

# HOW TO REDUCE THE COST OF RO/NF WATER TREATMENT

  
David H. Paul, Inc.  
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Courtesy Photos: DHP, Inc., Salt River Project, Tampa Bay Water

## Who Should Attend

Anyone responsible for ensuring the least cost for producing water from RO/NF units at any stage including design, startup, operation, maintenance, management and technical service. This includes:

- Lead operators
- Operations managers
- Results engineers
- Service technicians
- Others

## Why You Should Attend

Especially in today's economy it is essential that plant personnel operate their current process equipment in the most efficient way as possible. Reducing the amount of chemical injections, element replacement, downtime, and chemical cleanings will save a plant money. By incorporating what is learned during this seminar, you can save money many times over the cost of attending this seminar in just the first year.

***You can't afford NOT to attend this seminar!***

## Instructors



**David Paul** is the author of over 150 published articles on membrane water treatment, has developed and administers a 4,000 page correspondence training program on advanced water treatment, and has created and administers on-campus Associate Degree in Advanced Water Treatment programs at four different colleges in the United States. David is the President of David H. Paul, Inc. (DHP), an advanced water treatment training and consulting firm located in the USA. DHP has trained over 16,000 water treatment professionals worldwide since 1988.



**Bill Dees** provides water treatment training and consulting services for David H. Paul, Inc. (DHP). He has over 18 years of design, installation, operation, maintenance, troubleshooting, training and consulting experience of water treatment systems including membrane, ion exchange, pretreatment and post-treatment equipment. Bill is also the Technical Services Manager for DHP, responsible for membrane module autopsies and consulting. Bill holds an Associate of Applied Science Degree in Industrial Water Treatment from San Juan College, DHP's first on-campus, college degree program.

\*If you implement what you learn in a 2009 DHP seminar and you don't save more money at your water treatment plant in the next 12 months than the price of the training seminar(s) you attend, DHP will perform a Cost Reduction Audit of your water treatment system. The price of the audit will be reduced by the amount you paid to enroll in one or more 2009 DHP seminars. The Cost Reduction Audit is GUARANTEED to save you more money than you spend on the audit. This offer is limited to one person per facility. **Page 1**

## CONTENT

Page 1

[Who Should Attend](#)

[Why You Should Attend](#)

[What You'll Receive](#)

[Instructors](#)

Page 2

[Where and When](#)

[Daily Schedule](#)

[Overview of Topics](#)

[What You'll Learn](#)

[Certificate of Completion](#)

[What Others Say About DHP Training Seminars](#)

Page 3-5

[Detailed Agendum](#)

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# HOW TO REDUCE THE COST OF RO/NF WATER TREATMENT

## What You'll Receive

- 24 hrs of easy-to-understand training on how to reduce the cost of RO water treatment
- A highly illustrated workbook
- Break refreshments

## Where and When

For a list of where and when this seminar is being presented, [click here](#).

This seminar can also be presented at your facility.

## Daily Schedule

8:00 a.m. - 11:30 a.m.

Lunch Break

12:30 p.m. - 5:00 p.m.

## Overview of Topics

### How to evaluate and implement the lowest cost for chemical usage

- Chlorination/Dechlorination agents
- Acid/Caustic
- Antiscalant
- Coagulants/flocculants
- Sodium chloride (softener regenerations)

### How to reduce RO unit downtime and membrane element replacement rate

- Scaling control
- Fouling/Biological control
- Chemical Attack
- Non-Oxidizing biocide injection
- Element Autopsy
- Effective chemical cleanings

### How to reduce chemical cleanings and their cost

- Cleaning at an early stage
- Effective chemical cleaning procedures
- Effective chemicals
- Cleaning until no more changes are seen

## What You'll Learn

Everything you need to know to determine how to operate your system at the lowest cost.

## Certificate of Completion

Each attendee will receive a DHP certificate of completion following the course.

## What Others Say About DHP Training Seminars

DHP has trained over 16,000 water treatment professionals worldwide since 1988. Trainees include industrial, governmental and drinking water clients. The average rating given by attendees for all DHP seminars, including this one, is over 9 (on a scale of 1-10, with 1 being a terrible rating and 10 being an outstanding rating).

### The following are typical comments from attendees of DHP Seminars:

**“Great Course! Well worth the time.”**

Bob Castle - Water Quality Manager  
Marin Municipal Water District

**“Excellent training materials and presentation.”**

Gary Trent  
Abbott Laboratories

**“Excellent!”**

Eric Lozano - Austin Energy

**“Well presented and well worth the investment.”**

John Countz - Operations Manager  
Consolidated Water Co.

**“Excellent! More than I expected.”**

Mark Hall  
Texas Water Development Board

**“It was great!”**

Trent Hughes - Civil Engineer  
Black & Veatch

**“Great Course.”**

Joe Gonzales  
Xcel Energy

**“Most Excellent!”**

Mike Milner - Alternative H2O Solution



# HOW TO REDUCE THE COST OF RO/NF WATER TREATMENT

## Detailed Agendum

### Day One

**7:45 Refreshments (Provided)**

**8:00 Introductions**

**8:20 Workshop 1: Attendees' Process Flow Diagrams With Chemical Injections RO Water Treatment**

- Raw water – Pretreatment – RO Unit
- Raw water
  - Surface water
  - Well water
  - City water
  - Seawater
- Pretreatment Protects RO Unit From:
  - Scaling
  - Fouling
  - Chemical Attack



#### Scaling Control Introduction

- Acid
  1. pH
  2. Inorganic carbon spectrum
  3. Dosage controlled by pH meter

**9:00 Break (Refreshments Provided)**

**9:15 Scaling Control Introduction (continued)**

- Scale Inhibitors
  - Threshold inhibitors
  - Crystal modifiers
  - Dispersants
  - Dosage controlled by drop test or measurement (Trasar™)
- Softening
  - Sodium cycle
  - Hydrogen cycle
  - Normal service
  - Regenerations
  - Softener breakthrough
  - Throughput controlled by TH breakthrough



#### Workshop 2: Scaling Control

**10:15 Break (Refreshments Provided)**

**10:30 Scaling Control Cost Reduction**

- Water analysis
- Softening
  - Softener design program
  - How to reduce cost

#### Workshop 3: Reducing softener costs

**11:30 Lunch (Not Provided)**

**12:30 Scaling Control Cost Reduction (continued)**

- Acid injection only
  - Calcium carbonate reduction
  - LSI
  - RO/NF Design software
  - How to reduce cost

#### Workshop 4: Reducing acid costs

**1:45 Break (Refreshments Provided)**

**2:00 Scaling Control Cost Reduction (continued)**

- Scale inhibitor injection only
  - Calcium carbonate scale control
  - Sulfate scale control
  - RO/NF design software
  - Antiscalant dosing software
  - How to reduce cost



#### Workshop 5: Reducing antiscalant cost

**3:15 Break (Refreshments Provided)**

**3:30 Workshop 6: Attendees' PFDs & list of actions items to take back to reduce chemical costs**

**4:30 Daily Summary & Conclusions**

- Final Questions & Answers
- Daily evaluation



**5:00 End**

### Day Two:

**7:45 Refreshments (Provided)**

**8:00 Workshop 7: Day 1 Review**

**8:15 Fouling Control Introduction**

- Turbidity
  - SDI
  - Media filtration
    1. Loading rates
    2. Filtration mechanisms
      - a. Size exclusion
        - i) Impingement
        - ii) Adsorption
        - iii) Others



# HOW TO REDUCE THE COST OF RO/NF WATER TREATMENT

## Detailed Agendum (Cont'd)

- 3. Filter aid
  - a. Coagulant
  - b. Flocculant
  - c. Risks

### - Microfiltration/Ultrafiltration

- 1. Filter aid
  - a. Coagulant
  - b. Flocculant

### 9:00 Break (Refreshments Provided)

### 9:15 Fouling Control Cost Reduction

- Media filtration
  - Run time v. turbidity analysis
  - Filter aid
    - 1. Coagulant
    - 2. Flocculant
  - How to reduce cost
- MF/UF
  - Backwash frequency
  - Filter Aid
    - 1. Coagulant
    - 2. Flocculant
  - How to reduce cost



### Workshop 8: Reducing fouling control costs

### 10:15 Break (Refreshments Provided)

### 10:30 Chemical Attack Control Introduction

- Sulfite injection
  - Sulfite injection
  - Activated carbon
  - UV light

### Chemical Attack Control Cost Reduction

- Sulfite injection
  - Underfeeding
    - 1. Membrane damage
  - Over feeding
    - 1. Sulfite analysis of feed and concentrate
  - Pre- or post- cartridge filter injection
  - Feed water transition metals
  - How to reduce cost
- Activated carbon
  - Loading rate
  - Capacity
  - Analysis
    - 1. Iodine number
    - 2. Molasses number
  - How to reduce cost



### Workshop 9: Reducing chemical attack control costs

### 11:30 Lunch (not provided)

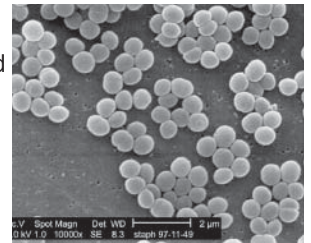
### 12:30 Reducing Element Replacement Introduction Review of RO/NF Membrane Elements & RO/NF Units

- Element features that promote fouling
- RO/NF design features that promote scaling/fouling
  - gfd
  - Crossflow
  - Beta factor
  - Percent recovery
  - Instrumentation calibration
  - Post-shutdown flush

### 1:45 Break (Refreshments Provided)

### 2:00 Reducing Element Replacement Introduction (continued)

- Pretreatment and RO/NF features that promote biofouling
  - Bacterial growth
  - Ideal conditions
  - Normal operating conditions
    - 1. Chlorination/dechlorination
    - 2. Sulfite overfeed
    - 3. Low crossflow
    - 4. High gfd
    - 5. Intermittent operation
- Today's typical design/operation parameters



### Workshop 10: Evaluating the fouling potential of RO/NF units

### 3:15 Break (Refreshments Provided)

### 3:30 Reducing Element Replacement Equals Cost Reduction

- Effective pretreatment operation
  - Scaling control
  - Fouling/Biofouling control
  - Chemical attack control
  - How to reduce cost
- Operate RO/NF units using low fouling/scaling parameters
  - Low gfd
  - High crossflow
  - Minimize downtime
  - Minimize biofouling
    - 1. Biocide injection if necessary
  - Others



# HOW TO REDUCE THE COST OF RO/NF WATER TREATMENT

## Detailed Agendum (Cont'd)

- How to reduce cost

### Workshop 11: Reducing cost through effective design & operation

#### 4:30 Daily Summary & Conclusions

- Final Questions & Answers
- Seminar evaluation

5:00 End

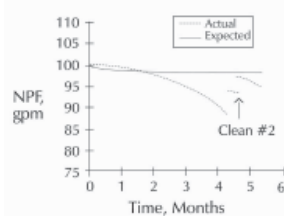
### Day Three:

#### 7:45 Refreshments (Provided)

#### 8:00 Workshop 12: Review of day 2

#### 8:15 Reducing Element Replacement Equals Cost Reduction (continued)

- Early detection of problems
  - Trending using software programs to catch problems as early as possible
    1. NPF
    2. NSP
    3. NPD
  - Performance changes seen with scaling, fouling & chemical attack
  - How to reduce cost



#### Workshop 13: Catching problems at an early stage

#### 9:00 Break (Refreshments Provided)

#### 9:15 Reducing Element Replacement Equals Cost Reduction (continued)

- Minimize chemical cleanings & maximize cleaning effectiveness
  - Catching problems at an early stage
    1. Cleaning implemented at an early stage
  - Good cleaning skid
  - Good cleaning procedure
  - Cleaning until no more changes are seen
  - Verifying cleaning results through performance monitoring
  - Clean upstream piping and equipment as needed
- The Components of a good cleaning skid
  - Sizing of the cleaning solution tank and pump
  - Valving to clean by stage
  - Heater
  - Other components of a good cleaning skid
  - How to reduce cost

#### Workshop 14: Evaluating good cleaning skids

#### 10:15 Break (Refreshments Provided)

#### 10:30 Good Cleaning Procedure

- Removing scalants
  - pH
  - Flow
  - Temperature
  - Time
- Removing foulants
  - pH
  - Flow
  - Temperature
  - Time



#### Cleaning Until No More Changes Are Seen

- How to determine when to stop cleaning
- Chemical cleaning log sheet and how it can reduce chemical cleanings

#### Verifying cleaning results through performance monitoring

- How to determine the effectiveness of a cleaning
- #### Clean upstream piping and equipment as needed

- How to reduce cost

#### 11:30 Lunch (not provided)

#### 12:30 Workshop 15: Attendees' chemical cleaning skids and procedures

#### Reducing Element Replacement Equals Cost Reduction (continued)

- Minimize the negative effects of downtime
  - Short term layout
    1. Pretreated feedwater flush
    2. RO permeate flush
    3. DI flush
    4. Non-oxidizing biocide layout
  - Long term layout
    1. Plant and RO condition
    2. Temperature
    3. Chemical cleaning
    4. Non-oxidizing biocide
    5. Sulfite compound



#### 1:45 Break (Refreshments Provided)

#### 2:00 Reducing Element Replacement Equals Cost Reduction (continued)

- Element autopsy
  - Identifies problems quickly when nothing else does
  - Case studies

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## Detailed Agendum (Cont'd)

- Cleaning study
  - Identifies the best cleaners and procedures to use without having to experiment at the plant
  - Case studies
- Technical Support
  - Identifies solutions quickly when there are multiple problems so complex that it takes someone with years of consulting experience to unravel
  - Case studies

### Summary of cost reduction techniques learned

**3:15** Break

**3:30** Workshop 16: Attendees' PFDs & list of actions items to take back to reduce chemical costs

**4:30** Daily Summary & Conclusions

- Final Questions & Answers
- Seminar evaluation

**5:00** End

