

Quality, Residuals and Cost of Water Treatment Processes

David Webb, Charles Cullen and Jorge Arevalo

**Faculty Advisors: J. S. Taylor, L. A. Mulford and J. D.
Dietz**

**2002 FLORIDA WATER RESOURCES CONFERENCE
March 24-27, 2002
Orlando, Florida**

Objective

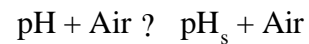
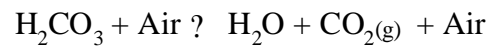
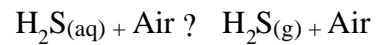
Compare five processes with different water sources based on:

- Water Quality
- Residuals
- Cost

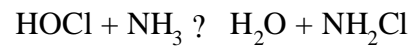
Treatment Process	Source Water
Conventional	Ground
Lime Softening	Blend
Enhanced Coagulation	Surface
Desalination	Sea
Integrated Membrane System	Surface

Conventional Treatment

Aeration



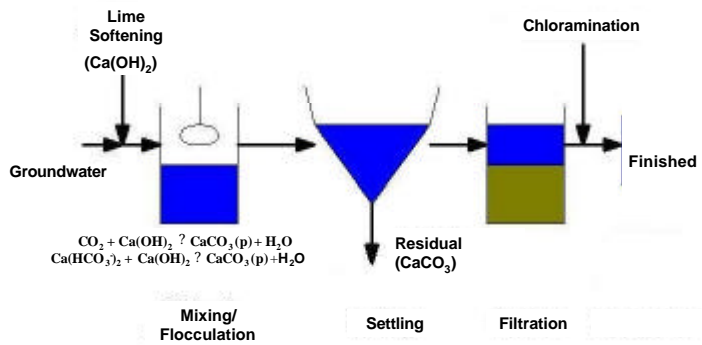
Disinfection (Chloramination)



Conventional Treatment Plant

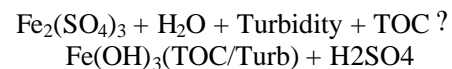


Lime Softening

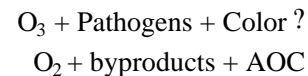


Enhanced Coagulation/O₃/BAC

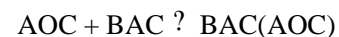
Coagulation



Ozonation



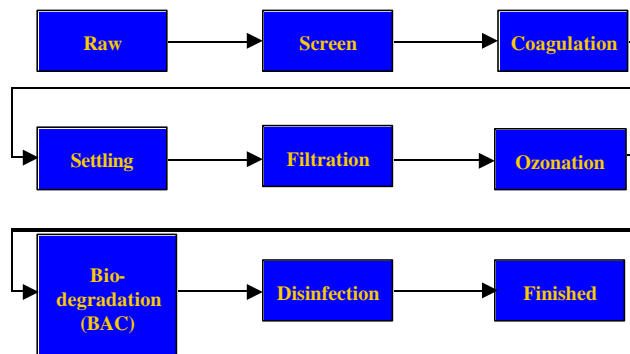
Adsorption



Disinfection

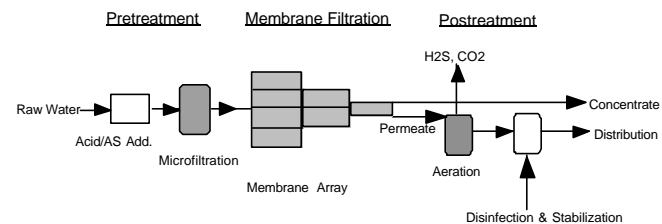
Chloramines

Enhanced Coagulation/O₃/BAC



Desalination

Conventional RO/NF System



RO/NF Pilot Unit

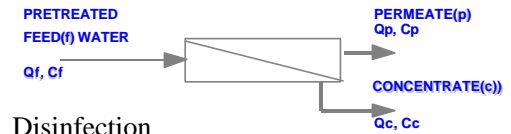


Integrated Membrane System

Coagulation

Ferric Sulfate

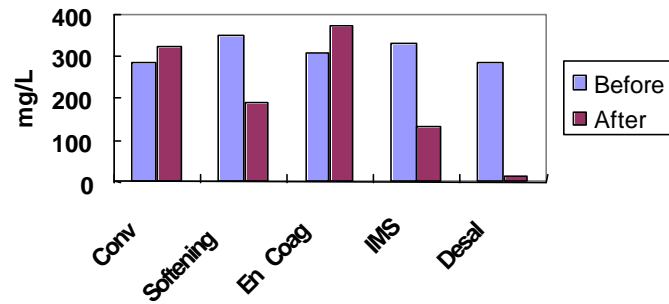
RO/NF Membranes



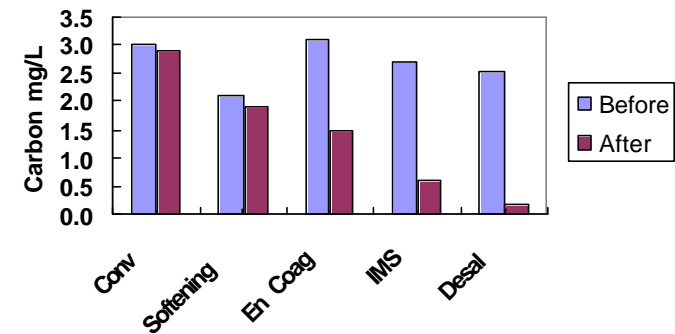
Disinfection

Chloramines

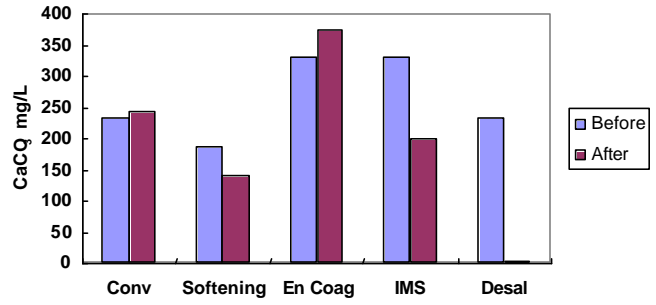
TDS Before and After Process



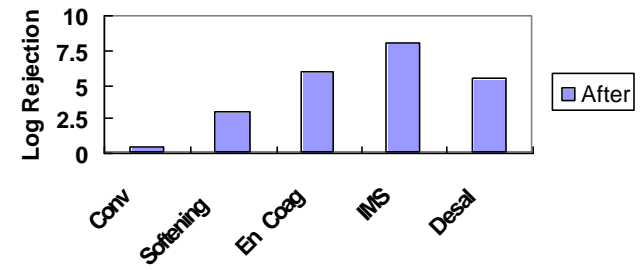
TOC Before and After Process



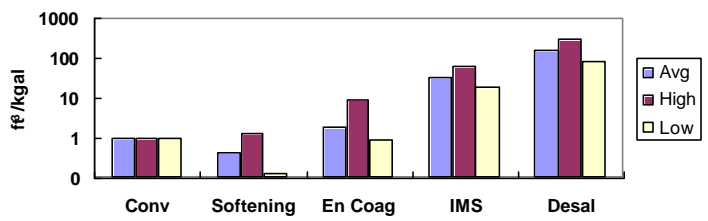
Total Hardness Before and After Process



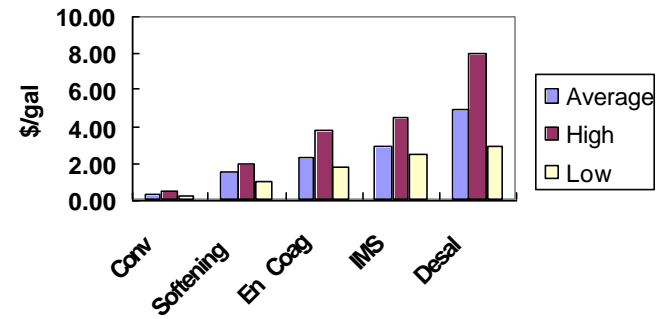
Typical Pathogen Log Rejection



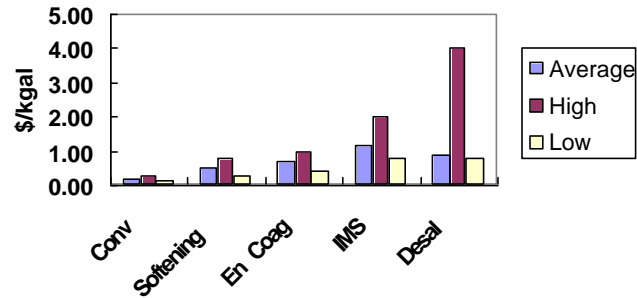
Process Residuals



Capital Costs



O & M Costs



Summary

•Water Quality

–TDS/TH

Conventional Treatment and Enhanced Coagulation increase TDS and remove no TH, whereas Softening, IMS and Desal reduce TDS and TH

–TOC

Conventional Treatment and Softening removing little TOC, whereas IMS and Desal removal nearly all TOC

–Pathogens

All process reduce pathogens due to mandatory disinfection. Processes involving membranes and advanced disinfection remove 1000 more pathogens.

Summary

- Residuals
 - Processes involving RO/NF (Desal and IMS) produce the greatest residual, whereas conventional treatment and softening produce the least residual.
- Cost
 - Processes involving Desal and IMS cost more than other processes, but produce higher quality. This cost is less than 1 penny per pound and 100 times less than a typical soft drink or alcoholic beverage

Acknowledgements

- CH2M Hill, Orlando FL
 - Matt Alvarez
 - Cory Johnson
- AwwaRF, Denver CO
 - Roy Martinez
- Tampa Bay Water, Clearwater FL
 - Chris Owen
- Reiss Environmental, Winter Park FL
 - Robert Reiss