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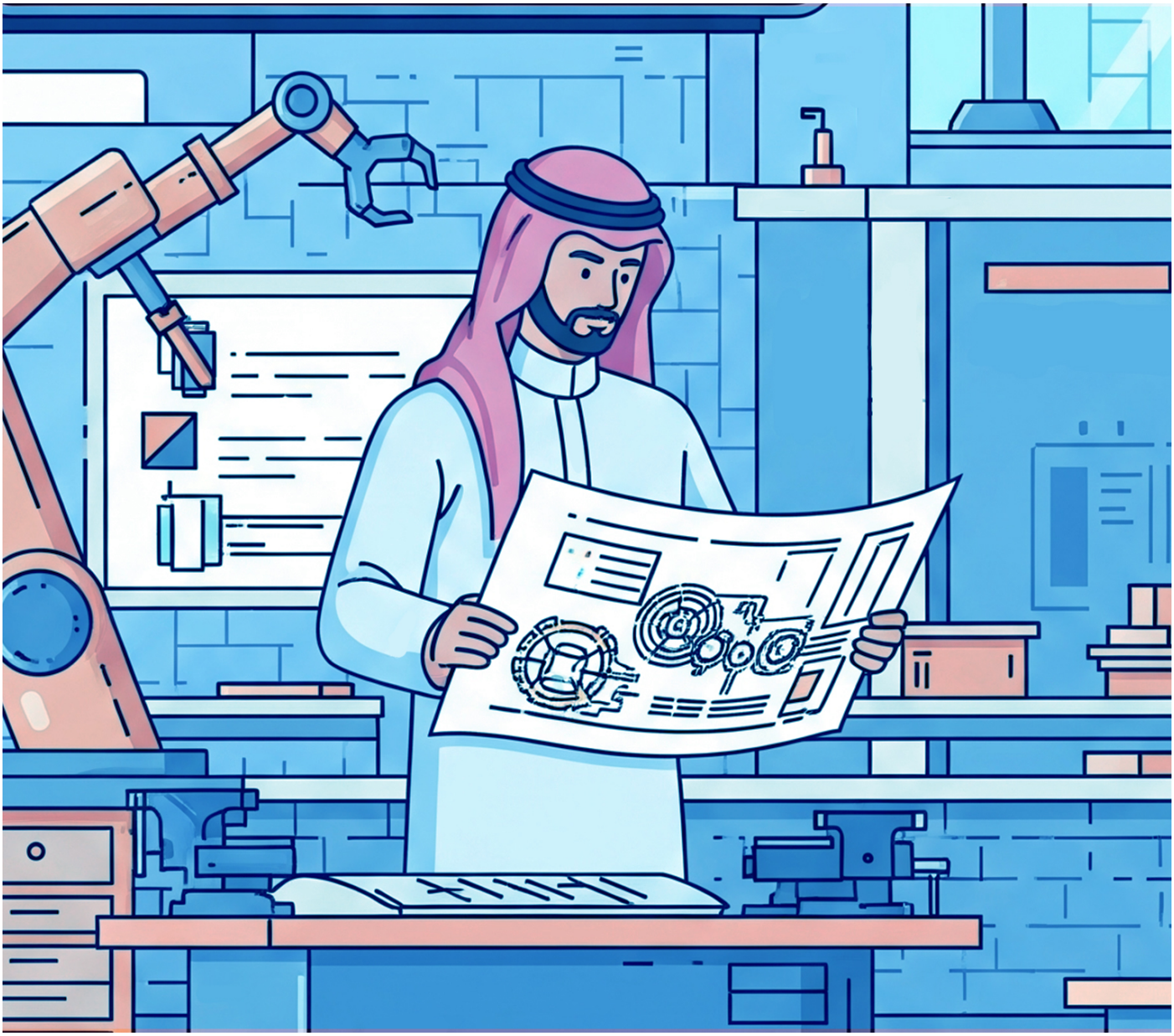

Mechanical Engineering

Modelling Reverse Osmosis (RO) Process Performance Techniques

Course Introduction

Reverse Osmosis (RO) is a Water Purification Technology whereby applied water pressure pushes water through a semipermeable membrane, removing many types of molecules and ions; this Membrane Technology is not a Filtration Method. In Reverse Osmosis, the applied pressure overcomes osmotic pressure, a colligative property, that is driven by Chemical Potential, a thermodynamic parameter.

Reverse osmosis is used in both Industrial Processes and producing potable water by retaining solute on the membrane's pressurized side and pure solvent to the unpressurized side. Membrane Processes such as reverse osmosis (RO) and Nano-Filtration (NF) are playing an increasingly important role around the world, and Canada is no exception.

Dealkalization, and demineralization

The installed RO capacity in Canada has more than doubled in the last five years alone. If you do not already operate such a system now, it is likely you will in the not-too-distant future. Membrane Technologies are now found across a wide number of industries and applications. Cost efficiencies versus more traditional ion-exchange processes (e.g. zeolite softening, dealkalization, and demineralization) and environmental benefits are the main drivers of change to this revolutionary technology. This course will help you determine whether replacing your current ion-exchange (e.g. zeolite softener) will cut your overall industrial water treatment costs. How RO can often assist your employer meet stricter environment legislation. It will help you understand the importance of well-designed and operated pre-treatment systems upstream of your RO plant to increase overall plant reliability and lower operating costs.

Target Audience

- Automotive Engineer
- Boiler Engineer
- Ceramics Engineer
- Equipment Engineer
- High-Pressure Engineer

- Marine Engineer
- Mechanical Design Engineer
- Mechanical Engineer
- Naval Architect
- Pipeline Engineer
- Power Engineer
- Rotating Equipment Engineer
- Senior Mechanical Engineer
- Turbine Engineer
- Validation Engineer

Learning Objectives

- Determine whether replacing your current ion exchange (e.g. zeolite softener) will cut your overall water treatment costs.
- Assist your employer in meeting stricter Environment Legislation and Quality Rules.
- Understand the importance of well-designed and operated Pre-treatment systems upstream of your RO plant to increase overall plant reliability and lower operating costs.
- Monitor key performance indicators and avoid data clutter.
- Predict fouling conditions before they bring down your plant or downstream process, costing you production losses and costly membrane replacements.
- Troubleshoot RO systems and associated pre-treatment determine what constitutes a successful chemical-cleaning regimen to maximize membrane life.
- Getting deep through notes regarding important points in the chemical analysis involved in the water treatment and also the instrumentation used in this trend.

Course Outline

- **01 DAY ONE**

  Module (01) Introduction to Reverse Osmosis

- 1.1 Reverse Osmosis Theory
- 1.2 RO Governing Equations
- 1.3 RO Performance Parameters
- 1.4 Cross Flow Membrane
- 1.5 Membrane Separations
- 1.6 Membrane Process Unit Operation
- 1.7 Water Source and Chemistry

Module (02) Pre-Treatment Process

- 2.1 Pre-Treatment to minimize Problems
- 2.2 Minimize Scaling
- (Softening, Acid Injection, Scale Inhibitor Injection)
- 2.3 Minimize Fouling
- (Clarification, Media, Cartridge, Micro Filtration)
- 2.4 Minimize Chemical Attack
- Activated Carbon, Sulphite Injection, Ultraviolet)
- 2.5 Seawater Pre-treatment
- (Conventional, Advanced)

• **02 DAY TWO**

Module (03) Literature Survey of RO Simulation

- 3.1 Concentration Polarization
- 3.2 Irreversible Thermodynamics Models.
- 3.3 Nonporous or homogeneous Membrane Models
- 3.4 Pore models
- 3.5 Other RO Membrane Transport Models
- 3.6 Artificial Neural Network (ANN)-based models

Module (04) Water Analysis for RO

- 4.1 Chloride, Hardness, Alkalinity, Acidity

- 4.2 Using Excel in Chemical Analysis
- 4.3 Langlier Saturation Index (LSI)
- 4.4 Ryznar Saturation Index (RSI)

- **03 DAY THREE**

Module (05) Membrane Modules

- 5.1 Plate and Frame Module
- 5.2 Tubular Module
- 5.3 Hollow Fibre Module
- 5.4 Spiral Wound

Module Module (06) Condition Monitoring

- 6.1 Need for Data Normalization
- 6.2 Data Collection & Log Sheet
- 6.3 Monitoring Parameters
- 6.4 How to normalize operating data?
- 6.5 Daily Monitoring 6.6 Weekly Trending

- **04 DAY FOUR**

Module (07) Fouling

- 7.1 Colloidal Fouling
- 7.2 Biological Fouling
- 7.3 Scaling
- 7.4 Silica
- 7.5 Organic Fouling
- 7.6 Fouling Control

Module (08) Membrane Cleaning

- 8.1 Cleaning Method Selection

- 8.2 Generic versus proprietary cleaning solutions
- 8.3 Cleaning Biological Fouling
- 8.4 Cleaning Iron Fouling
- 8.5 Cleaning Silt Fouling
- 8.6 Cleaning Carbon Fouling
- 8.7 Chemical Attack
- 8.8 Permeate Backpressure
- 8.9 Cleaning Process

• **05 DAY FIVE**

Module (09) Performance Monitoring of RO Plant

- 9.1 Performance and Efficiency
- 9.2 Performance Monitoring Techniques
- 9.3 RO Plant History and Forecasting

Module (10) Troubleshooting of RO Plant

- 10.1 Why we keep Records?
- 10.2 General Rules of Operations
- 10.3 Routine Inspection
- 10.4 Profiling and Probing RO Banks
- 10.5 Troubleshooting Matrix

Confirmed Sessions

FROM	TO	DURATION	FEES	LOCATION
June 23, 2025	June 27, 2025	5 days	2150.00 $	Virtual - Online
Sept. 28, 2025	Oct. 2, 2025	5 days	4250.00 $	KSA - Riyadh

FROM	TO	DURATION	FEES	LOCATION
Dec. 22, 2025	Dec. 26, 2025	5 days	5950.00 $	USA - Texas