Desalination Directory Online By Miriam Balaban

RO Technology

European Desalination Society

MEMBRANE TECHNOLOGY, PROCESS AND SYSTEM DESIGN

Online intensive course

April 11–12 and April 15–18, 2024

Lecture hours 7–10 am PST (California) 4–7 pm (CET)

Lecturer Mark Wilf, Ph.D.

The course aims to deliver practical information on the development of treatment process of membrane filtration and RO desalination systems, evaluation of process economics, membrane systems design, operation and maintenance. The course is for engineers and water treatment professionals involved with process development and design and operation of membrane plants and water professionals, who evaluate feasibility and economics of future water treatment projects.

Topics include practical information about performance and operating conditions of reverse osmosis and nanofiltration technology for brackish and seawater desalination and wastewater reclamation.

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 illustrated).
- Modern microfiltration and ultrafiltration technology applied for treatment of potable water and as a pretreatment of feed water for RO systems.

An overview of commercial MF and UF membrane products will be provided together with information on equipment sizing and estimation of chemicals usage followed by a description of the project implementation process in large membrane treatment plants. Course material also includes introductory information on process and equipment applied in membrane bioreactor (MBR) systems.

The course is structured in the form of six, three hour daily sessions, conducted over a period of ten days of live, online presentation combined with hands-on exercises of calculations of membrane plant operating parameters and evaluation of process economics.

Knowledge gained during the course will enable participants to conduct critical evaluation of feasibility and design parameters of water treatment and wastewater reclamation projects based on membrane technology and estimation of capital and operating cost of membrane systems.

It will be possible to interact with Dr. Wilf with questions and discussions.

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DESAL+ LIVING LAB

Lecturer

Dr. Wilf has been involved in process development, system design, project execution, plant operation and maintenance of large, commercial desalination and wastewater reclamation plants in US, Europe and Middle East since 1977. Dr. Wilf has been involved in development of new desalination process and optimization of membrane technologies. Some of his inventions have resulted in patent applications and are being used in commercial desalination systems. Dr. Wilf is a regular contributor to professional journals, wrote chapters on membrane technology processes and applications to a number of books. He edited and wrote with other coauthors *The Guidebook to Membrane Desalination Technology* that has been published in 2006. The second book on membrane technology that he edited and contributed, *The Guidebook to Membrane Technology for Wastewater Reclamation*, has been published in 2010. Dr. Wilf regularly presents and teaches desalination and membrane technology subjects to engineers and water professionals. His teaching activity includes teaching course on membrane technology and desalination for European Desalination Society, and other courses for industrial companies and engineering organizations.

OUTLINE OF THE COURSE ON MEMBRANE TECHNOLOGY

Module 1

Fundamentals of membrane desalination processes

RO process terms
Concept of semipermeable membranes for water – salt separation
Configuration of asymmetric and composite membranes
Membrane types: microfiltration, ultrafiltration, softening, brackish, seawater
Membrane elements configuration: spiral wound and hollow fibers
Membrane elements manufacturing process
Nominal performance and nominal test conditions
Water transport and salt transport

Membrane performance

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

Module 2

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

Post treatment

Chemistry of post treatment process
Stabilization of permeate in brackish water RO
Stabilization of permeate in seawater RO

Configuration of commercial desalination plants

Large desalination plant
Containerized desalination unit

Selective rejection of nanofiltration membranes

Treatment of low salinity water for organics reduction
Reduction of sulfate concentration in sweater for oil fields injection

Module 3

Feed water supply sources

- Brackish wells
- Seawater beach wells
- Seawater intakes
- Municipal effluent
- Feed water quality indicators

Pretreatment process configuration

- Pretreatment system configurations
- Brackish desalination systems
- Seawater desalination systems
  - Conventional pretreatment
  - Membrane pretreatment

Pretreatment process design

- Components of conventional pretreatment systems
  - Coagulation and flocculation
  - Medial 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

RO system configuration

- RO unit configuration: single stage and multistage concentrate processing, two pass permeate treatment configuration

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

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

Advanced process design

- "Split Partial" two pass permeate processing
- Hybrid system configurations

Module 4

Pumping and energy recovery equipment

- RO plant hydraulic profile
- Pumps types in RO applications
- Energy recovery devices in RO applications
- Alternative configurations of feed water pumping in RO systems
- Components of energy usage in RO process
- Optimization of energy usage in RO process

Control system in RO process

- Configuration of the control system
- Gauges, sensors and transmitters
- Control of RO system operation

Application of membrane technology to wastewater reclamation

Overview of treatment of municipal wastewater
Range of compositions of the secondary effluent
Configuration of advanced wastewater reclamation systems
Design parameters of wastewater reclamation process
Sizing of major equipment and system design

Membrane fouling and performance recovery

Membrane fouling phenomena
Symptoms of membrane fouling
Membrane elements performance testing and examination procedures
Membrane cleaning procedures
Optimization of performance recovery through membranes cleaning

Engineering procedures of system design

Process flow diagram (PFD)
Process and instrumentation diagram (P&ID)
System layout
Mechanical drawings

Module 5

Pilot unit configurations and operation

Objectives of pilot unit testing program
Alternative configuration of pilot units
Operation of pilot unit, data recording and evaluation of results

Economics of RO process

Components of system capital cost
Components of operating cost
Optimization of project economics for "Turnkey" and "Design Build Operate"
Project delivery methods

Membrane filtration technology

Fundamentals of membrane filtration technology
Membranes and membrane modules configuration
Pressure driven membrane filtration technology
Vacuum driven membrane filtration technology
Ceramic membranes
Membrane filtration system configurations
Sizing membrane filtration systems
Membrane integrity testing

Module 6

Membrane filtration applications

Membrane filtration applied to potable water treatment
Membrane filtration applied to wastewater reclamation
Membrane filtration applied to seawater desalination
Determination of operating parameters and usage of chemicals
Membrane filtration cleaning procedures
Comparison of conventional and membrane pretreatment

Boron reduction alternatives

Adjustment of feed water pH
Two pass systems
Ion exchange

Introduction to MBR technology

Overview of conventional wastewater treatment process
Fundamentals of biological nutrients reduction process
Configuration of membrane bioreactors systems
MBR process parameters
Sizing of major equipment in MBR process

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REGISTRATION FORM

Surname _____ Name _____

Affiliation _____

Address _____

Country _____ Telephone _____

Email _____

Registration fee: €2,200

The fee includes access to lectures recording during the days the course is conducted, ability to ask questions every day during the duration of the course for ~30 minutes. Online copy of slides presentation in PDF format will be provided.

Payment can be made by:

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