

CUYAMACA COLLEGE
COURSE OUTLINE OF RECORD

CENTER FOR WATER STUDIES 268 – MEMBRANE PLANT OPERATION

3 hours lecture, 3 units

Catalog Description

Study of basic membrane technology and the application of this technology to water and wastewater treatment. This course explores the operation and maintenance of membrane components within a water and wastewater treatment system, as well as pre and post treatment considerations.

Prerequisite

“C” grade or higher or “Pass” in CWS 112 or 114 or equivalent

Entrance Skills

Without the following skills, competencies and/or knowledge, students entering this course will be highly unlikely to succeed:

- 1) Describe the various methods, techniques, system components, and processes used in water or wastewater treatment.
- 2) Describe safety procedures commonly employed in the operation of water or wastewater treatment facilities.
- 3) Describe basic water quality parameters and demonstrate the tests for monitoring water quality.
- 4) Perform calculations for chemical dosages, detention time, volume, flow, filter loading, sedimentation, hydraulics, and organic loading.
- 5) Describe the various sources of water or wastewater and their characteristics and required treatment processes.

Course Content

- 1) Scope and objectives of course
 - a. Current water quality standards
 - b. Application of membrane technology in the water/wastewater treatment industry
 - c. Integration with conventional treatment technologies
- 2) Introduction to membrane processing
 - a. Water permeable membranes
 - b. Water impervious membranes
- 3) Membrane system pretreatment
 - a. Pretreatment chemicals
 - b. Pretreatment filtration
- 4) Pressure driven membranes
 - a. Basic principles
 - b. Applications
 - c. System construction
 - d. Operational considerations/troubleshooting
- 5) Vacuum driven membranes
 - a. Basic principles
 - b. Applications
 - c. System construction
 - d. Operational considerations/troubleshooting
- 6) Membrane Bioreactor Systems

- a. Basic principles
 - b. Applications
 - c. System construction
 - d. Operational considerations/troubleshooting
- 7) Water chemistry
- a. Importance of solubility to membrane operations
 - b. Scale formation
- 8) Chemical dosing
- a. Calculations
 - b. Water supply considerations
 - c. Chemical and physical water parameters for optimal system effectiveness
- 9) Post treatment
- a. Regulatory standards and treatment goals
 - b. Degasification
 - c. Chemical stabilization
 - d. Blending stabilization
- 10) Membrane cleaning
- a. When to clean
 - b. Types of cleaning agents
 - c. Monitoring cleaning cycle
- 11) Additional system considerations
- a. Data collection
 - b. Normalizing operating parameters
 - c. Instrumentation and control
 - d. Safety
 - e. Waste stream management

Course Objectives

Students will be able to:

- 1) Identify in detail the unique characteristics, advantages and disadvantages of each type of membrane treatment used in potable water applications.
- 2) Compare and contrast the construction and function of pressure driven, vacuum driven membranes and membrane bioreactor systems.
- 3) Demonstrate understanding of basic water chemistry principles and how these relate to the operation and maintenance of a membrane treatment system.
- 4) Explain the concept and importance of osmosis and permeability and the relationship of net driving pressure to membrane fouling, degradations, compaction, temperature and salinity.
- 5) Explain the common chemicals used at a membrane water treatment plant, both pre and post treatment, and their purpose to finished water quality and membrane operational life.
- 6) Perform basic mathematical calculations and conversions relating to chemical dosage and membrane operation.
- 7) Describe the basic equipment and instrumentation components typically used to monitor and control membrane system performance.

Method of Evaluation

A grading system will be established by the instructor and implemented uniformly. Grades will be based on demonstrated proficiency in subject matter determined by multiple measurements for evaluation, one of which must be essay exams, skills demonstration or, where appropriate, the symbol system.

- 1) Quizzes and exams that measure students' ability to:
 - a. Identify membranes by type and function; describe the appropriate application to the treatment of water and wastewater given a variety of source water quality considerations.
 - b. Analyze problems common to membrane treatment operation and suggest plans for utilizing materials, methods and procedures common to the industry to address problems.

- c. Calculate water flow, pressure, velocity, chemical dosage in relation to membrane treatment systems.
- 2) Exercises that demonstrate students' ability to calculate water flow, pressure, velocity, and chemical dosage in relation to membrane treatment systems.
- 3) Projects, writing assignments, and exams/quizzes which measure students' ability to describe the essential operational parameters of membranes in water and wastewater treatment applications, and describe the problems/constraints of being outside these parameters.
- 4) Projects, writing assignments, and exams/quizzes which measure students' ability to identify how pre and post treatment chemical dosing affects finished water quality and membrane operational life.
- 5) Projects and assignments utilizing the Field Operations Skills Yard

Special Materials Required of Student

None

Minimum Instructional Facilities

Smart classroom

Method of Instruction

- 1) Lecture and discussion
- 2) Multimedia presentations
- 3) Field trips
- 4) Demonstrations utilizing the Field Operations Skills Yard

Out-of-Class Assignments

- 1) Reading assignments
- 2) Writing assignments

Texts and References

- 1) Required (representative example): *Handbook for Membrane Plant Operators Training, Modules 1 and 2*, Southeast Desalting Association, eighth edition, 2017.
- 2) Supplemental: American Water Works Association INTEGRATION OF MEMBRANE FILTRATION INTO WATER TREATMENT SYSTEMS ISBN: 9781583214428, 2006.

Student Learning Outcomes

Upon successful completion of this course, students will be able to:

- 1) Describe the different types of membranes used in potable water treatment plants and explain the basic function of each.
- 2) Explain why different physical and chemical characteristics of water affect membrane function and finished water quality.
- 3) Explain the purpose of pre and post treatment chemicals and demonstrate the ability to perform related mathematical calculations and conversions.
- 4) Describe the equipment and control processes commonly utilized in membrane treatment plants.