

SEAWATER REVERSE OSMOSIS OPERATION & MAINTENANCE



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Courtesy Photos: Perth Desalination Plant, RAWEC, Tampa Bay Water, Siemens

Who Should Attend

Anyone desiring to know the latest, UNBIASED information on seawater reverse osmosis (SWRO) water treatment (DHP is a training company, NOT an equipment vendor).

Why You Should Attend

Much of the information presented in this seminar is typically not found in Operations & Maintenance (O & M) manuals and other vendor material. The information is practical and immediately useable to improve plant design, specification, operation, troubleshooting, etc. This is the first of four seminars on seawater reverse osmosis (SWRO). Whether you have zero or 20 years of SWRO experience you'll walk away with enough valuable information to justify the time and resources expended to attend the seminar. This is based on training over 16,000 people during the past 20 years, many of whom have said "I learned more in 1-4 days of training than I learned in 5-20 years on the job!" Unless you've attended another DHP RO seminar or have gone through a DHP on-line RO training program, most attendees find that the material covered in this seminar is essential to the complete understanding of any other DHP SWRO seminar. This seminar covers the fundamental concepts and information you need to know for the smallest to the largest SWRO units.

What You'll Receive

- 8 hours of practical, interesting, easy-to-understand SWRO water treatment training
- 8 hours of the latest in multimedia training including video & 3-D animations
- A highly illustrated workbook
- Break refreshments (lunch not included)

Instructors



David Paul was an operator for 2.5 years, first-level supervisor for 1 year and manager for 8 years of one of the most advanced water treatment systems in the world. He then began David H. Paul, Inc. (DHP) and has trained and consulted since 1988. David is the author of over 150 published articles on advanced 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 three different colleges in the United States. David is the President of DHP, an advanced water treatment training and consulting firm located in Farmington, New Mexico, 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.

SEAWATER REVERSE OSMOSIS OPERATION & MAINTENANCE

Overview of Topics

- Water Contaminants Overview
- Semipermeable Membranes
- Osmosis & Reverse Osmosis
- SWRO Membranes-Hollow Fiber & Flat Sheet
- Membrane Elements
- Pressure Vessels
- RO Units
- Seawater RO Unit Operation
- Potential Problems
- Seawater pretreatment to minimize problems
- Chemical Cleaning of SWRO units

What You'll Learn

You'll learn all of the practical information necessary to thoroughly understand the SWRO water treatment. At the end of the seminar you'll be able to go into any fresh, brackish or SWRO facility in the world and know what each piece of equipment is doing. You'll also know good chemical cleaning procedures.

Certificate of Completion

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



Courtesy: City of Robinson, TX, US Army

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:

**“Your lectures help a lot in the operation of the RO system.
We can apply all the knowledge we learned from you!”**

Luisito Agua - Plant Shift Leader
RAWEC - Saudi Arabia

“The workshop's are excellent, they actually make you think. You also cover things very thoroughly.”

Cory Wirth - Technical Service
Osmoflo - Australia

“After 15 years in the industry, this class filled many holes gained from being self taught.”

Scott Risser - Senior Chemical Engineer
Tucson Electric Power - Springerville, AZ

“Excellent Training!”

Daniel Barge - Municipal Water Treatment
Brazos River Authority - Granbury, TX

“Great Class!”

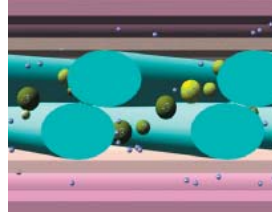
Martin Rocks - Maintenance Technician
Tropicana Products

SEAWATER REVERSE OSMOSIS OPERATION & MAINTENANCE

7:45 Refreshments (Provided)

8:00 Introductions
Water Contaminants Overview

- Ions
- Gases
- Organics
- Silica



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Semipermeable Membranes

- Structure
- Water Flux
- Salt Flux
- Rejection of contaminants

9:00 Break (Refreshments Provided)

9:15 Osmosis & Reverse Osmosis

- Osmotic pressure
- Applied pressure
- Net Driving Pressure
- Water flux
- Salt flux

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Membranes

- Flat sheet, hollow fiber
- Manufacturers
- Membrane Elements
- Standard 8" (20 cm) elements
- New 16" (41 cm) and new 18.25" (46 cm) elements
- Envelopes
- Feed water spacer
- Permeate spacer
- Flow path



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Workshop 1: Build a simulated element

10:15 Break (Refreshments Provided)

10:30 Pressure Vessels

- 8", 16", 18.25"
- End port, side port, multi-port
- Shimming elements

SWRO Units

- Single stage, multi-stage
- Single pass, double pass

11:30 Lunch (Not Provided)

12:30 SWRO Unit Operation

- Single pass
- Double pass
- Recovery rate
- Concentration
- Water flux per element
- Net driving pressure (NDP) per element
- Salt passage per element
- NDP and SP versus temperature

Seawater RO Unit Operation

- Single stage, double stage
- Single pass, double pass

Workshop 2: RO Unit Operation

1:45 Break (Refreshments Provided)

2:00 Potential Problems

- Scaling
- Fouling
- Chemical Attack

Pretreatment to minimize scaling, fouling, chemical attack

- Minimize scaling
 - Acid injection
 - Scale inhibitor injection
- Minimize fouling
 - Chlorination
 - Filter aid injection
 - Media filtration
 - Cartridge filtration
 - Microfiltration/ultrafiltration
- Minimize chemical attack
 - Sulfite injection

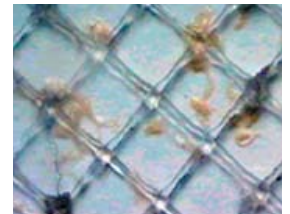
Seawater pretreatment summary

- Conventional
- Advanced

3:15 Break (Refreshments Provided)

3:30 Chemical Cleaning

- Removing scalants
- Removing foulants
- A good cleaning procedure
- How to determine when to stop cleaning
- How to determine the effectiveness of a cleaning



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4:45 Summary & Conclusions

- Final Questions & Answers
- Seminar evaluation

5:00 End