
RO Chemicals 종류 및 운영



Mr. Tom Martinson
(Argo Scientific, U.S.A.)

TOTAL MEMBRANE SUPPORT TECHNOLOGY



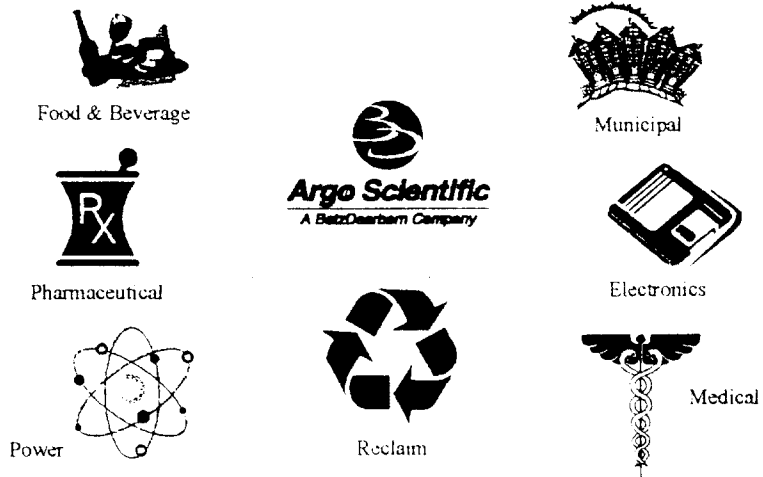
Argo Scientific

A BetzDearborn Company

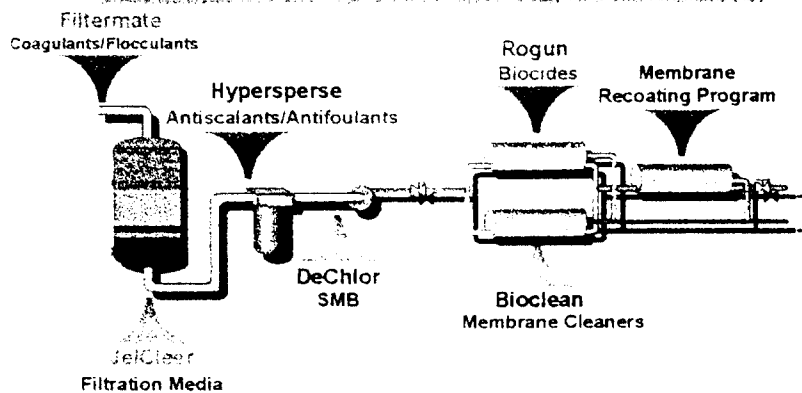
REGIONAL ARGO SCIENTIFIC LOCATIONS



MARKETS WE SERVE



Membrane Support Technology



PRODUCTS & SERVICES

- ◆ NSF and UL Classified Antiscalants/Dispersants
- ◆ Membrane Regeneration Process
- ◆ Cleaning Chemicals
- ◆ Technical Services
- ◆ Biocides
- ◆ JelClear Filtration Media
- ◆ Filtration Aids

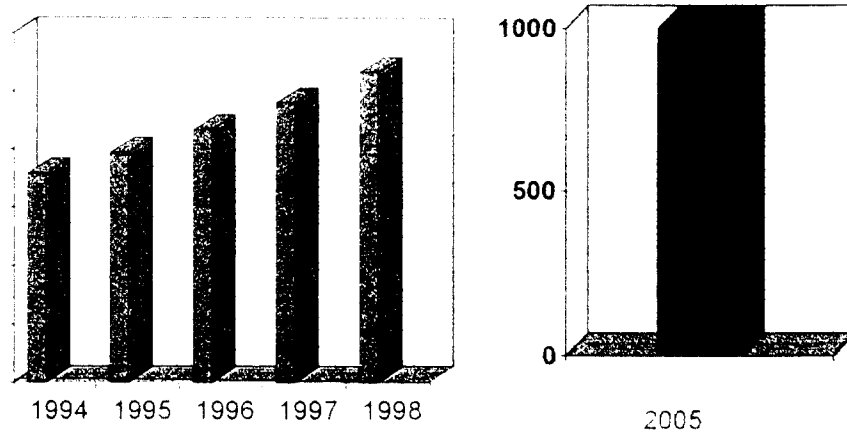
COMPANY OVERVIEW

- ◆ Worldwide Supplier to the Membrane Industry
- ◆ Facilities in N. America, Europe, Asia and Middle East
- ◆ Extensive Product Lines for Membrane and Filtration Processes
- ◆ Complete Membrane Testing and Regeneration Capability
- ◆ Technical Support Capability
- ◆ On-going Research and Development

MEMBRANE TECHNOLOGY MARKET TRENDS

- ◆ Industry acceptance of membrane technology
- ◆ Depleting natural water supplies require increase in water reclamation & re-use
- ◆ New application requiring specialized membrane
- ◆ Increasing process water quality requirements
- ◆ Global consolidation of fluid separations industry

Reverse Osmosis and Nanofiltration Global Membrane Sales (\$ Millions)

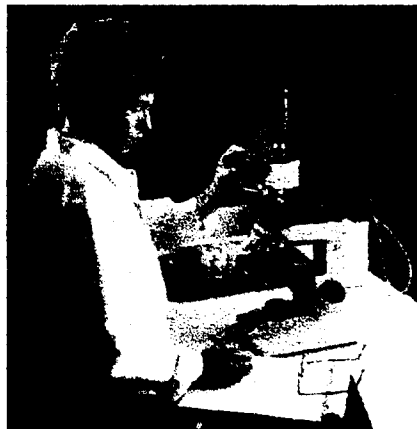


ARGO SCIENTIFIC PRODUCTS & SERVICES

- ◆ Dispersants & Scale Control for Membrane Systems
- ◆ Coagulants for Filtration & Clarification
- ◆ Biocides for Membrane Systems
- ◆ Cleaning Chemicals for Membrane Systems

ANALYTICAL SERVICES

- ◆ Water Analysis
- ◆ Membrane Autopsy/Foulant Analysis
- ◆ Cleaner & Antiscalant Recommendations
- ◆ Membrane Cleaning Evaluation
- ◆ Crossflow Fouling Index (CFI)



ON-SITE SERVICES

- ◆ Technical Training
- ◆ System Audits
- ◆ System Start-up
- ◆ Cleaning Assistance



RO SYSTEM & MEMBRANCE SUPPORT TECHNOLOGY

Membrane Fouling

- Colloidal Fouling
- Scale Fouling
- Biological Fouling
- Chemical Fouling

Causes of Fouling in RO Membranes

- ◆ Fundamental Problems with Pretreatment
- ◆ Fundamental Problems with Cleaning Procedures

Proper Pretreatment Protects Against...

- ◆ Scale Formation
- ◆ Colloidal Fouling
- ◆ Biological Fouling
- ◆ Chemical Fouling

Protecting Against Scale

- ◆ Complete Water Analysis
- ◆ Perform Scaling Calculations
- ◆ Choose Pretreatment

Components for a Complete Water Analysis

- ◆ Calcium
- ◆ Magnesium
- ◆ Sodium
- ◆ Potassium
- ◆ Barium
- ◆ Strontium
- ◆ Iron
- ◆ Silica
- ◆ Aluminum
- ◆ Sulfate
- ◆ Bicarbonate
- ◆ Chloride
- ◆ Nitrate
- ◆ Phosphate
- ◆ Fluoride
- ◆ pH

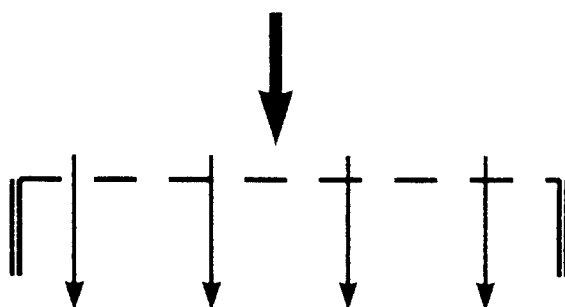
Membrane Foulants

Typically a mixture of two or more of the following materials

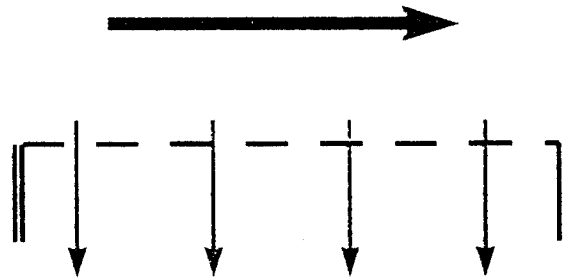
- ◆ Bacteria and bacterial slime
- ◆ Organic Debris (e.g. algae)
- ◆ Colloids (e.g. clays and colloidal silica)
- ◆ Metal Hydroxides
- ◆ Chemical precipitates

commonly water treatment chemicals

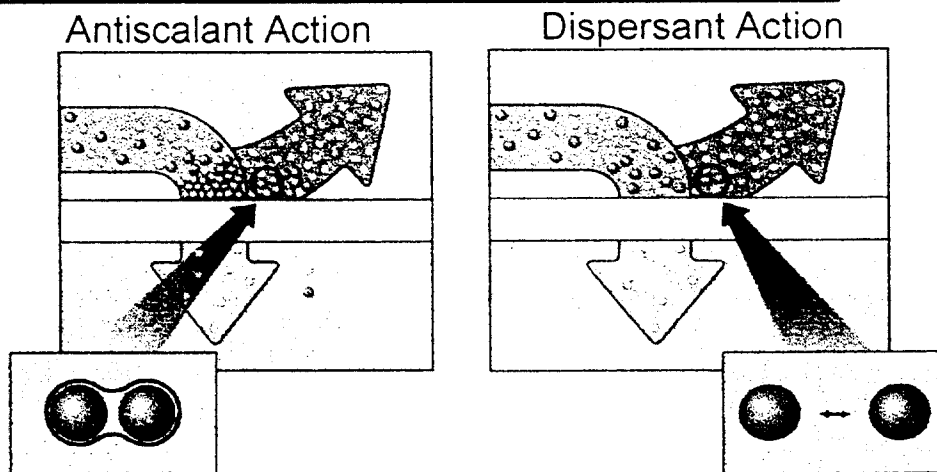
SILT DENSITY INDEX (SDI)



CROSS-FLOW FOULING INDEX (CFI)



ANTISCALANT/ANTIFOULANT PROPERTIES



PROTECTING AGAINST COLLOIDAL FOULING

- ◆ Understanding the fouling potential of the water
- ◆ Proper pretreatment

CONTROLLING BIOLOGICAL FOULING

- ◆ Clean Pretreatment Equipment and Piping
- ◆ Clean & Sanitize RO
- ◆ Biogrowth Control Program
- ◆ (Non-oxidizing biocides)

short life time

BIOLOGICAL FOULING

- | | |
|---|--|
| <ul style="list-style-type: none">◆ <u>Causes:</u><ul style="list-style-type: none">– Improper carbon bed maintenance– High biological count in the feed water– System sitting idle without adequate preservation | <ul style="list-style-type: none">◆ <u>Symptoms:</u><ul style="list-style-type: none">– High system delta P– Reduced permeate flows– Maintained or increased salt rejection– Odor or visible slime growth |
|---|--|

Solutions:

Disinfect system with Bioclean 442 or Bioclean 882; follow with high pH clean with Bioclean 511. Finish with Rogun 2881.

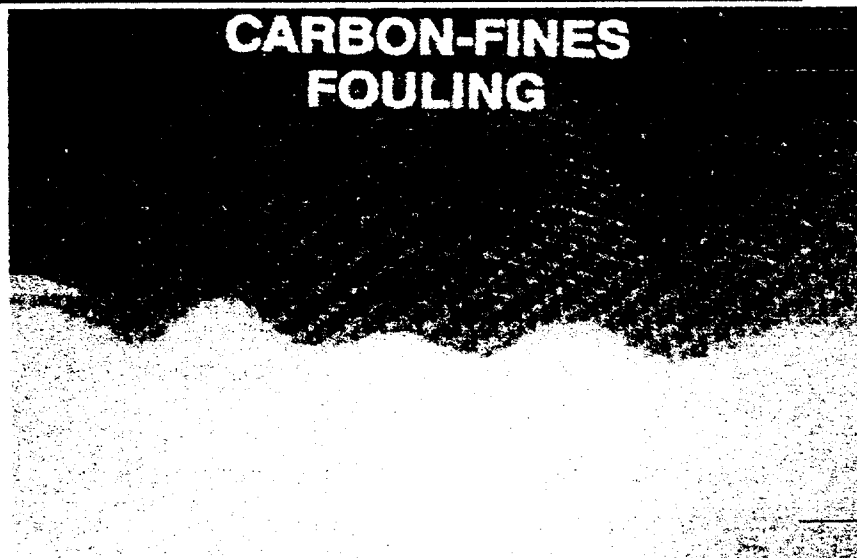
BIOGROWTH CONTROL PROGRAM

- ◆ Sanitize the System (Bioclean 442 or 882)
- ◆ Clean Biological Fouling (Bioclean 511 or 411)
- ◆ Control Biological Growth (Rogun 2881 or 781)

PROTECTING AGAINST CHEMICAL FOULING

- ◆ Use Membrane Compatible Chemicals
- ◆ Identify Chemical Being Used by Municipality & Others

CARBON FOULING



CARBON FOULING

- | | |
|--|--|
| <ul style="list-style-type: none">◆ <u>Causes:</u><ul style="list-style-type: none">– Inadequate flushing of the Carbon Beds– Soft Carbon | <ul style="list-style-type: none">◆ <u>Symptoms:</u><ul style="list-style-type: none">– First stage: Low Permeate Flow and Poor Salt Rejection– Latter Stages: High permeate Flow/Poor Salt Rejection |
|--|--|

Solution:

High pH clean with Bioclean 511 at reduced cleaning flow rates initially, increase flow rates gradually as Carbon comes off the membrane.

SILT FOULING



SILT FOULING

◆ Causes:

- Surface waters with high colloidal content
- Inadequate pretreatment
- Filter breakthrough
- Advanced biological fouling retaining colloidal particles

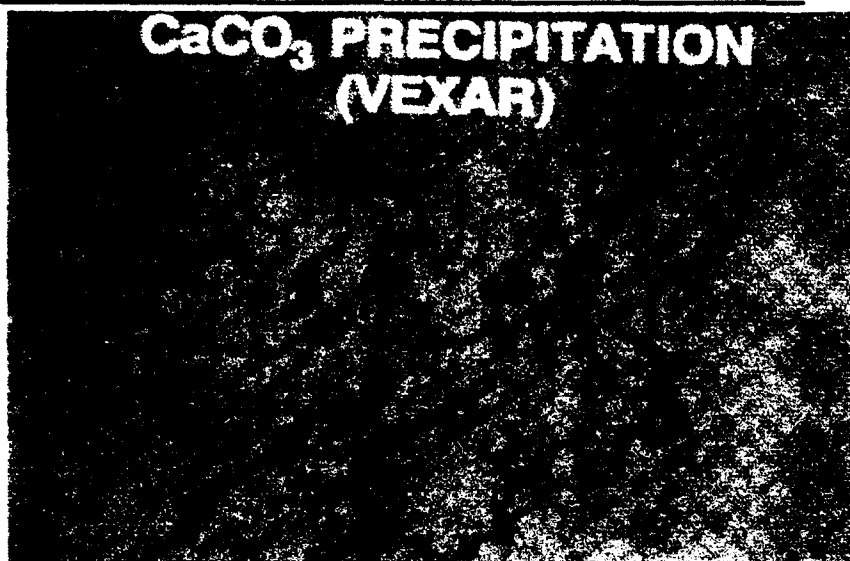
◆ Symptoms:

- Reduction in permeate flow rate
- Reduction in salt rejection
- Increase in first stage delta P
- Visible element discoloration

Solution:

Clean system with high pH cleaner-Bioclean 511

CALCIUM CARBONATE SCALING



CAUSES OF FOULING IN RO MEMBRANES

- ◆ Fundamental Problems with Pretreatment
- ◆ Fundamental Problems with Cleaning Procedures

UNDERSTANDING AND DEALING WITH BIOLOGICAL FOULING

- ◆ Rule Out All Other Fouling
- ◆ Understanding Biological Activity and Fouling in a RO System
- ◆ Dealing with Biological Fouling in the RO System
 - Cleaning Bio-Fouled Systems
 - Biocide Treatments

THE FIRST STEP TO IDENTIFY BIOLOGICAL FOULING

- ◆ Rule Out and Correct All Other Fouling Problems
 - Improper Cleaning Procedures
 - Colloidal Fouling
 - Scale Precipitation
 - Chemical Fouling
 - System Design Problems

UNDERSTANDING BIOLOGICAL ACTIVITY AND FOULING IN A RO SYSTEM

- ◆ Species are not important
- ◆ Problems with overdosing bisulfite
- ◆ Anaerobic vs. Aerobic Bacteria
- ◆ Effects of chlorine and other oxidizers
- ◆ The Myth of mutating bacteria
- ◆ Slime can entrap particles
- ◆ Slime formation in pretreatment piping
- ◆ Problem vs. Symptom

*File 1000-001-001-001
see 1000-001-001-001*

PROBLEMS FROM OVERDOSING BISULFITE

- ◆ Bisulfite is a reducing agent
Changes the environment from aerobic which may be the cause of the biological fouling.
- ◆ The bisulfite can be a source for food for sulfur reducing bacteria.
- ◆ Overfeeding bisulfite works against the biocide due to bisulfite being a reducing agent.

✓ SPECIES ARE NOT IMPORTANT

- ◆ Is the biological activity causing biological fouling of the RO?
The biological activity needs to be controlled to a point where it will not cause fouling of the RO.
- ◆ All surface water RO systems have biological activity; however, biological fouling does not occur in all RO systems.

AEROBIC VS. ANAEROBIC BACTERIA

- ◆ Aerobic bacteria need oxygen to live
- ◆ Anaerobic bacteria live in an environment where there is no oxygen.

EFFECTS OF CHLORINE AND OTHER OXIDIZERS ON BACTERIA

- ◆ Chlorine or other oxidizers will not kill all bacteria.
- ◆ Some bacteria will encapsulate (produce a protective shell) when they come in contact with the oxidizer.
- ◆ Once the oxidizer is removed from the water the bacteria will come out of its dormant state. The bacteria that did not survive can then become a food source for the surviving bacteria.

* non-oxidizing disinfectant
* short-life time

THE MYTH OF MUTATING BACTERIA

- ◆ **Bacteria do not mutate**

It is as difficult for bacteria to mutate as it is for any other living organism

Population shifts occur where one species becomes dominant because of an environment change. (pH, temperature, aerobic environment, anaerobic environment, bisulfite, oxidizing agents, etc.)

SLIME ENTRAPPED PARTICLES

- ◆ In severely biologically fouled membranes, autopsies have revealed high amounts of particles and metals.
- ◆ A slime matrix can entrap these particles which normally would be carried away in the concentrate stream.
- ◆ This entrapment can compound the problem and can lead you down the wrong path.

SLIME FORMATION IN THE PRETREATMENT PIPING

- ◆ The slime in the pretreatment piping can re-inoculate the RO after a cleaning.
- ◆ It is important to clean and sanitize the piping using the chlorine followed by caustic.

200 ppm of chlorine followed by a pH of 12 or higher will clean and strip the slime from the piping.

CONTROLLING BIOLOGICAL FOULING

- ◆ Clean Pretreatment Equipment and Piping
- ◆ Clean & Sanitize RO
- ◆ Biogrowth Control (Non-oxidizing biocides)

A Visible Difference in Fluid Filtration

 **JELCLEER™**

 **Argo Scientific**
A BetzDearborn Company

A Visible Difference in Fluid Filtration



Drawbacks of Conventional Granular Media Filtration

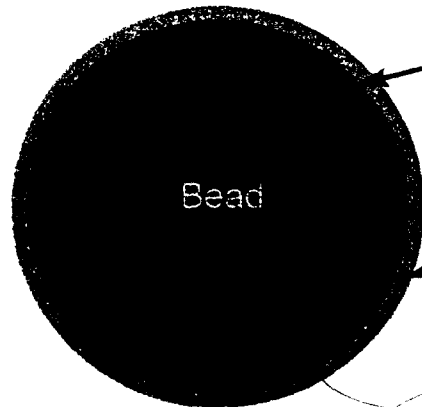
- ◆ Sometimes difficult to produce consistent quality filtrate without coagulant addition
- ◆ Difficult to maintain optimum coagulant dosage.
- ◆ Excess coagulant will reduce filtration efficiency.
- ◆ Excess coagulant may precipitate antiscalants and other feedwater constituents.

JelCleeR Fluid Filtration Systems

- ◆ Deliver Consistent Water Quality
- ◆ Handle Changing Feedwater Conditions
- ◆ No Polymer Feed Required
- ◆ Eliminate Incompatibility with Antiscalant
- ◆ Reduced Backwash Flow Rate
- ◆ No ripening □ Period After Backwash

JelCleer Process

51372 field exp
 lifetime 2-10 years

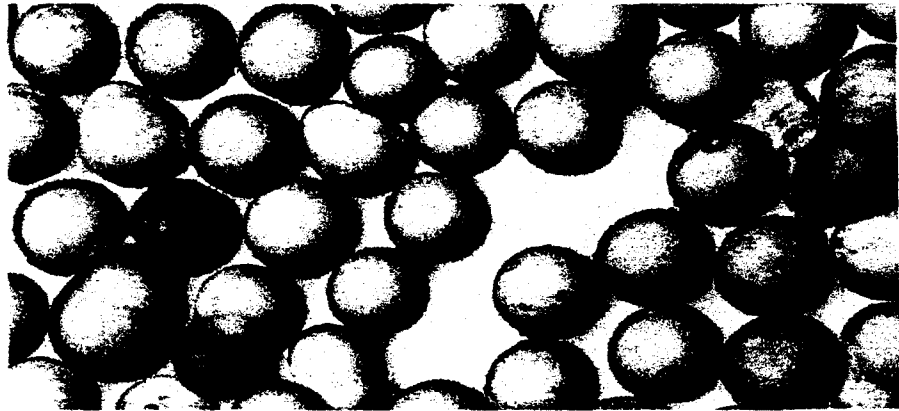


Primary Coating (polyacrylic acid)

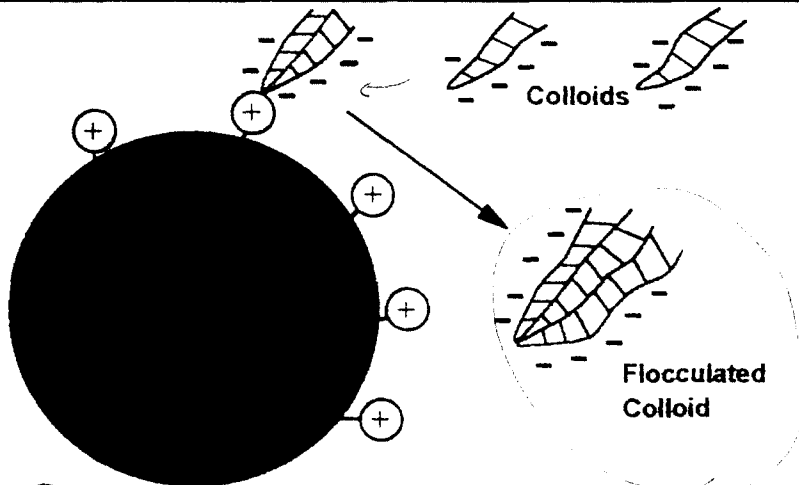
Secondary Coating (column의 충전 재료 2-6 μm의 secondary coating)

51372

JelCleer Composite Bead



JelCleer Advanced Filter Technology

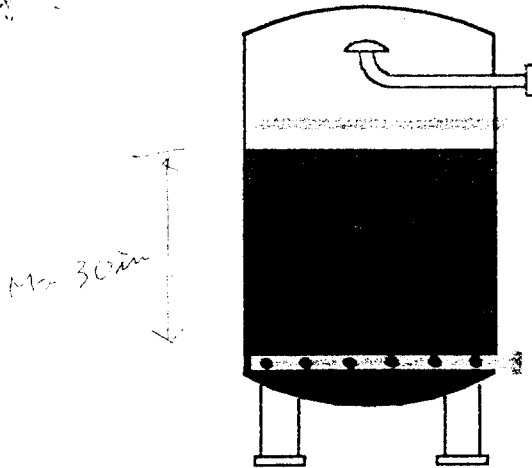


* What pretreatment of JelCleer required?
 * life-time of?
 * cost
 * bacterial rejection?



JelCleer Fluid Filtration Systems

retrofit



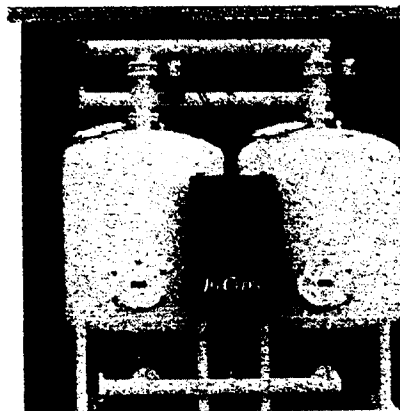
- ◆ Spherical Beads
 - Coated & Conditioned
- ◆ Support Bed
 - Gravel & Garnet
- ◆ Lateral Underdrain
- ◆ Filter Construction
 - Lined Steel

Operating Conditions

Vessel Size (Side Shell)	72" minimum
Bed Depth	30"
Service Flow	<u>12.2 m³/hr / m²</u>
Backwash Flow	<u>28.1 m³/hr / m²</u>

JelCleer Fluid Filtration Systems

- ◆ Modular Systems
- ◆ Custom Build
- ◆ Retrofit
- ◆ Solid State Controls
- ◆ Automatic Backwash
 - Elapsed Time
 - Pressure Differential



Feed Water Sources

- ◆ Municipal
- ◆ River
- ◆ Ground & Well
- ◆ Sea Water
- ◆ Waste Water

Feedwater Conditions

Turbidity, NTU	< 10
SDI	<10
Color	<10
pH	4 - 9
Chlorine	Determined by pilot

Operating Results

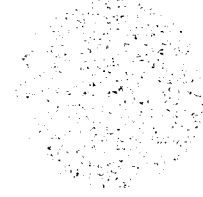
	<u>Feedwater</u>	<u>Filtrate</u>
Turbidity, NTU	< 10	< <u>0.2</u>
SDI	< 10	<u>0.5 - 5.0</u>
Color	< <u>10</u>	< 5

.45 Micron SDI Filter Pads

**Multimedia
without
Coagulant**



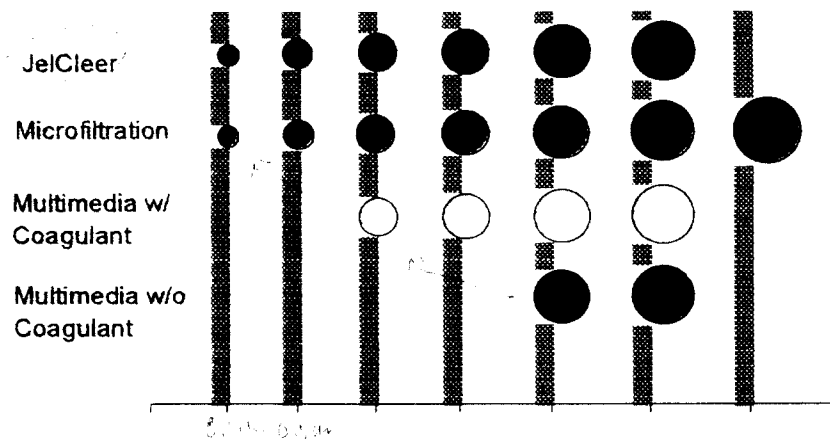
**Multimedia
with
Coagulant**



JelCleer

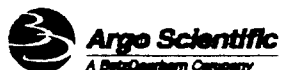
Microfiltration

Capacity for Particle Screening



JelCleer Benefits

- ◆ Produces High Quality Filtrate
- ◆ Reduces RO Cleaning & Replacement
- ◆ Reduces Cartridge Replacement
- ◆ No Continuous Polymer Injection
- ◆ Lower Costs



JelCleen Existing Filter Systems

- ◆ Installations
 - Over 40 installations World Wide
- ◆ Industries
 - Power
 - Municipalities
 - Electronics & Semiconductor
 - Bottling & Beverage
 - Pharmaceutical

JelCleen Existing Installation

Colorado Springs Cogen

Type:	New, 6/96
Filter Size:	(2) 60"x 60"
Flow:	200 gpm
Feedwater Source:	Surface Water

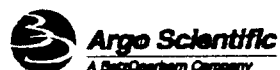
Performance:	
Cleaning Frequency	>120 Days
Non-JelCleen RO	30 Days

JelCleen Existing Installation

7-up, Los Angeles (Beverage)

Type:	Retrofit
Filter Size:	72"x 90"
Flow:	141 gpm
Feedwater Source:	Municipal

Performance:	
Previous Clean Freq	14 Days
Current Clean Freq	180 Days



JelClear Existing Installation

Kyocera, San Diego

Type:	Retrofit
Filter Size:	36" x 60"
Flow:	35 gpm
Feedwater Source:	Municipal

Performance:	
Previous Clean Freq	14 Days
Current Clean Freq	180 Days



***Don'T let this be the final step in
your membrane cleaning process***



***Don'T let this be the final step in
your membrane cleaning process***



MEMBRANE RECOATING PROGRAM (MRP)

- ◆ **Membrane Recoating Program (MRP) is a proprietary technique offering significant benefits:**
 - Dramatically improved membrane performance**
 - Cost is a fraction of replacement membranes**
 - Requires no on-site chemical mixing or disposal**
 - Reduces system downtime**
 - Lower direct labor costs**
 - Quantified results. Each element is individually tested before and after procedure.**
 - Process is repeatable**

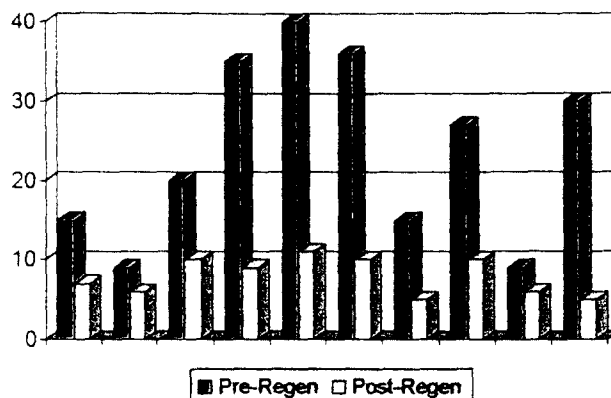
MEMBRANE RECOATING PROCESS

Combines customized cleaning formulations with a physical process too complex to be performed in the field.

- ◆ **Programs consists of:**
 - Visual inspection of each element**
 - Pretesting each element to determine performance**
 - Patent Pending Membrane Recoating and Cleaning Process**
 - Post test elements to determine improved performance**
 - Normalized data to membrane manufacturers referenced conditions (77 degrees F, 2000 ppm at 225 psi)**
 - Elements are individually preserved, bagged and boxed- elements are ready for immediate use or storage**

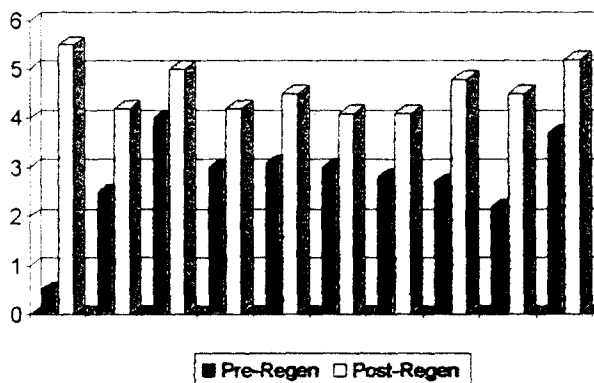
DELTA PRESSURE RESULTS

PSI



FLOW RESULTS

GPM



REJECTION RESULTS

Rejection

