



European
Desalination Society



Genoa University
Department of Chemistry and
Industrial Chemistry

MEMBRANE TECHNOLOGY, PROCESS AND SYSTEM DESIGN

A 3-day intensive course

Lecturer Mark Wilf, Ph.D.

February 20–22, 2012, Genoa, Italy

The seminar topics include practical information about performance and operating conditions of reverse osmosis and nanofiltration technology for brackish and seawater desalting. The program includes introduction to membrane technology, description of commercial membrane elements, illustration of the membrane system design process and overview of systems operation. Calculations of the investment and operating cost of membrane plants, based on design cases will be illustrated. A section of the seminar is dedicated to the modern microfiltration and ultrafiltration technology applied for treatment of potable water and as a pretreatment of feed water for RO systems. Course material also includes information on process and equipment applied in membrane bioreactor (MBR) systems. An overview of commercial MF and UF membrane products will be provided. It will be followed by a description of the implementation process in large membrane treatment plants. The seminar is structured in the form of three seven hour a day sessions of frontal presentation combined with hands-on exercises of calculations of operating parameters and evaluation of process economics. It is expected that knowledge gained during the seminar will enable participants to conduct critical evaluation of feasibility and design parameters of water development projects based on membrane technology and estimation of capital and operating cost. The seminar is directed toward professionals who are familiar with membrane technology, with the objective of providing practical information on commercial products, the design process, operation conditions of membrane systems and economics of the membrane desalting and water treatment applications.



Venue *Hotel Mediterranee*

Via Lungomare 69, 16155 Genoa Pegli, Italy
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The courses will be held in an 18th century building with sea-front accommodation on the picturesque Italian Riviera, just 3 km from C. Colombo Airport and 1 km from the motorway tollgate.



Located in Pegli, near the historical town of Genoa, this former residence of the Lomellini family is sheltered from the winds, enjoying a mild climate in winter and temperate in summer.

The beach is nearby and there is a frequent bus service to the centre of Genoa. There is a nearby port and railway station for making a day trip to the beautiful areas of Portofino and Rapallo.

Lecturer

Dr. Mark Wilf, Director of Membrane Technology for engineering firm — Tetra Tech, California, has planned and will deliver the course. Recognized as a global expert for commercial membrane applications, Dr. Wilf provides technical 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 and micro-filtration technologies applied for water desalination, potable water treatment, and industrial and municipal wastewater reclamation. Dr. Wilf is active in reviewing research projects and publications being a member of the Editorial Board of the *Desalination Journal*, Advisory Expert to the Middle East Desalination Research Center and peer reviewer to a number of journals on water treatment. Dr. Wilf is regular contributor to professional journals, holds number of patents, wrote chapters on membrane technology to a number of books and recently completed the second guidebook on application of membrane technology to wastewater reclamation (www.desline.com).

PROGRAM

Day 1 Commercial membranes and water chemistry

09:00 Commercial membranes and membrane module configurations

Concept of semipermeable membranes for water – salt separation
Configuration of asymmetric and composite membranes
Membrane types: microfiltration, ultrafiltration, softening, brackish, seawater
Special membrane materials: highly charged, low fouling, selective permeability
Membrane elements configuration: spiral wound and hollow fibers
Membrane elements manufacturing process
Nominal performance and nominal test conditions

Membrane performance

Effect of feed water composition and process parameters on membrane performance
Translation of nominal test data to element performance in field conditions
Effect of feed water composition and process parameters on membrane and system operation

10:45 Coffee break

11:00 Water chemistry of the desalination process

Feed water types and representative water composition
Analytical data required for the desalination process design
Chemicals used in the pretreatment process
The carbonate system, alkalinity calculations
Calcium carbonate saturation indicators, methods of calculation. Saturation limits of other sparingly soluble salts. Scale inhibitors.

Pretreatment process alternatives

Feed water sources and feed water delivery alternatives
Feed water quality indicators
Pretreatment system configurations
 Brackish desalination systems
 Seawater desalination systems
 Conventional pretreatment
 Membrane pretreatment

13:00 Lunch

14:00 Pretreatment process alternatives (cont.)

Components of conventional pretreatment systems
Coagulation and flocculation
Media filtration
 Dissolved Air flotation
 Chemicals dosing systems
Sizing of conventional filtration systems
Operation of conventional pretreatment system
Determination of operating parameters and usage of chemicals

16:00 Summary and discussion

Day 2 Feed water pretreatment and energy usage

09:00 Membrane filtration technology

- Fundamentals of membrane filtration technology
- Membranes and membrane modules configuration
- Membrane filtration system configurations
- Sizing membrane filtration systems
- Operation of membrane filtration systems
- Membrane filtration applied to wastewater reclamation
- Membrane filtration applied to seawater desalination
- Determination of operating parameters and usage of chemicals
- Comparison of conventional and membrane pretreatment

10:45 Coffee break

11:00 Fundamentals of commercial membrane bioreactor technology

- Membranes, membrane modules and nominal performance
- MBR systems components and configurations
- Layout of MBR systems
- Sizing of MBR systems
- Operating cost components in MBR systems
- Procedures for recovery of membrane productivity
- Effluent quality requirements
- Outline of control strategy of the MBR system
- Integration of RO units with MBR systems
- Example of design of MBR + RO plant
- Determination of MBR unit configuration
- Projection of operating parameters and performance of MBR unit

13:00 Lunch

14:00 Energy usage in desalination systems

- Components of energy use
- Configuration of pumping systems including energy recovery devices
- Calculation of energy use and energy optimization

Computer projections of RO system performance

- Methods of RO membranes performance calculations
- Algorithm of computer program for performance projection
- Features of commercial computer programs
- Examples of determination of process parameters and performance calculations
- Optimization of system performance utilizing computer calculations

16:00 Summary and discussion

Day 3 Desalination system design

09:00 Introduction to desalination system design

- Project specifications
- Process development
- Calculation of membrane performance
- Process and instrumentation diagram
- Bill of materials
- Major equipment components
- System layout

10:45 Coffee break

11:00 Boron reduction and post treatment processes

- Boron reduction alternatives
 - Adjustment of feed water pH
 - Two pass systems
 - Ion exchange

Post treatment

- Chemistry of post treatment process
- Stabilization of RO permeate
 - Reduction of CO₂
 - pH adjustment
 - Increase of hardness and alkalinity
- Disinfection

13:00 Lunch

14:00 Normalization of membrane performance

- Recording of operational data
- System and membrane performance normalization.
- Determination of performance trends

Membrane fouling and performance recovery

- Type of membrane fouling processes
- Indicators of fouling conditions
- Elements examination and identification of composition of fouling layer
- Procedures for membrane cleaning and cleaning solution compositions

16:00 Summary and discussion

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REGISTRATION FORM

Surname _____ Name _____

Address _____

Country _____ Telephone _____

Fax _____ Email _____

Registration fee:

- EDS members **€2,500**
 Non-members **€2,700**

The fee includes 4 nights accommodation, lunches, coffee, dinners, course Workbook and CD, and *Guidebook on Membrane Desalination Technology* by Mark Wilf with chapters by Leon Awerbuch, Craig Bartels, Mike Mickley, Graeme Pearce and Nikolay Voutchkov.

Payment can be made by:

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