



European
Desalination Society



Genoa University
Department of Chemistry and
Industrial Chemistry

ION-EXCHANGE MEMBRANE PROCESSES: THEIR PRINCIPLE AND PRACTICAL APPLICATIONS

A 3-day intensive course

Lecturer Prof. Heiner Strathmann

June 4–6, 2012, Genoa, Italy

The seminar is directed towards professionals and students with the objective of providing a comprehensive introduction to ion-exchange membrane processes and their practical applications.

During the second half of the last century ion-exchange membranes and their practical utilization in electromembrane processes have gained significant technical and commercial importance in water deionization and purification as well as in electrochemical synthesis and in energy conversion and energy storage. Certain processes such as electrodialysis are mature state-of-the-art techniques, while other processes such as capacitive electrodeionization and electrodialysis with bipolar membranes or the use of ion-exchange membranes in fuel cells and energy conversion are more recent developments which show a large number of interesting applications.

The literature covering ion-exchange processes and their applications is very fragmented and contained in a number of scientific journals or in a large number of patents. This makes it difficult to gain an overview of today's available ion-exchange membrane processes and their applications.

The objective of this seminar is to provide a comprehensive description of the fundamentals of ion-exchange membranes processes and their applications. The subject is covered in six chapters. First, a very general overview of relevant ion-exchange membrane processes is given. Then some electrochemical and thermodynamic fundamentals are discussed. The preparation and characterization of ion-exchange membranes is described next. This is followed by a discussion of the various processes as unit operations and the design of systems and equipment. Finally, present and possible future applications of ion-exchange membrane processes are treated and research needs are pointed out.

CONTENT OF THE SEMINAR

Introduction to Ion-Exchange Membrane Processes

- The structure of ion-exchange membranes
- Ion-exchange membranes in separation processes
- Ion-exchange membranes in electrochemical synthesis
- Ion-exchange membranes in energy conversion and generation

Electrochemical and Thermodynamic Fundamentals

- Basic electrochemical relations
- Basic thermodynamic relations
- Transport of ions in solutions and ion-exchange membranes
- Electrical current and ion fluxes
- The transport and transference numbers
- Membrane permselectivity and the Donnan exclusion
- Fluxes of none-ionic components through ion-exchange membranes

Preparation and Characterization of Ion-Exchange Membranes

- Preparation of homogeneous ion-exchanged membranes
- Preparation of heterogeneous ion-exchange membranes
- Preparation of special property ion-exchange membranes
- Determination of the mechanical properties of ion-exchange membranes
- Determination of the electrical properties of ion-exchange membranes
- Water transport in ion-exchange membranes

Operating Principle of Ion-Exchange Membrane Processes

- The principle of electrodialysis with mono and bipolar membranes
- The principle of chlorine-alkaline electrolysis
- The principle of diffusion and Donnan dialysis
- The principle of continuous electrodeionization
- The principle of capacitive electrodeionization
- The principle of polymer electrolyte fuel cell
- The principle of energy generation by reverse electrodialysis

Ion-Exchange Membrane Process and Equipment Design

- Design of electrodialysis processes and equipment
- Operational problems in electrodialysis
- Energy requirements process economics in electrodialysis
- Design of bipolar membrane electrodialysis process and equipment
- Operational problems in bipolar membrane electrodialysis
- Diffusion dialysis process and equipment design
- Operational problems and limitations in diffusion dialysis
- Continuous electrodeionization process and equipment design
- Capacitive electrodeionization process and equipment design
- Operational problems in practical applications of electrodeionization
- Reverse electrodialysis energy generation process design
- Polymer electrolyte fuel cell design

Applications of Ion-Exchange Membrane Separation Processes

- Practical application of electrodialysis
- Brackish water desalination by electrodialysis
- Production of industrial water by electrodialysis
- Food processing by electrodialysis
- Pre-concentration of salts by electrodialysis
- Practical applications of bipolar membrane electrodialysis
- Production of acids and bases by bipolar membrane electrodialysis
- Applications of bipolar membrane electrodialysis in biotechnology
- Practical applications of diffusion and Donnan dialysis
- Practical applications of continuous electrodeionization
- Practical applications of capacitive electrodeionization

Recent Developments and Research Needs in Ion-Exchange Membrane Processes

- Development of better ion-exchange membranes
- Improvements of equipment and process design

Venue *Hotel Mediterranee*

Via Lungomare 69, 16155 Genoa Pegli, Italy
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The course 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.

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June 4–6, 2012

REGISTRATION FORM

Surname _____ Name _____

Address _____

Country _____ Telephone _____

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Registration fee:

- | | | |
|--------------------------|-------------|---------------|
| <input type="checkbox"/> | EDS members | €2,150 |
| <input type="checkbox"/> | Non-members | €2,350 |

The fee includes 4 nights accommodation, lunches, coffee, dinners and course materials.

Payment can be made by:

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