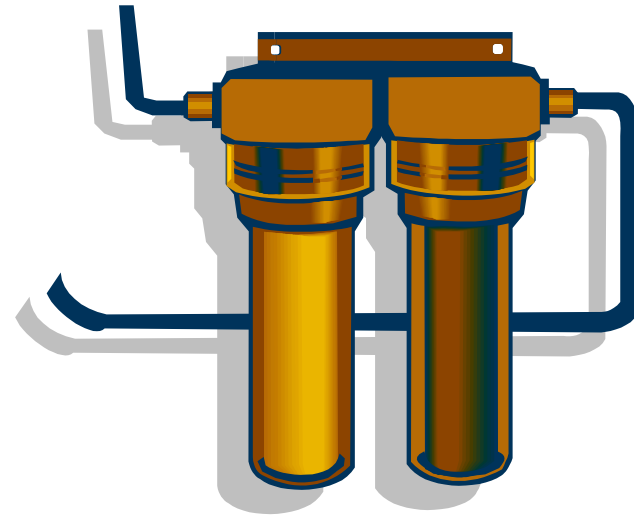


Membrane Cleaning Basics



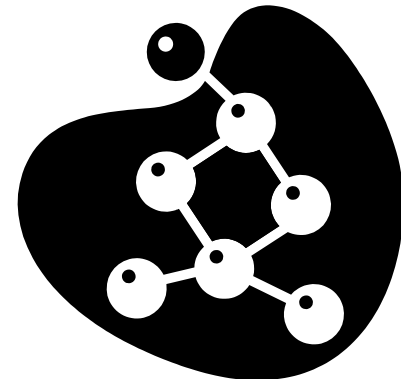
General Membrane Compatibility & Performance Factors

- Chlorine tolerance
- Temperature
- Pressure
- pH
 - $< 2; > 10.5$
- Solvent cleaners
- Cationic surfactants
- Low HLB nonionics



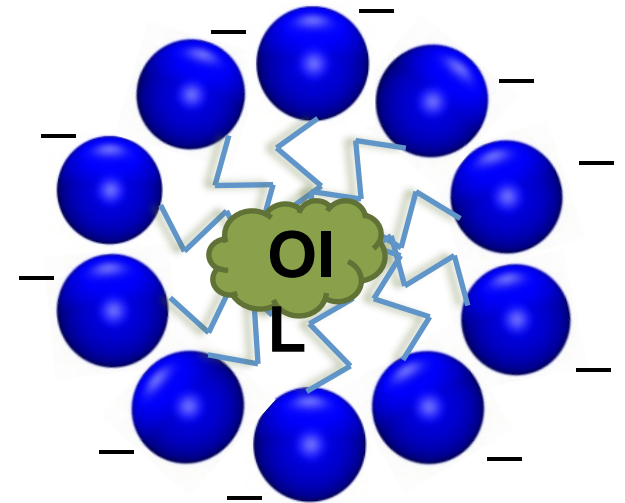
Membrane Fouling

- Mechanism
 - Most membrane surfaces are negatively charged
 - Van der Waal forces of soils create a hydrophobic attraction to the negative membrane surface
 - Salt bridges – multivalent cations allow for a denser soil layer to coat the membrane
- Soils
 - Natural organic matter
 - Proteins
 - Biofilm
 - Multivalent cations
 - Polymers
 - Scale



Cleaning Mechanism

- Introduce functional groups to the fouling layer
 - Creates an electrostatic repulsion from the membrane surface
 - Hydrophilic in nature
- Cleaner types
 - Caustic
 - Bleach
 - Oxidizers
 - Enzymes
 - Surfactants
 - Acids
 - Chelants (EDTA)
 - Formulated mixtures



Cleaner Manufacturers

Commodity Manufacturer

- Make (import) and sell one chemical
 - Sulfuric Acid, Caustic
- Each chemical targets one type of soil
- Initial lower costs



Specialty Manufacturer

- Formulated blends of ingredients
 - Tested, proven, consistent, synergy
- Economical in long run
- Each product attacks many soils
- Product / Cleaning regimen tailored to specific application
- Certified quality assurance program
- Technical expertise
- Customer assistance



Alkaline and Acid

Alkaline Cleaners

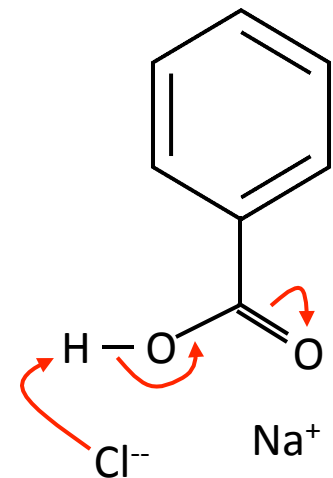
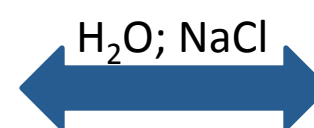
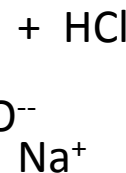
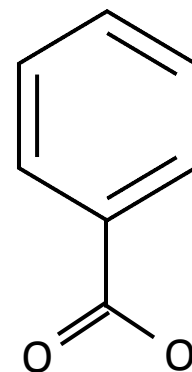
- pH > 9
- Effective against oils and greases
- Surfactants and Builders
 - Anionic and nonionic surfactants
 - Dissolve/emulsify oils and greases
 - Builders and alkalinity
 - Improves detergency
 - Improves water quality
 - Allows surfactants to work better

Acid Cleaners

- pH < 4
- Effective against metals (*iron, calcium, magnesium*), oxides, inorganics, scale

Citric Acid

- Safe choice of acid
 - Organic
 - Compatible
 - Biodegradable
 - Non-corrosive



To chelate or not to chelate?

- Assets

- Improves water quality
- Grabs metals
- Increases detergency
- Alkaline and acid types

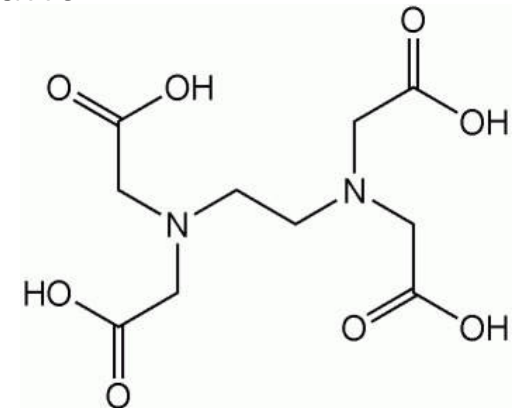
- Liabilities

- Sequestered metals pass through membranes
- Many don't biodegrade
- pH extremes



The most prevalent chelant – EDTA

- When EDTA recovery is necessary,
 - Precipitate EDTA with acid
 - Precipitate metals by reduction / oxidation
 - Precipitate metals with high pH or sulfide
 - Displace metal with another
 - Proprietary polymers eliminate metals/chelant
 - » **OR CHOOSE**
 - Effective biodegradable chelants



When to clean your membranes?

10% RULE

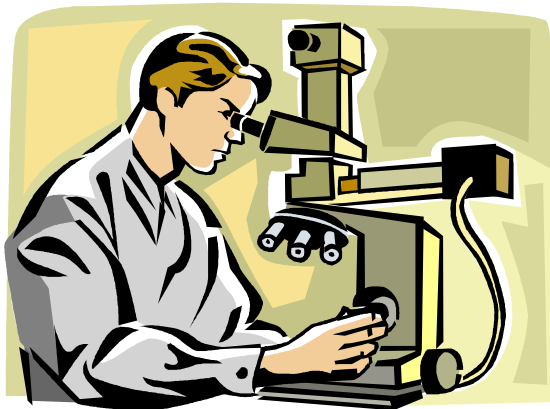
- Pressure increases up to 10%
- Flux decreases up to 10%
- Permeate quality decreases up to 10%



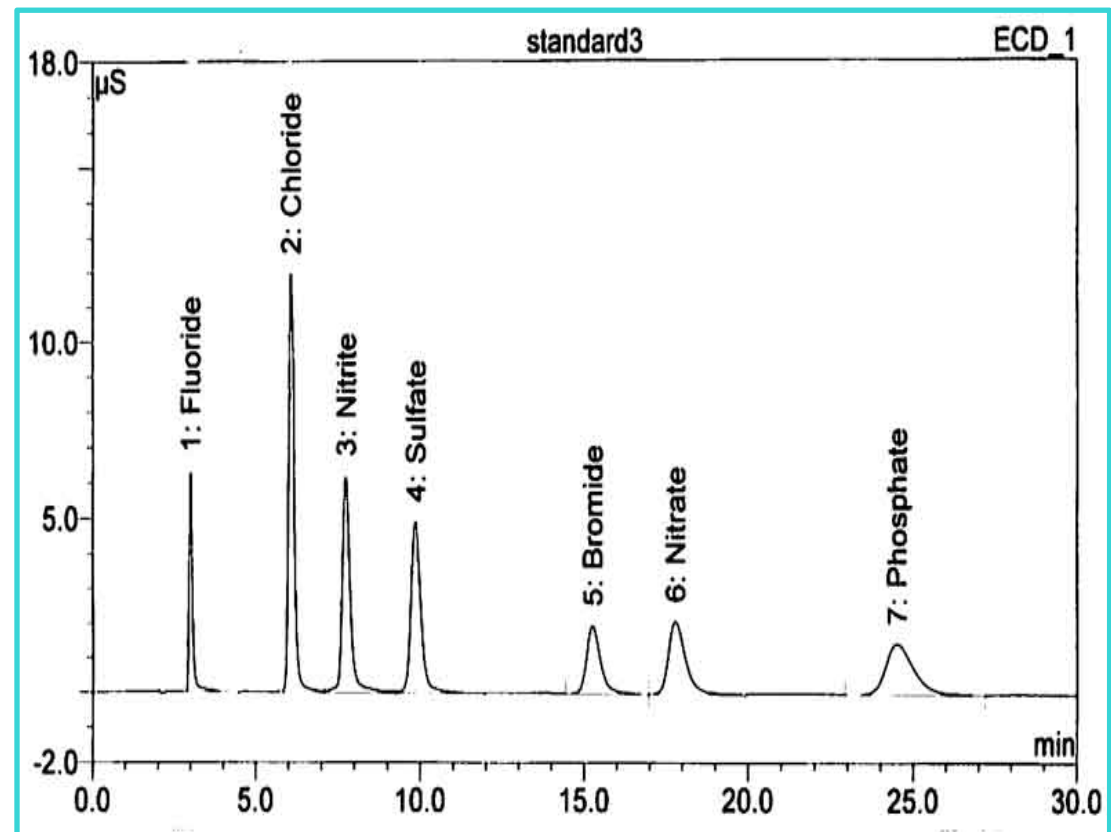
Permeate Quality

Methods:

- HPLC / IC
- Conductivity
- Hardness
- pH
- Total dissolved solids



Typical IC Chromatogram of Anions



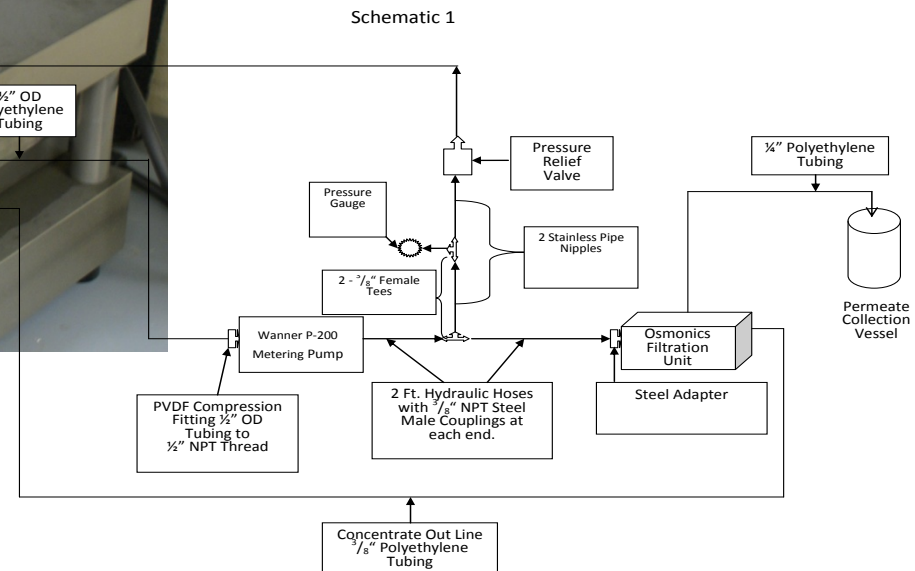
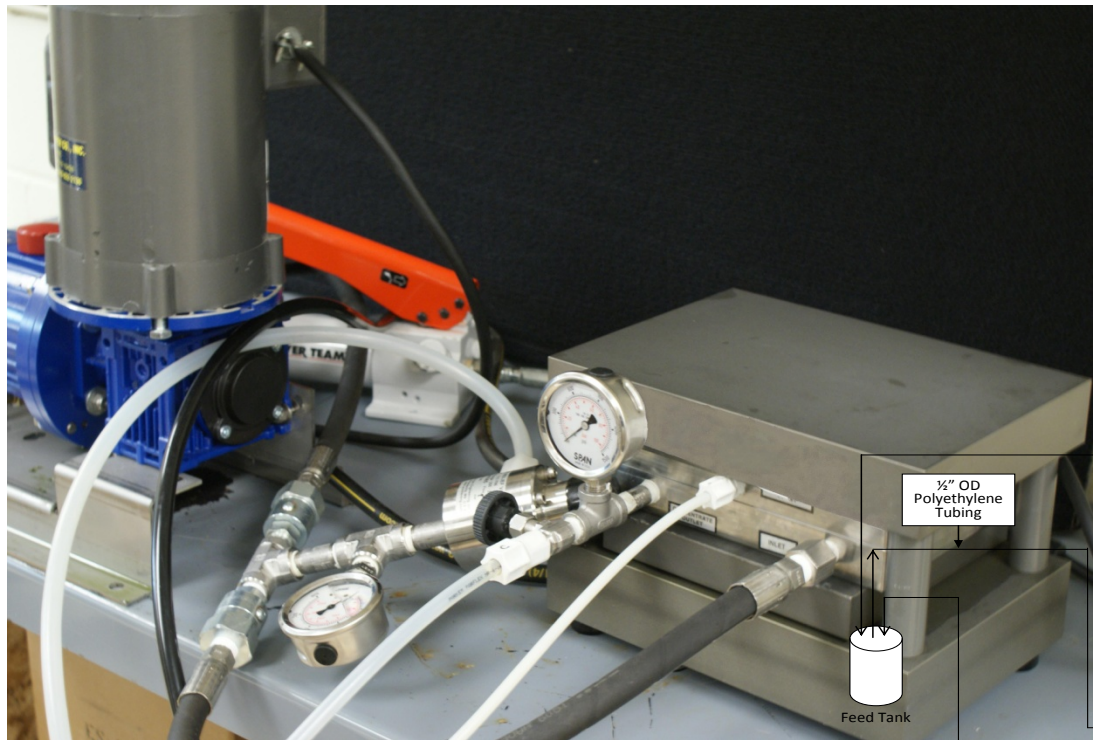
Match soil to cleaner - Soils in Major Industries

Industry	Primary Foulant	Secondary Foulant(s)	Cleaner Type(s)
Municipal Wastewater	Oils, greases, scale, natural organic matter	Metals	Alkaline
Metalworking (Industrial Waste Water)	Oils, greases, salts	Metals	Alkaline or Acid
Pharmaceutical	Proteins Oils	Oils Proteins	Enzyme or Alkaline
Dairy	Milkstone	Protein	Acid or Enzyme
Food	Oils Protein	Protein Oil	Alkaline or Enzyme

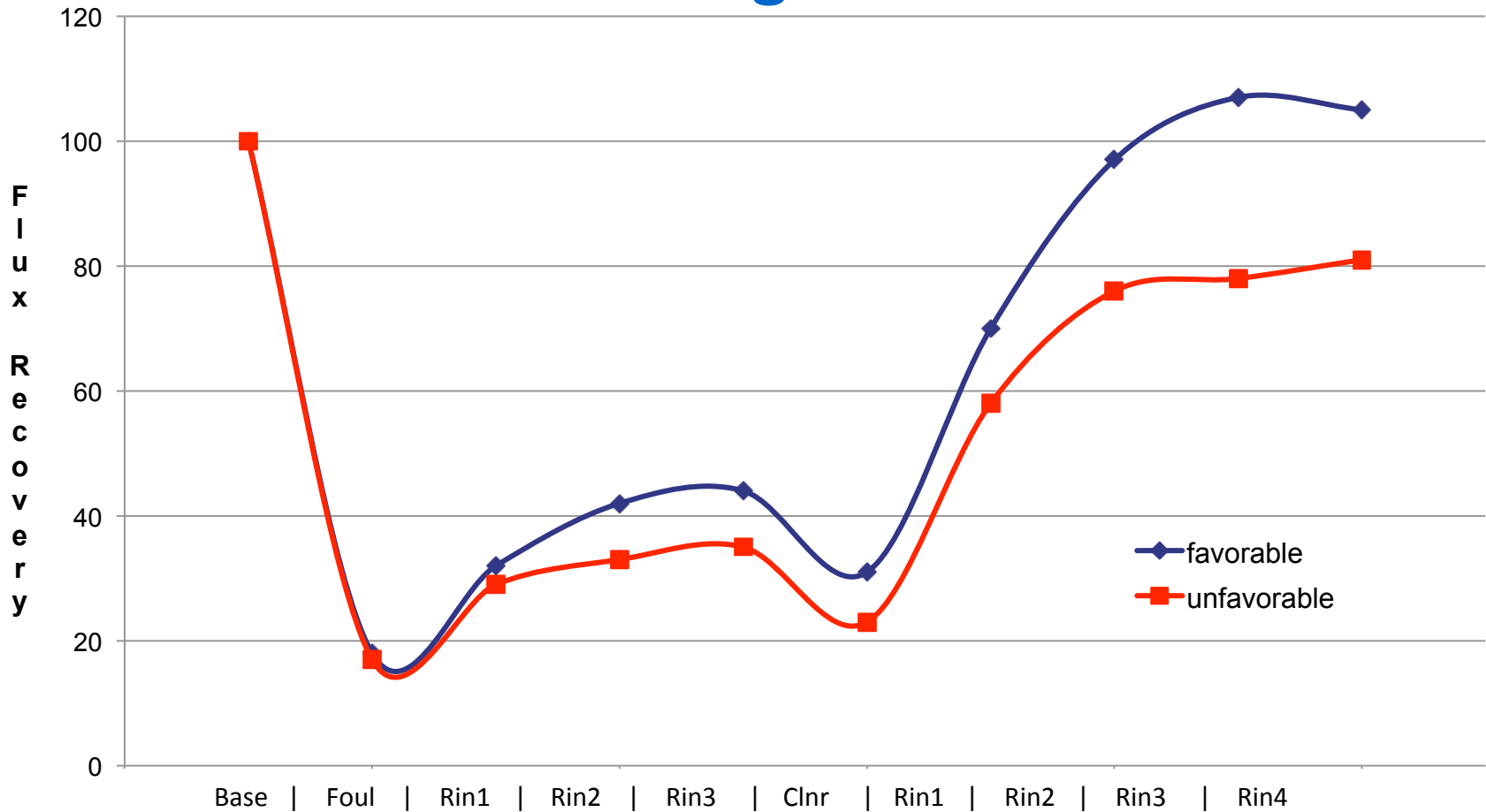
Laboratory Cleaning Experiments

- Equipment used:
 - Cross flow benchtop filtration unit
- Membrane used:
 - Polyethersulfone UF 5000 MWCO
- Foulants used:
 - Emulsified coolant
- Make-Up Water:
 - RO or hard water (200 ppm) as indicated
- 2% Cleaner concentration at room temperature
- Typical baseline flux values:
 - ~ 35 Gal/ft²/day
- Standard rinse cycle:
 - One hour at 200 PSIGs
- Standard fouling and cleaning cycle:
 - Thirty minutes at 400 PSIGs

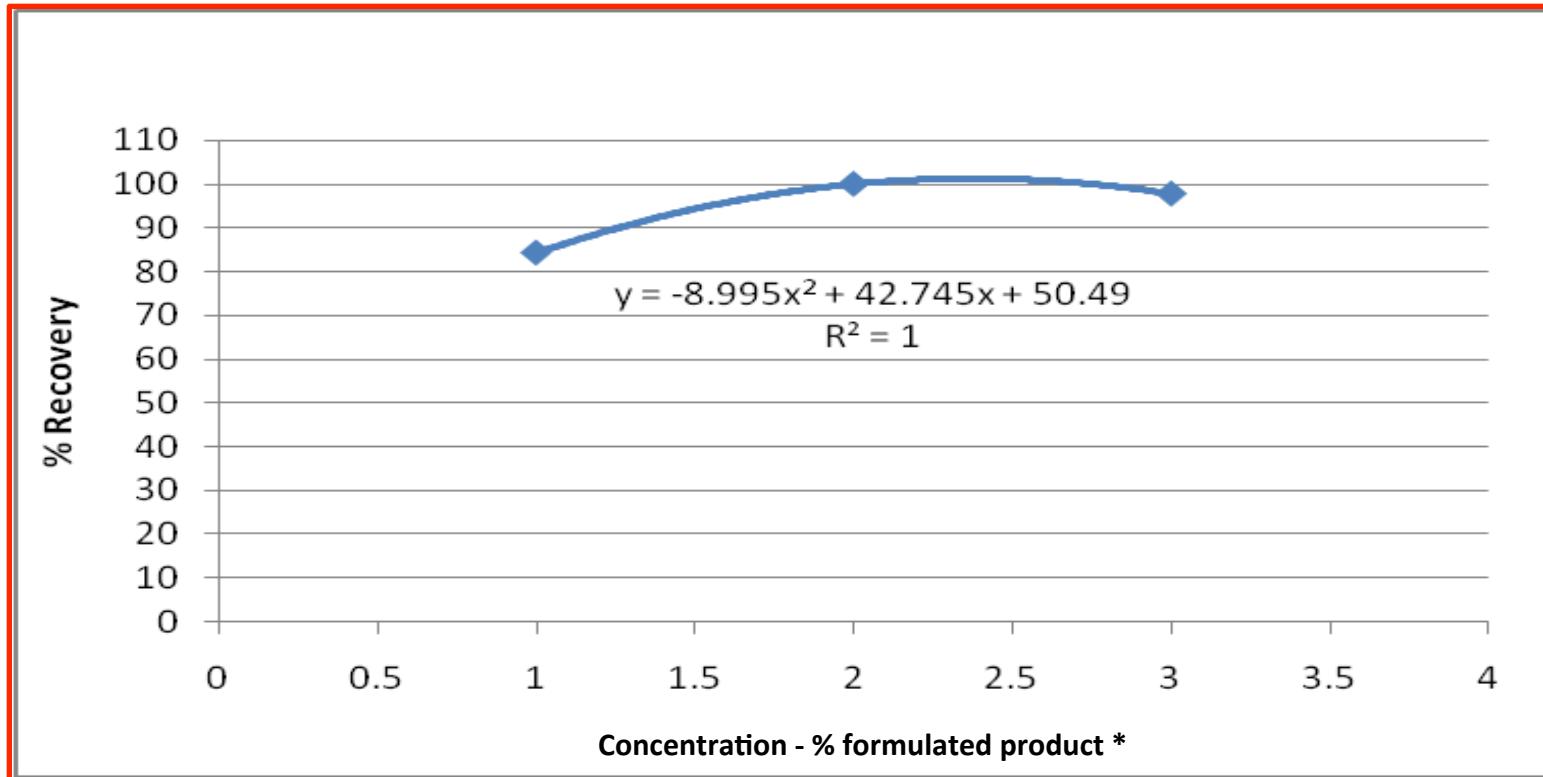
IPC's Membrane/Cleaner Evaluation Unit



Favorable vs. Unfavorable Cleaning Profile



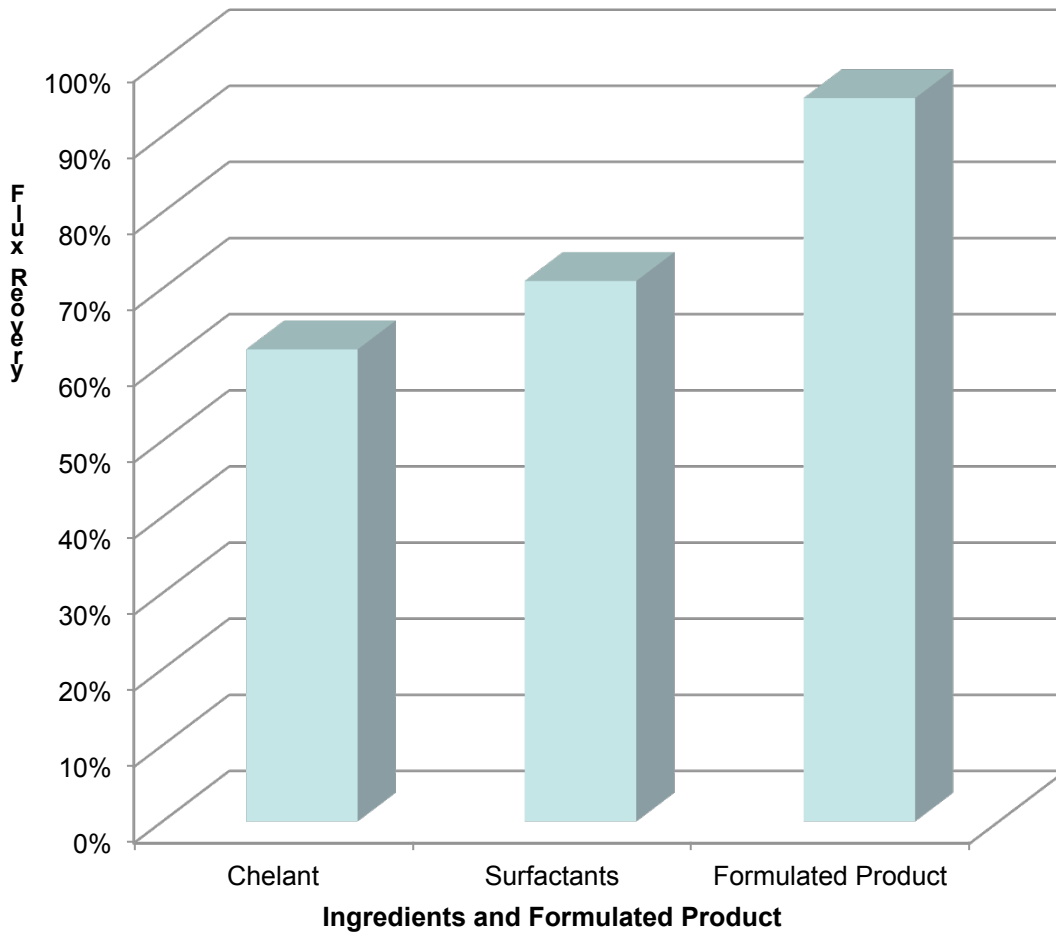
Optimal Effect of Formulated Product* on Flux Recovery



According to the Concentration / % Recovery curve a concentration of 2.4% formulated product* will theoretically provide optimal cleaning performance in this situation (101.26% Recovery).

**Micro-90® Concentrated Cleaning Solution*

Synergy of Formulated Membrane Cleaner

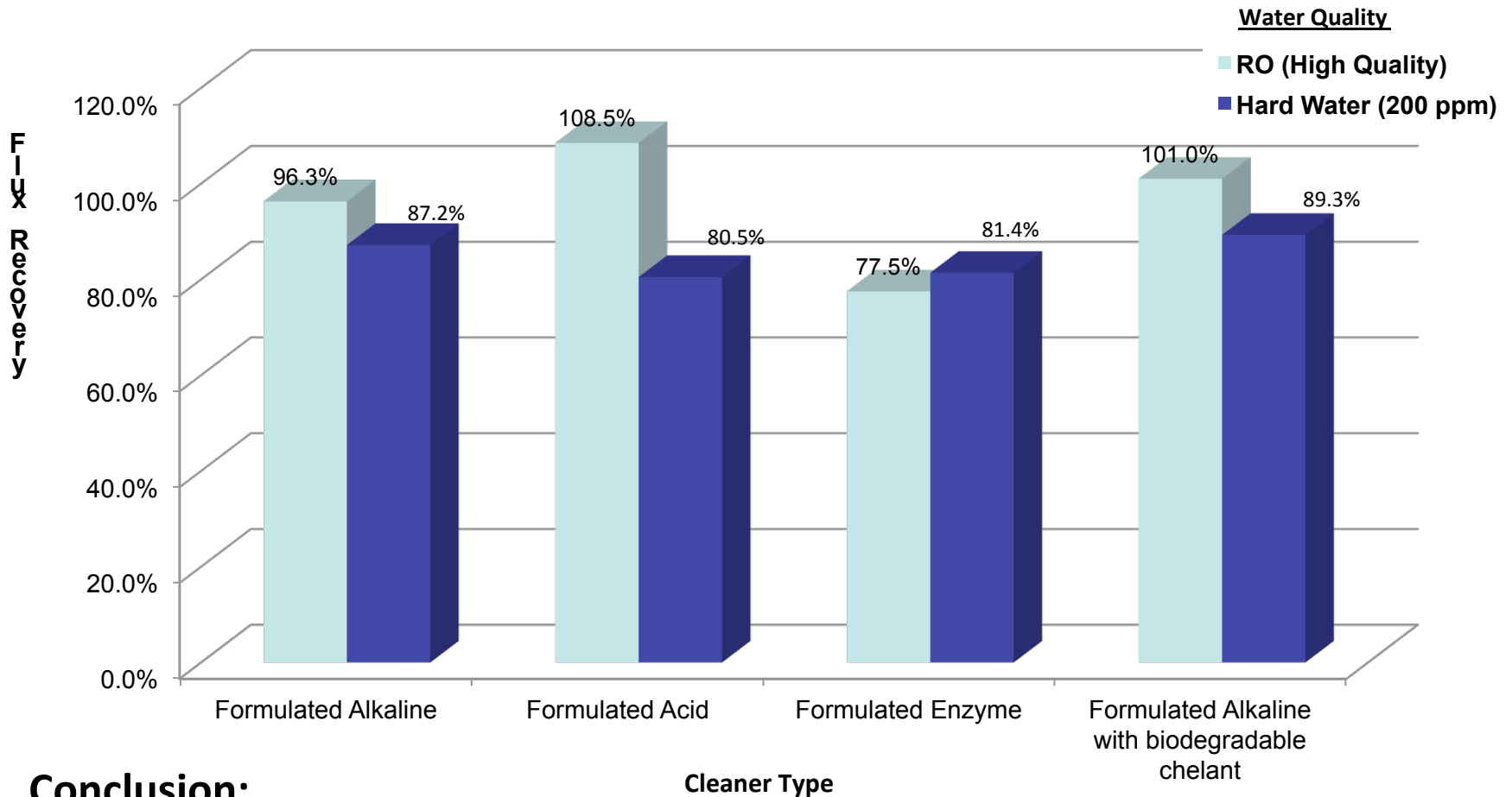


$$1 + 1 = 3!$$



Conclusion :
The formulated cleaner has better results than its individual components.

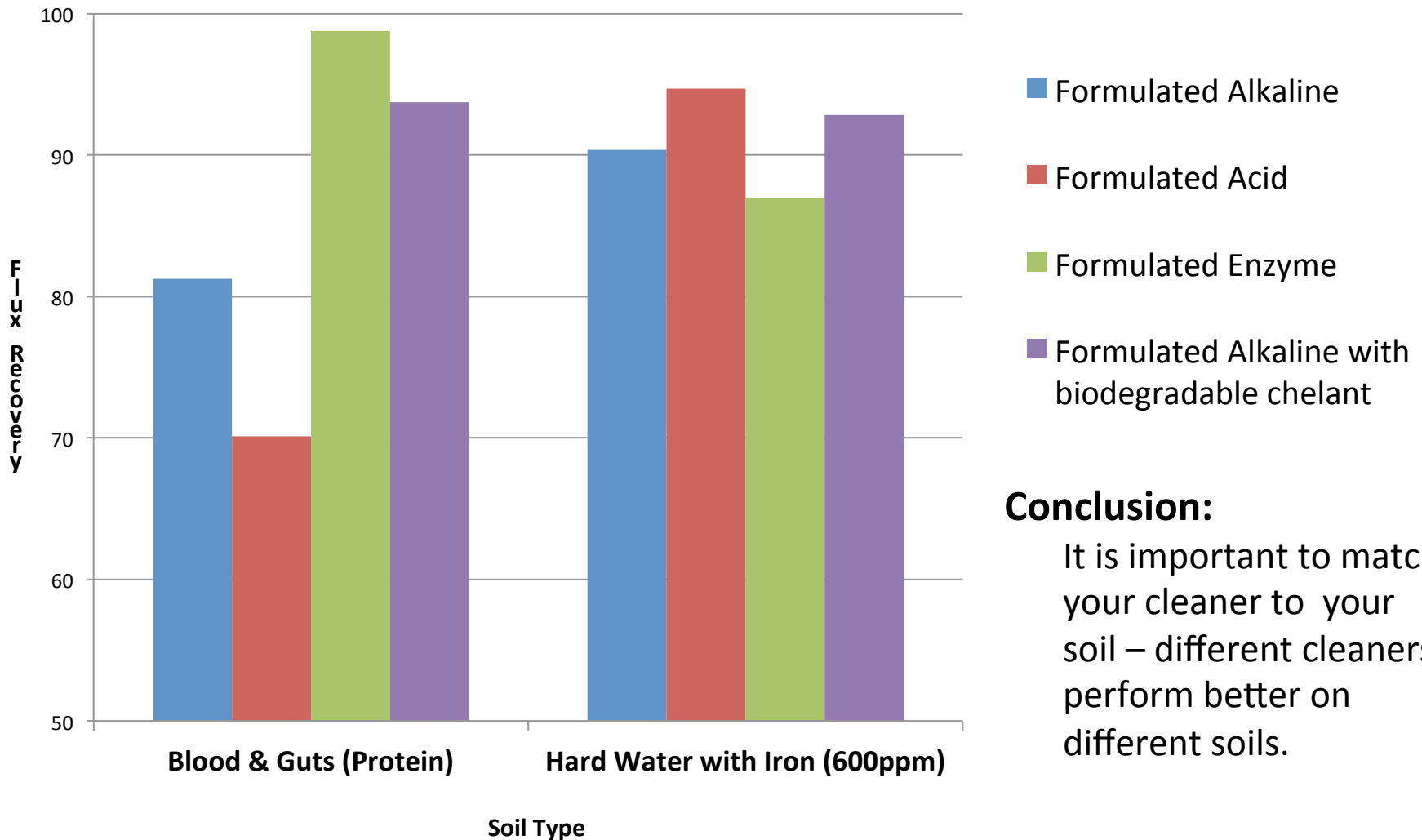
Flux Recovery by Cleaner Type and by Water Quality



Conclusion:

1. Water quality affects detergency.
2. Match cleaner to soil

Matching Cleaner to Soil Type

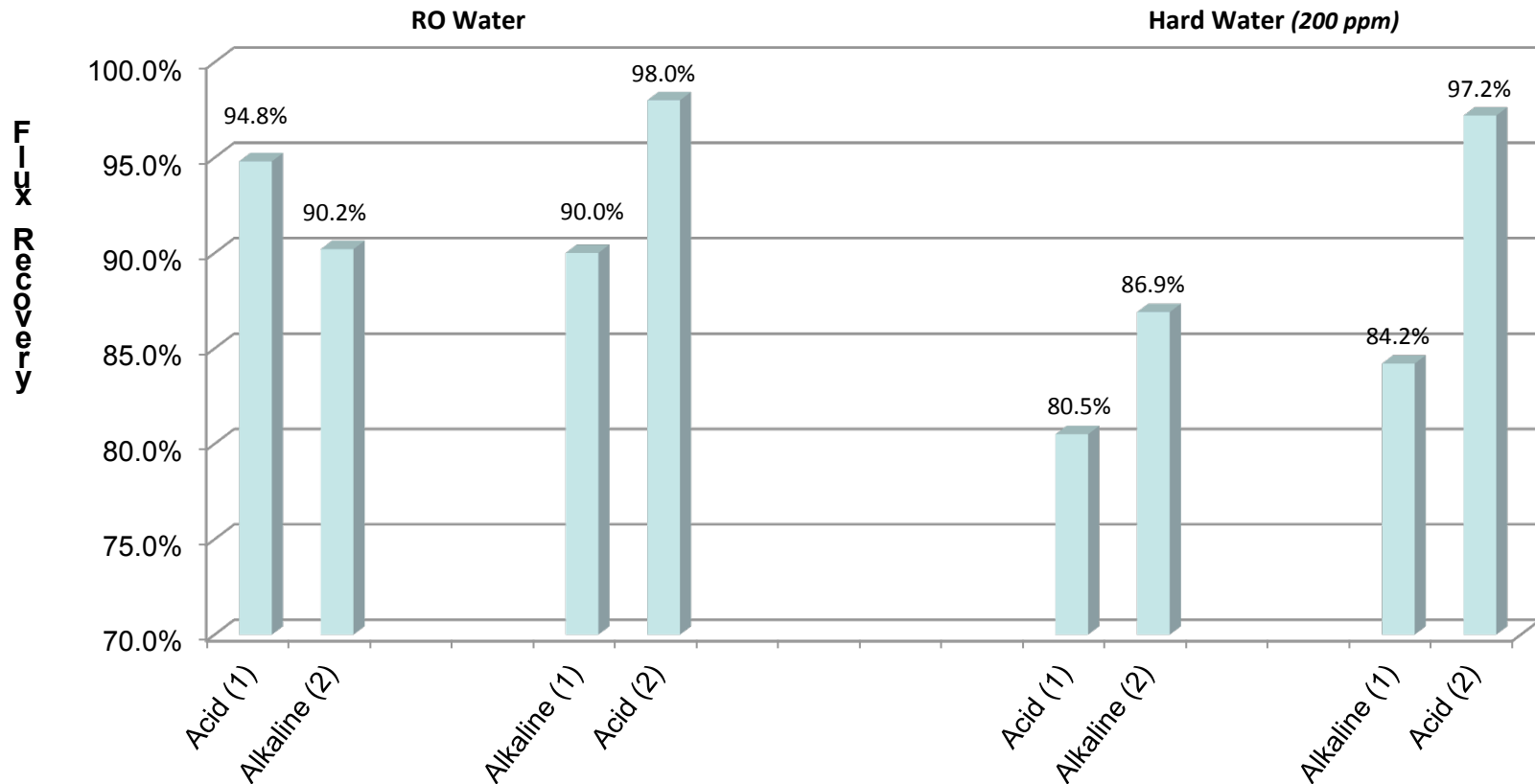


Conclusion:

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

The Effects of Using Cleaners in Series

Flux vs. Cleaner Series and Water Quality



Conclusion:

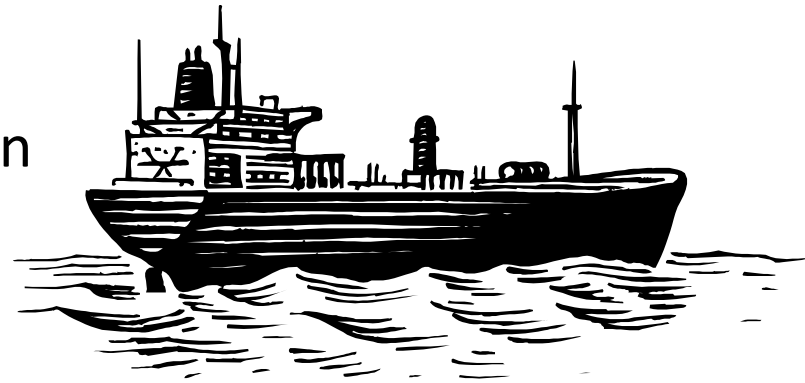
1. Water quality affects flux.
2. Alkaline followed by acid is best in this trial.

What's Next?

- Optimal concentration of cleaners

Case Study: *Overview*

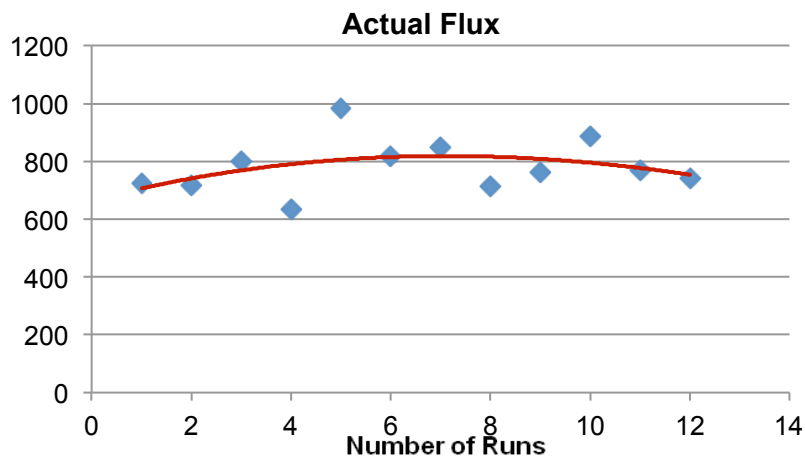
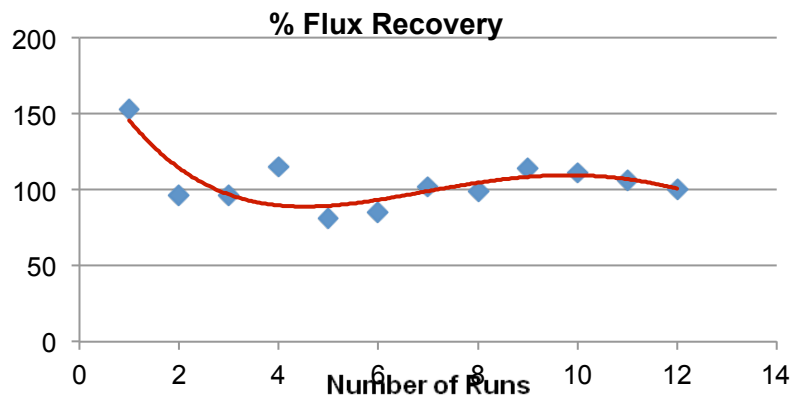
- Bilge water treatment customer switched to a d'limonene based cleaner
 - Pleasant fragrance
 - Better oil / water separation
 - Better flux results
 - Worked faster
- Lab test:
 - 100,000 MWCO membrane – modified polyacrylonitrile (PAN)
 - Formulated alkaline cleaner with d'limonene



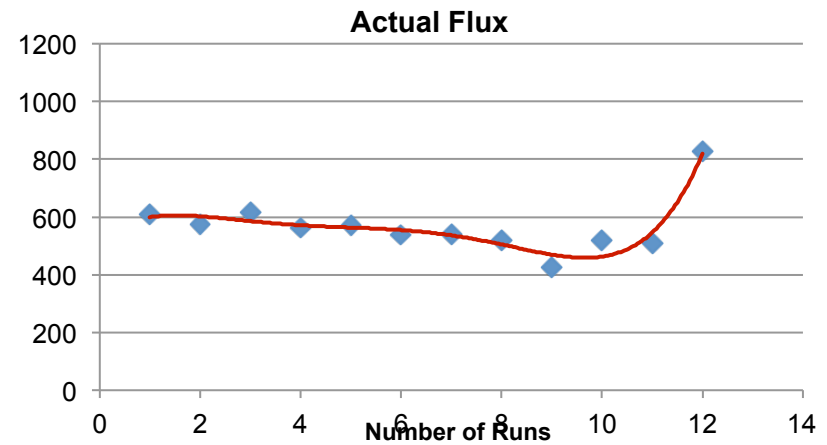
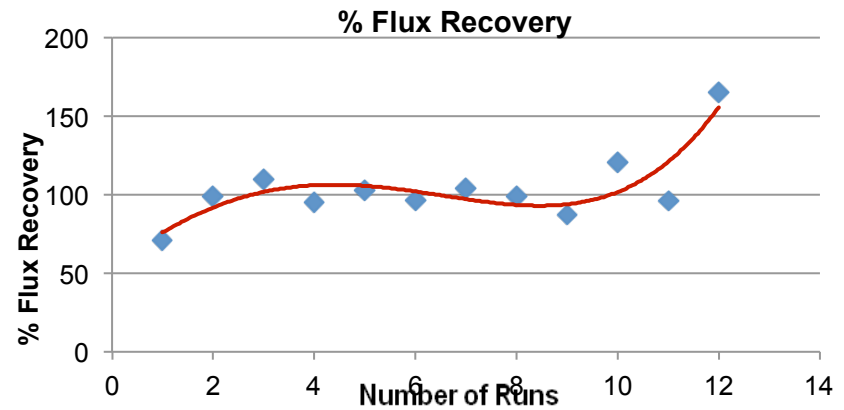
Case Study: *Comparison of Cleaners*

Lab-Scale Cross Filtration Membrane

Original Alkaline Cleaner



D`Limonene Based Cleaner

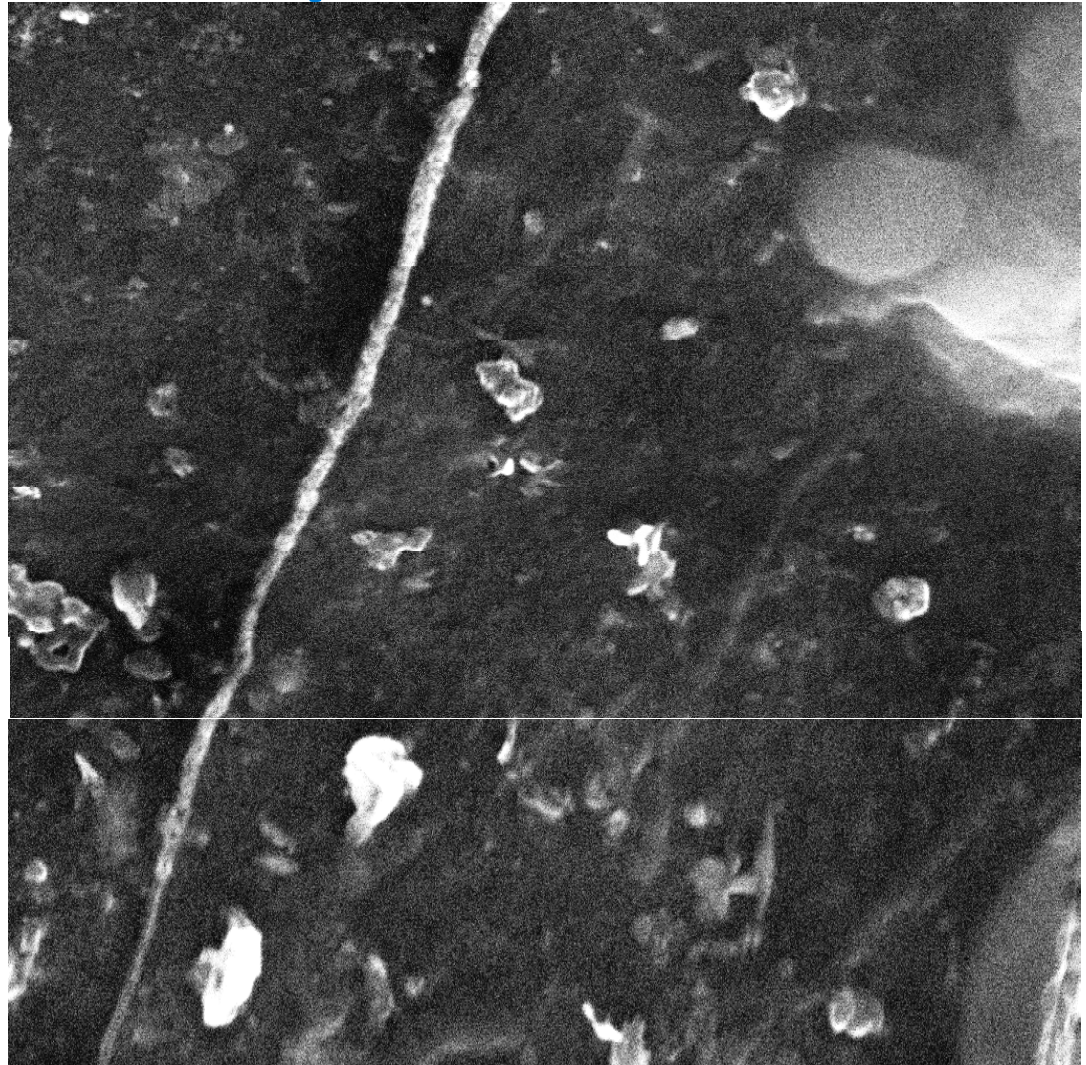


Case Study: *Microscopic Evaluation*

- 14,720x magnification
- Organic and iron oxide particles
- Ridge developed from top - center to bottom-left of the membrane

Conclusion:

D'Limonene-based cleaner is not recommended for this cleaning application





Conclusions



- Formulated cleaners offer many benefits
 - Custom-formulated
 - Performance tested
 - Compatibility tested
 - Consistency
 - Quality assurance
 - Long-term performance
- Specialty manufacturers
 - Technical know-how
 - Performance / compatibility
 - Share knowledge to keep experience in-house

tests



Contact Us

Contact us to request **free** cleaner samples.

Lab Trials / Membrane Compatibility tests also available.

International Products Corporation

201 Connecticut Drive, Burlington NJ 08016 USA

Telephone: 609-386-8770 Facsimile: 609-386-8438

Email: mkt@ipcol.com Website: www.ipcol.com

Thank you!

