Course Syllabus

Nanofiltration and Reverse Osmosis in Water Treatment

Introduction

This course will introduce you to the fascinating world of membrane technology in drinking water production and industrial water treatment. The emphasis of the course is on spiral wound reverse osmosis, which is the most commonly applied membrane configuration.

During the course, you will learn theoretical background (e.g. of mass balances, rejection, and concentration polarization) and you will have the chance to engage in practical applications such as designing a reverse osmosis installation with the use of commercial computer programs. In addition to this, there are several virtual excursions planned to make you familiar with functioning reverse osmosis installations.

We expect the learner to have basic knowledge of chemistry, math and physics (Pre-university education level) when entering the course.

Course overview

The course is divided in 7 sections (the weekly units/modules) and subsections (the topics with the learning activities and content). Each subsection consists of several units (pages) with tasks to complete and educational resources to study. We might also refer to a subsection as a learning sequence, since it is created based on pedagogical principles in order to enhance your knowledge of the topic(s). Each learning sequence starts with an introduction, after that comes the content (videos) and the learning activities (quizzes). Followed by the practice problems and the graded assignment. Every module has a forum to post questions and discuss about nanofiltration technologies.

Learning objectives

After taking this course, you will be able to:
- Recognize and classify different types of membrane
- Calculate the mass balances, recovery, rejection, pressure and water quality in RO installations
- Describe the rejection of ions and organic compounds in the membrane system
- Explain the advantages and disadvantages of the application of RO
- Explain different application of the RO membranes (seawater, brackish water and freshwater)
- Explain different water flows and their routing in a membrane module
- Describe an RO treatment plant and explain the particulate and biological fouling in the membrane
- Explain the concentration polarization mechanism and scaling problem
- Calculate the requirements of an RO unit and design a treatment plant (seawater, brackish and freshwater)

What we expect from you

As an online student we expect you to be an active participant in this course, contributing to a positive atmosphere by questioning, sharing and helping out others, engaging in meaningful discussions where knowledge construction is revealed. Regarding the deadlines, we expect you to keep on track in order to benefit from learning within a community.

What you can expect from us/the course team

The course team will guide you throughout the course, launching the weekly content, promoting and engaging in discussions, and providing feedback regarding your performance after each week. Guidance and support will happen on a regular basis by the course team.

Course structure

The course is organized in 7 modules.

Getting started

In the getting started section you'll get to know the course structure, get familiarized with the virtual learning environment, complete your profile, meet your fellow students and the e-moderator. These introductory tasks should be completed in the beginning of the course, after your first login.

Module 1: Introduction to Reverse Osmosis

This modules introduces you to the basic concepts of membrane technology including advantages and disadvantages, classification, importance and difficulties in application. Basic calculations related to RO membranes such as mass balance, recovery, rejection and permeate quality. The module consists of 4 videos and 4 quizzes, 1 practice problem and 1 graded assignment.

Module 2: Seawater Reverse Osmosis

In this module we will discuss the different types of desalination techniques, with a focus on reverse osmosis and its characteristics. We will explain the importance of energy recovery and we will differentiate between the types of energy recovery devices. In a practical example of a seawater desalination unit you will be shown around a Marine ship in a virtual excursion. The module consists of 3 videos and 3 quizzes, 1 practice problem and 1 graded assignment.

Module 3: Brackish Water

In this module we will discuss the particularities of brackish water and the influence it has on the choice of treatment scheme. We will analyze the differences between brackish water and seawater desalination. We will also elaborate on the challenge of brackish water concentrate disposal and on the existing handling technologies. A practical example of a brackish water reverse osmosis unit will be shown to you during a virtual excursion. The module consists of 3 videos and 3 quizzes and 1 graded assignment.

Module 4: Scaling and pretreatment

What is concentration polarization? Which pre-treatment is needed before RO? The module consists of 4 videos and 4 quizzes, 1 practice problem and 1 graded assignment.

Module 5: Application of RO on freshwater and industrial water

Removal of micro pollutants and pathogens with RO. The importance of the application of RO in the production of water for industry. The module consists of 3 videos and 3 quizzes and 1 graded assignment.

Module 6: Biofouling and configuration of Spiral Wound Membranes for RO

Examines the biofouling mechanism and its relation to the configuration of spiral wound modules. The module consists of 4 videos and 4 quizzes, 1 practice problem and 1 graded assignment.

Module 7: Concentrate, Permeate and Modeling of an RO installation

Making potable water from RO-permeate. Environmental issues related to the application of RO. Designing an RO unit using a commercial computer program. The module consists of 3 videos and 3 quizzes and 1 graded assignment.

Assessment

The course consists of 7 graded module assignments, all assignments are mandatory. In order to successfully complete the course you will need to finish all the assignments with a score of at least 60% in total. In case you miss one assignment, your total score needs to be at least 80% in total. Missing more than one assignment is not allowed. Assessment criteria for the assignments is detailed in the course. A new module opens every week on Wednesday and the deadline for the graded assignment is two weeks later.

Resources & Tools

All educational resources will be available in the course (including software). They consist of short videos and readings to support you in the completion of the weekly learning activities. The course material is copyright protected, due to agreements with other companies. All course material is made available for you as a student of Delft University of Technology and is to be used for this course only. It is not allowed to reuse, remix, revise, or redistribute this article without the permission of the publishers.