

MEMBRANE SYSTEM DESIGN



Courtesy Photos: Pall, GE -Zenon, City of Ft. Myers, City of Chandler

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New DHP Seminar!!

There are a lot of poorly to marginally designed membrane systems out there. There are designs that have a relatively low capital cost but very high O & M costs.

This 4-day seminar covers everything from an overview of available membrane products, to how they work, to which applications to use with which membrane and how to select suitable system equipment, to advanced system design and optimization of performance and process economics. As is true for all DHP seminars, there is no sales pitch for a particular technology, manufacturer or company.

Who Should Attend

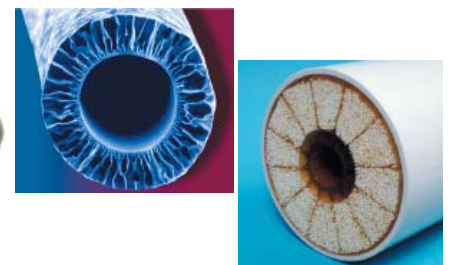
This seminar was created to provide the greatest value to people who deal in the design, specification, construction and installation of membrane systems or evaluate economic feasibility of future membrane projects. Those new to membrane system design will receive what they need to create reliable and cost effective systems. Those with some experience will benefit from learning current advances in membrane technology and system configurations. Engineers and city planners will walk through the process of value engineering of capital and operating cost as it is applied to large membrane projects.



Courtesy Photo: Tampa Bay Water

Technologies Covered

- Microfiltration (MF)
- Ultrafiltration (UF)
- Membrane Bioreactors (MBR)
- Nanofiltration (NF)
- Reverse Osmosis (RO)



Courtesy Photos: Dow, Koch Membrane Systems, Norit

Why You Should Attend

Decisions made today affect your design, operation, and budget tomorrow. It's hard to get unbiased information about which membrane product to use and the risks and benefits of different membrane products.

- What you need to know about each membrane technology (MF, UF, MBR, NF, RO) to determine which is best for your application(s)
- How to select suitable system equipment, including I & C components
- What you need to know to design effective fresh water, brackish water and seawater membrane systems
- How to optimize plant performance
- Economics of membrane projects
- Advanced process designs
- Hybrid systems
- Energy recovery options
- Pumping system configurations
- Optimization of energy usage
- Logistics of pilot unit operation
- Acceptance test procedure

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Why You Should Attend (Cont'd)

This seminar has been designed to offer you an unbiased, fact-finding, well-rounded experience that will put membrane water treatment design in perspective and in a way that is simple to understand.

This seminar is presented in an easy-to-understand, step-by-step, interesting and educational format, delivered without a sales pitch and taught by unbiased industry experts. Return to your job with the ability to make good decisions and good designs based on what you learned.

What You'll Receive

- 32 hrs of enjoyable, interesting, easy-to-understand membrane water treatment design training
- A highly illustrated workbook
- Break refreshments

Instructors



David Paul - David 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 15,000 water treatment professionals worldwide since 1988.



Mark Wilf, PhD - Recognized as a global expert for membrane applications, Dr. Wilf provides expertise to the engineering and scientific community worldwide and participates in professional forums defining future directions for membrane technology and application development. This includes reverse osmosis, nanofiltration, ultrafiltration, microfiltration technologies

applied for water desalination, potable water treatment, and industrial and municipal wastewater reclamation. Dr. Wilf regularly presents and teaches desalination and membrane technology subjects to engineers and water professionals. Dr. Wilf has been involved in process development, system design, project execution, plant operation and maintenance of large, commercial desalination plants in US, Europe and Middle East since 1977.

Certificate of Completion

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



Courtesy Photo: Hydranautic

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 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 DHP Seminars :



Courtesy Photo: Siemens

“Excellent!”

Mike Heaton - Reclamation Supervisor
East Bay Municipal Utility District

“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 Seminar.”

Jared Thornburgh - Designer
Siemens

“Excellent Training!”

Daniel Barge - Municipality
Brazos River Authority

“Excellent Course!”

Joseph Mendo
City of Cape May

MEMBRANE SYSTEM DESIGN

Detailed Agendum

Day 1 - Overview of Membrane Water Treatment

7:45 Refreshments (Provided)

8:00 Introductions

8:15 Water Contaminant Overview

- Contaminants (Dissolved & Suspended)
- The characteristics of contaminants that cause their removal by membrane technologies

Membrane Water Treatment Overview

- Pressure driven membrane technologies
- Membrane configurations (Flat Sheet, Hollow Fiber, Tubular)
- Membrane Elements (Spiral Wound, Hollow Fiber Modules)
- Membrane Element & Module Operation
- Applications for each membrane technology
- Chemicals commonly used for each membrane technology

9:00 Break (Refreshments Provided)

9:15 Microfiltration & Ultrafiltration

- Four reasons for the explosive growth
- Microfiltration membranes
- Ultrafiltration membranes
- Pretreatment options
- Module operation
 - Inside-out configuration
 - Outside-in configuration
 - Pressurized modules
 - Submerged modules
 - Crossflow filtration
 - Dead-end filtration
 - Water flux
 - Trans-membrane pressure
 - Backwash
 - Chemically-enhanced backwash
 - Clean-in-place



Courtesy Photo: Pall

10:15 Break (Refreshments Provided)

10:30 Microfiltration & Ultrafiltration (Continued)

- Step-by-step video presentation of the modules, normal operation and backwash of:
 - Pressurized outside-in modules
 - Submerged outside-in modules
 - Pressurized inside-out modules
 - Integrity testing and fiber breakage repair

Workshop 1: MF & UF

11:30 Lunch (Not Provided)

12:30 Nanofiltration & Reverse Osmosis

- Brackish water
- Seawater
- Osmosis

12:30 Nanofiltration & Reverse Osmosis (Cont'd)

- Reverse osmosis
- Membranes
- Membrane elements
 - How they work
 - How they're made
 - New large elements

1:45 Break (Refreshments Provided)

2:00 Nanofiltration & Reverse Osmosis (Cont'd)

- RO unit design
 - Pressure vessels
 - Crossflow
 - Water flux



Courtesy Photo: Pall

3:15 Break (Refreshments Provided)

3:30 Workshop 2: NF & RO

4:30 Summary, Discussion & Day One Evaluation

- Final Questions & Answers
- Day 1 evaluation

5:00 End

Day 2 - System Configuration and Projection of Performance

7:45 Refreshments (Provided)

8:00 RO system configuration

- Feed water sources and feed water quality indicators
- Feed water supply system alternatives
- Pretreatment process alternatives, system configurations and operation

9:00 Break (Refreshments Provided)

9:15 RO system configuration (Cont'd)

- Pumping system configuration, pumps and energy recovery devices
- Performance parameters of pumping systems
- Components of energy consumption, optimization of energy use

10:15 Break (Refreshments Provided)

10:30 RO system configuration (Cont'd)

- RO unit configuration: single stage and multistage concentrate processing, two pass permeate treatment configuration
- Architecture and components of instrumentation and control system
- Procedures for control of operation of RO system
- Computer projections of RO system performance

11:30 Lunch (Not Provided)

12:30 RO system configuration (Cont'd)

- Methods of RO membranes performance calculations
- Algorithm of computer program for performance projection

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Day 2 - System Configuration and Projection of Performance (Cont'd)

- 12:30 RO system configuration (Cont'd)**
- Features of commercial computer programs
 - Examples of determination of process parameters and performance calculations
 - Optimization of system performance utilizing computer calculations
- 1:45 Break (Refreshments Provided)**
- 2:00 Introduction to desalination system design**
- Project specifications
 - Process development
 - Calculation of membrane performance
- 3:15 Break (Refreshments Provided)**
- 3:30 Introduction to desalination system design (Cont'd)**
- Bill of materials
 - Major equipment components
 - System layout
- 4:30 Summary, Discussion, & Day Two Evaluation**
- 5:00 End**

Day 3 - Membrane System Design, Project Implementation and Operation

- 7:45 Refreshments (Provided)**
- 8:00 Operation of pilot unit for design verification**
- Objectives of operation of pilot program
 - Pilot unit configuration
 - Testing program and evaluation of results
 - Logistics of pilot unit operation
- 9:00 Break (Refreshments Provided)**
- 9:15 Desalination system startup procedure**
- Project implementation steps and duration
 - Preparation for system startup
 - Acceptance test procedure
 - Performance follow up
- 10:15 Break (Refreshments Provided)**
- 10:30 Normalization of membrane performance**
- Recording of operational data
 - System and membrane performance normalization
 - Determination of performance trends
 - Membrane fouling and performance recovery
- 11:30 Lunch (Not Provided)**
- 12:30 Normalization of membrane performance - (Cont'd)**
- Type of membrane fouling processes
 - Indicators of fouling conditions
 - Elements examination and identification of composition of fouling layer
 - Procedure for membrane cleaning and cleaning solution composition

- 1:45 Break (Refreshments Provided)**
- 2:00 Economics of membrane projects**
- Components of project cost
 - Components of operating cost
 - Optimization of project economics for "Turn key" and "Design Built Operate" project delivery methods
- 3:15 Break (Refreshments Provided)**
- 3:30 Economics of membrane projects (Cont'd)**
- Advanced process design
 - "Split Partial" two pass permeate processing
 - Hybrid system configurations
 - Process alternatives for boron reduction
- 4:30 Summary, Discussion, & Day Three Evaluation**
- 5:00 End**

Day 4 - Membrane Filtration and MBR Technology

- 7:45 Refreshments (Provided)**
- 8:00 Introduction to membrane filtration and MBR technology**
- Fundamentals of membrane filtration process
 - Membrane, membrane modules, types and configurations
 - Mode of operation and operating parameters
- 9:00 Break (Refreshments Provided)**
- 9:15 Introduction to membrane filtration and MBR technology (Cont'd)**
- Parameters affecting membrane and system performance
 - System configurations: potable applications, RO pretreatment, wastewater reclamation, MBR
- 10:15 Break (Refreshments Provided)**
- 10:30 Membrane filtration and MBR system design**
- System design
 - Major equipment components
- 11:30 Lunch (Not Provided)**
- 12:30 Membrane filtration and MBR system design (Cont'd)**
- Sizing of membrane units
 - System layout
- 1:45 Break (Refreshments Provided)**
- 2:00 Operation and economics**
- Sequence of operation
 - Range of operating parameters
 - Effluent quality requirements
- 2:15 Break (Refreshments Provided)**
- 3:30 Operation and economics (Cont'd)**
- Calculation of energy requirements and chemicals use
 - Capital and operating cost of membrane filtration and MBR systems
- 4:30 Summary, Discussion, & Day Four Evaluation**
- 5:00 End**