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# Seawater Desalination Education Week 2017



**27-30 November 2017**  
**Hong Kong**

**Instructor: Nikolay Voutchkov**



## **Course List**

**Pretreatment for Seawater  
Reverse Osmosis Desalination Plants**  
27-28 November 2017, Hong Kong

**Cost Modeling of Seawater  
Reverse Osmosis Desalination Projects**  
29-30 November 2017, Hong Kong

# Pretreatment for Seawater Reverse Osmosis Desalination Plants

**27 - 28 November 2017, Hong Kong**

This training program provides practical understanding of key pretreatment processes widely used in reverse osmosis (RO) desalination plants worldwide and focuses on selection, operation, maintenance, monitoring, troubleshooting and optimization of conventional and membrane pretreatment technologies.

## Reverse Osmosis and Pretreatment Process Fundamentals

- Pretreatment and Desalination Process Overview
- Chemical Conditioning of Source Water
- Sedimentation and Dissolved Air Flotation
- Granular Media Pressure Filtration
- UF and MF Membrane Filtration
- Cartridge Filtration

## Source Water Quality Characterization

- Source Water Quality Factors
- Suspended Solids/Turbidity/SDI
- Type of Membrane Foulants
- Particulate Fouling – TSS, Turbidity and SDI
- Colloidal Fouling – THC, Fe, Mn
- Fouling from Natural Organic Matter (NOM)
- Biofouling
- Understanding the Process of Membrane Biofouling
- Algal Blooms and Biofouling
- Membrane Mineral Scaling
- Chemicals with Destructive Impact on RO Membranes

## Source Water Screening

- Bar, Band and Drum Screens
- Microscreens
- Operation and Maintenance Considerations

## Source Water Conditioning

- Pre-chlorination and Use of Biocides
- Coagulation and Flocculation
- Flocculation
- Type of Flocculation Chemicals and Feed Systems
- Scale Inhibitors
- Chemicals for Enhanced Boron Removal

## Sedimentation and Dissolved Air Flotation

- Sedimentation Tanks
  - Function, Types and Configurations
  - Operation and Maintenance Considerations
- Dissolved Air Flotation Clarifiers
  - Function, Types and Configurations
  - Key Performance Parameters
  - Examples of Existing DAF Systems – Operation
  - Challenges and Solutions

## Granular Media Pretreatment Filters - Overview

- Filter Types and Configurations
- Filters Combined with DAF Clarifiers - O & M Considerations
- Gravity and Pressure Filters – Key Advantages and Disadvantages
- Handling of Spent Filter Backwash

## Granular Media Filters - Performance Monitoring

- Key Performance Parameters
- Removal of Solids/Silt
- Removal of Organics and Microorganisms
- Routine Operations Tasks
- Performance Monitoring and Control

## Case Studies of Full-scale SWRO Plant Pretreatment

- Fujairah SWRO Plant Pretreatment System, UAE
- Al Dur SWRO Plant, Bahrain

## Membrane Pretreatment Filters - Overview

- Filter Types and Configurations
- Filter Vessels and Modules – Materials and Configurations
- Membrane Filtration Media – Key Performance Parameters
- Comparison of Pressurized and Submerged Systems

## Membrane Pretreatment Filters - Performance Monitoring

- Key Performance Parameters
- Removal of Solids/Silt
- Removal of Organics and Microorganisms
- Source Water Pretreatment Prior to Membrane Filtration
- Examples of Full-scale Membrane Pretreatment Systems

## Comparison of Granular Media and Membrane Pretreatment

- Effect of Source Water Quality on Performance
- Surface Area Requirements
- Quantity and Quality of Generated Residuals
- Chemical and Power Use
- Filtration Media Replacement Costs
- Commoditization;
- Water Production Costs;
- Guidelines for Selecting Pretreatment System

## Optimization of Chemical Use for Pretreatment

- Minimizing Use of Intake Chlorination
- Use of Ferric Sulfate vs. Ferric Chloride
- Application of Other Source Water Conditioning Chemicals
- Biofouling Management
- Reduction of Antiscalant Use

## Troubleshooting and Optimization of DAF Systems

- Potential Challenges
- Troubleshooting Practices

## Troubleshooting and Optimization of Pretreatment Filters

- Cartridge Filters
- Gravity Media Filters
- Membrane Pretreatment Filters

# Cost Modeling of Seawater Reverse Osmosis Desalination Projects

**29 - 30 November 2017, Hong Kong**

This training course presents methodology and excel-spreadsheet based models for preparation of cost estimates for medium and large-size seawater reverse osmosis (SWRO) desalination projects. The cost modeling encompasses plant construction expenditures; annual operation and maintenance (O&M) costs; and overall fresh water production costs. The course provides practical understanding of key technical and economic factors such as source water quality, desired product water quality, plant size, funding mechanism, method of project delivery, energy, labor, chemicals, materials and consumables which determine the site specific capital and O&M costs for a given desalination project. The three-day training course includes one-day of interactive hands-on session in which participants will have the opportunity to learn how to use an excel spreadsheet-based cost estimating model and will have the opportunity to apply this model for a specific SWRO desalination project case study.

## Project Cost Estimating – Overview

- Project Cost Definitions
- General Methodology for Preparation of Project Cost Estimates
- Type and Accuracy of Project Cost Estimates
- Cost Models

## Project Cost Factors

- Introduction
- Factors Impacting Project Costs within the Control of Project Owner
  - Project Size
  - Capacity Availability Factor
  - Source Water Quality
  - Target Product Water Quality
  - Concentrate Disposal Method
  - Power Supply and Unit Power Costs
  - Project Risk Profile
  - Other Project Cost Factors
- Project Cost Factors Outside of the Control of Project Owner

## Estimating Direct Capital (Construction) Costs

- Plant-site Related Construction Costs
- Intake Costs
- Pretreatment Facility Construction Costs
- SWRO System Equipment Costs
- Post-treatment Costs
- Concentrate Disposal Costs
- Waste and Solids Handling Costs
- Costs of Electrical and Instrumentation Systems
- Costs of Auxiliary and Service Equipment and Utilities
- Building Costs
- Startup, Commissioning and Acceptance Testing Costs

## Estimating Indirect and Total Capital Costs

- Costs for Project Engineering Services
  - Preliminary Engineering
  - Pilot Testing
  - Detailed Design
  - Construction Management and Oversight
- Project Development Costs
  - Project Administration, Contracting and Management
  - Environmental Permitting
  - Legal Services

- Project Financing Costs
  - Government Financing
  - Conventional (Bond or Construction Loan) Financing
  - Private Project Financing
  - Interest During Construction
  - Debt Service Reserve
  - Other Financing Costs
- Contingency

## Variable O&M Costs

- Power
- Chemicals
- Replacement of Membranes and Cartridge Filters
- Waste Stream Disposal

## RO Fixed O&M Costs

- Labor
- Maintenance
- Environmental and Performance Monitoring
- Indirect O&M Costs

## Cost of Water Production

- Fixed Cost Components
  - Capital Cost Recovery
  - Other Fixed Costs
- Variable Cost Components
- Total Cost of Water Production

## Desalination Cost Trends

- Overview Recent SWRO Desalination Projects and Their Cost Breakdown
- High-End Cost Projects – Key Factors Contributing to Their High Costs
- Low-End Cost Projects – Key Factors Resulting in Their Low Costs
- Impact of Project Delivery Method of Costs
  - Design-Bid-Build (DBB) Projects
  - Design-Build-Operate (DBO) Projects
  - Build-Own-Operate-Transfer (BOOT) Projects

## Example of SWRO Project Cost Estimate

- Project Description
- Breakdown of Project Capital Costs
- Annual O&M Costs
- Cost of Water Estimate

### Introduction to Excel Cost-Estimating Spreadsheet

- Master Data Input Form – Parameters and Use
- Advanced Input Form
- Capital Cost Output
- O&M Cost Output

### Project Case Study Demonstrating the Use of the Cost Model

- Overview of Project Input Data
- Definition of Baseline and Worst-Case Scenarios Used for Cost Estimating
- Review of Cost Model Outputs for Baseline and Worst-case Scenarios

- Demonstration of Cost Impacts of Various Project Factors
- Division of Project Participants into Five 7-People Work Teams and Assignment of Individual Project Case Study to Each Team

### Development of Project Cost Estimates by the Work Teams

- Work of Seven Individual Teams on their Project Cost Assignments

### Presentations of Cost Estimates Developed by the Work Teams

- Each of Five Work Teams Gives 15-minute Presentation of their Cost Estimate

**Instructor: Mr. Nikolay Voutchkov, PE, BCEE, President, Water Globe Consultants, LLC**



**Mr. Voutchkov** has over 25 years of experience in the field of seawater desalination, and water and wastewater treatment. He is an independent technical advisor and a former chief technology officer for Poseidon Resources Corporation – a private company specialized in development, financing and implementation of water and wastewater projects in the USA and worldwide. Mr. Voutchkov has published over 40 technical articles and co-authored 11 books in the field of desalination, water and wastewater treatment, and reuse. He is one of the principal authors of the American Water Works Association's Manual of Water Supply Practices (AWWA M46) on Reverse Osmosis and Nanofiltration, the Australia Guidelines for Pretreatment for Seawater Desalination Plants and of the World Health Organization Guidance for the Health and Environmental Aspects Applicable to Desalination. At present, Mr. Voutchkov is a member of the Faculty of the IDA Desalination Academy and a lecturer of the Heriot-Watts University teaching Master of Science Class on Water Technology and Desalination.

### Registration Fee/Person

Course Code	Course Name	Register before 30 Sept'17	Register after 30 Sept'17
UTI-17-06	Seawater Desalination Pretreatment	850 US\$	950 US\$
UTI-17-07	Cost Modelling-Desalination	850 US\$	950 US\$

#### Remarks:

- The registration fee includes training documentation, lunch and refreshments.
- Group Registration Discount: If 3 or more than 3 delegates join from the same organization, 10% discount will be offered on total registration fee.
- Participants are responsible for their own accommodation arrangements.



### Registration Procedure:

Please download registration form at [www.utility-technology.org](http://www.utility-technology.org), fill the details in the form and send the form to [training@technobiz-asia.com](mailto:training@technobiz-asia.com). Invoice will be sent after receiving registration form to process registration fee payment.

### Venue:

This program will be held at a hotel in Hong Kong. All the registered delegates will be notified about the venue by 15 October 2017.

### To Register, Please contact



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