COURSE OVERVIEW TE0085
Reverse Osmosis Desalination

Course Title
Reverse Osmosis Desalination

Course Date/Venue
Session 1: June 16-20, 2025/Glasshouse Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE
Session 2: October 06-10, 2025/Glasshouse Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE

Course Reference
TE0085

Course Duration/Credits
Five days/3.0 CEUs/30 PDHs

Course Description

This practical and highly-interactive course includes various practical sessions and exercises. Theory learnt will be applied using our state-of-the-art simulators.

Reverse osmosis is rapidly growing as a water treatment technology used for many applications, such as boiler feed water and recovering wastewater for reuse. This “green” technology is becoming more and more widely used in m any setting, especially in industry. Even as the technology becomes more widespread, the understanding of the technology is lagging behind.

The course is designed to provide delegates with a detailed and up-to-date overview of RO water wesalination. The course will cover reverse osmosis; the different RO and NF membrane processes which include membrane module configurations, RO pressure tube construction, typical RO membrane pressure vessel, etc.; the different RO water chemistry which includes alkalinity, bicarbonate, color, conductivity, nitrate, pH, SDI (Silt Density Index), temperature, etc.; the hyperfiltration of RO and NF membranes processes, applications of membrane processes and the mode of operation of NF and RO; and the design of reverse osmosis by taking note of performance parameters in RO and design parameters affecting performance.

The course will further discuss the hydranautics design limits of RO plants and become familiar with the terms and equations used in reverse osmosis; the corrective measures and fouling control for fouling of MF and UF systems and illustrate the proper cleaning of these MF and UF systems; the system components, concentrate recirculation, concentrate staging and flow distribution of the flow configuration of RO water desalination; the need for membrane performance normalization, RO cleaning in place (CIP) system, NF/RO processes, pre-treatment and electrodialysis reversal; and the proper troubleshooting of RO plants, list ways to avoid trouble, identify problems and come up with an RO troubleshooting matrix

Course Objectives

Upon the successful completion of this course, each participant will be able to:-

- Apply and gain an in-depth knowledge on RO operation
- Define reverse osmosis and illustrate the different RO and NF membrane processes which include membrane module configurations, RO pressure tube construction, typical RO membrane pressure vessel, etc.
- Enumerate the different RO water chemistry which includes alkalinity, bicarbonate, color, conductivity, nitrate, pH, SDI (Silt Density Index), temperature, etc.
- Discuss hyperfiltration of RO & NF membranes processes, applications of membrane processes and the mode of operation of NF & RO
- Acquire knowledge on the design of reverse osmosis by taking note of performance parameters in RO and design parameters affecting performance
- Explain the hydranautics design limits of RO plants and become familiar with the terms and equations used in Reverse Osmosis
- Apply corrective measures and fouling control for fouling of MF and UF systems and illustrate the proper cleaning of these MF and UF systems
- Discuss the system components, concentrate recirculation, concentrate staging and flow distribution of the flow configuration of RO water desalination
- Recognize the need for membrane performance normalization, RO cleaning in place (CIP) system, NF/RO processes, pre-treatment and electrodialysis reversal
- Illustrate the proper troubleshooting of RO plants, list ways to avoid trouble, identify problems and come up with an RO troubleshooting matrix

Exclusive Smart Training Kit - H-STK®

*Participants of this course will receive the exclusive "Haward Smart Training Kit" (**H-STK®**). The **H-STK®** consists of a comprehensive set of technical content which includes **electronic version** of the course materials conveniently saved in a **Tablet PC**.*

Course Fee

US$ 5,500 per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Who Should Attend

This course covers systematic techniques and methodologies on RO operation for engineers, scientists and technologists involved in the planning, management and operation of water treatment plants.

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course who completed a minimum of 80% of the total tuition hours

Certificate Accreditations

Certificates are accredited by the following international accreditation organizations: -

- British Accreditation Council (BAC)

  Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

- The International Accreditors for Continuing Education and Training (IACET - USA)

  Haward Technology is an Authorized Training Provider by the International Accreditors for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 2018-1 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 2018-1 Standard**.

  Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units** (CEUs) in accordance with the rules & regulations of the International Accreditors for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

  Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

Course Instructor(s)

This course will be conducted by the following instructor(s). However, we have the right to change the course instructor(s) prior to the course date and inform participants accordingly:

Mr. Kyle Bester is a **Senior Water Engineer** with extensive years of practical experience within the **Oil & Gas**, **Power & Water Utilities** and other **Energy** sectors. His expertise includes **Water Reservoir**, **Water Tanks**, **Water Pumping** Station, **Water Distribution** System, **Water Network** System, **Water Pipes & Fittings**, **Water Hydraulic** Modelling, **Water Storage Reservoir**, **Reservoirs & Pumping** Stations Design & Operation, **Pumping** Systems, Interconnecting **Pipelines**, **Water Network Hydraulic** Simulation Modelling, **Water Supply** Design, **Water Balance Modelling**, **Water Distribution Network**, **Water Network** System Analysis, **Water Forecasts** Demand, **Water Pipelines** Materials & Fittings, **Water Network** System Design, Pump Houses & Booster Pumping Stations, **Potable Water Transmission**, **Water Distribution Network**, Districts Meters Areas (DMAs), **Water Supply & Desalination Plants** Rehabilitation, **Water Reservoirs & Pumping Stations**, **Water Network System** Extension, Water Network System Replacement & Upgrade, **Water Networks** Optimization, **Water Supply & Distribution** Systems Efficiency & Effectiveness, **Pipe** Materials & Fittings, **Service Reservoir** Design & Operation, **Pipes & Fittings**, **Water Network** System Design & Operation, **Supply Water Network** Rehabilitation, **Water Loss** Reduction, **Main Water** System Construction, **Main Water Line** Construction, Transmission & Distribution **Pipelines**, **Water Distribution** Design & Modelling, **Water Supply** System, Oilfield **Water Treatment**, Best Practice in **Sewage** & Industrial **Wastewater Treatment** & Environmental Protection, **Water Distribution** Design & Modelling, **Desilting**, Treating & Handling Oily **Water**, **Water Chemistry** for **Power Plant**, **Water** Sector Orientation, Environmental Impact Assessment (**EIA**), **Potable Water**, **Reverse Osmosis** Treatment Technology and **Chlorination** System, **Well** Inventory, Monitoring & Conservation, **Qualitative Analysis** of Soil & Ground Water, **Water** Networking, **Hydraulic Modelling** Systems, **Pumping** Stations, **Centrifugal Pumps**, **Pipelines & Pumping**, **Water Reservoirs**, **Water Storage Tanks**, Extended Activated **Sludge** Treatment, **Sewage & Industrial Wastewater** Treatment & Environmental Protection, Supervising & Monitoring **Sewage Works**, **Water Desalination** Technologies, **Water Distribution & Pump** Station, Best **Water Equipment** Selection & Inspection, **Hydraulic Modelling** for Water Network Design, **Water Utility** Industry, **Water Desalination** Technologies & New Development, **Water Hydrology**, **Water Conveyors**, **Water Networks** Rehabilitation. He is currently the **Part Owner & Manager** of Extreme Water SA wherein he manages, re-designed and commissioned a water and wastewater treatment plants.

During his career life, Mr. Bester has gained his practical and field experience through his various significant positions and dedication as the **Project Manager**, **Asset Manager**, **Manager**, **Water Engineer**, **Supervisor**, **Team Leader**, **Analyst**, **Process Technician**, **Landscape Designer** and **Senior Instructor/Trainer** for various international companies, infrastructures, water and wastewater treatment plants from New Zealand, UK, Samoa, Zimbabwe and South Africa, just to name a few.

Mr. Bester holds a **Diploma** in **Wastewater Treatment** and a **National Certificate** in **Wastewater & Water Treatment**. Further, he is a **Certified Instructor/Trainer**, an **Approved Chemical Handler** and has delivered numerous courses, trainings, conferences, seminars and workshops internationally.

Training Methodology

All our Courses are including **Hands-on Practical Sessions** using equipment, State-of-the-Art Simulators, Drawings, Case Studies, Videos and Exercises. The courses include the following training methodologies as a percentage of the total tuition hours:-

30% Lectures
20% Practical Workshops & Work Presentations
30% Hands-on Practical Exercises & Case Studies
20% Simulators (Hardware & Software) & Videos

In an unlikely event, the course instructor may modify the above training methodology before or during the course for technical reasons.

Accommodation

Accommodation is not included in the course fees. However, any accommodation required can be arranged at the time of booking.

Course Program

The following program is planned for this course. However, the course instructor(s) may modify this program before or during the course for technical reasons with no prior notice to participants. Nevertheless, the course objectives will always be met:

Day 1

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***What is Reverse Osmosis?*** *Historical Background ● What is Semi-Permeable? ● What is Osmosis? ● Reverse Osmosis ● Principles of Natural Osmoses ● Principles of Reverse Osmosis*
0930 – 0945	*Break*
0945 – 1130	***RO & NF Membranes Processes*** *Cellulose Acetate (CA) Membrane ● Composite Aromatic Polyamide (CAP) Membrane ● Membrane Module Configurations ● Hollow Fiber RO Membrane*
1130 - 1230	***RO & NF Membranes Processes (cont'd)*** *Spiral Wound RO Membrane ● Spiral Wound Membrane Element ● Cut-Out View of Spiral Wound Membrane Element ● RO Pressure Tube Construction*
1230 – 1245	*Break*
1245 – 1420	***RO & NF Membranes Processes (cont'd)*** *RO Flow Path ● RO Pressure Vessel with a Flow Path Identified ● Typical RO Membrane Pressure Vessel ● Typical RO system and Components*
1420 – 1430	***Recap***
1430	*Lunch & End of Day One*

Day 2

0730 – 0930	***RO Water Chemistry*** *Alkalinity ● Minerals ● Bicarbonate ● BOD (Biological Oxygen Demand) ● Brackish Water ● Carbon Dioxide ● COD (Chemical Oxygen Demand) ● Color ● Conductivity*
0930 – 0945	*Break*

0945 – 1130	***RO Water Chemistry (cont'd)*** *Grains (Per Gallon) ● Ionic Strength ● LSI (Langlier Saturation Index) ● Milli-Equivalent • Milligram per liter ● Nitrate ● Osmotic Pressure ● pH ● ppb (parts per billion)*
1130 - 1230	***RO Water Chemistry (cont'd)*** *ppm (parts per million) ● ppm as CaCO3 ● SDI (Silt Density Index) ● SDSI (Stiff Davis Saturation Index) ● TDS (Total Dissolved Solids) ● Temperature ● TOC (Total Organic Carbon) ● Turbidity*
1230 – 1245	*Break*
1245 – 1420	***Overview of RO & NF Membranes*** *Hyperfiltration (RO & NF) Processes ● Synthetic membrane Filtration Reminder ● Applications of Membrane Processes ● Mode of Operation NF & RO ● NF/RO Processes*
1420 - 1430	***Recap***
1430	*Lunch & End of Day Two*

Day 3

0730 – 0930	***Design of Reverse Osmoses*** *RO Design Steps ● RO Design Using Software ● Performance Parameters in RO ● Design Parameters Effecting Performance*
0930 – 0945	*Break*
0945 – 1130	***Hydranautics Design Limits*** *Average Flux Rates & Expected % Decrease in Flux Per Year ● Expected % Salt Passage Increase Per Year ● Maximum Feed Flow and Minimum Concentrate Flow Rates Per Vessel*
1130 - 1230	***Hydranautics Design Limits (cont'd)*** *Saturation Limits for Sparingly Soluble Salts in the Concentrate ● Limits of Saturation Indices*
1230 – 1245	*Break*
1245 – 1420	***Terms and Equations of Reverse Osmosis*** *Osmotic Pressure ● Water Transport ● Salt Transport ● Salt Passage ● Salt Rejection ● Permeate Recovery Rate (Conversion) ● Concentration Polarization*
1420 – 1430	***Recap***
1430	*Lunch & End of Day Three*

Day 4

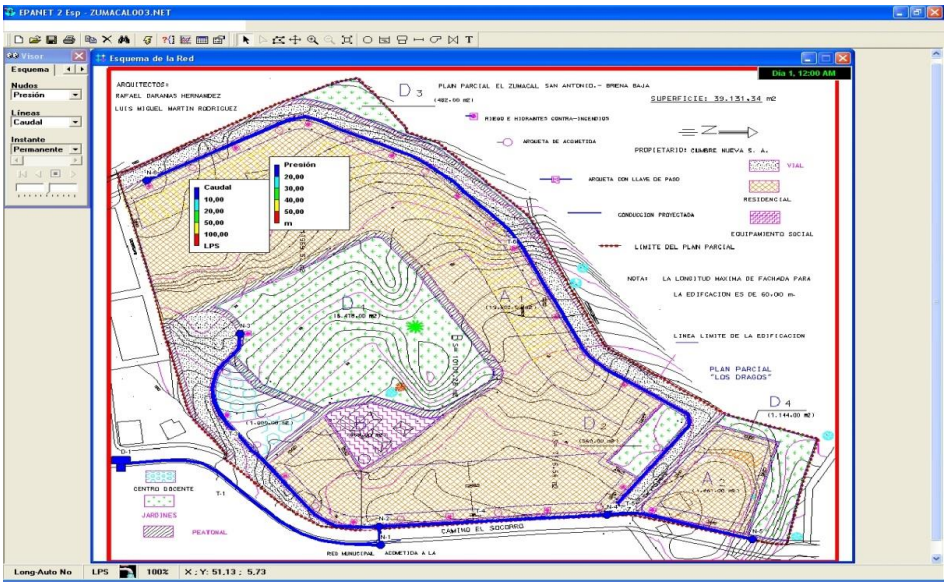
0730 – 0930	***Fouling of MF & UF Systems*** *Fouling of Membranes Systems ● Common Foulants & Scalants in Feed Water ● Membrane Fouling Types*
0930 – 0945	*Break*
0945 – 1130	***Fouling of MF & UF Systems (cont'd)*** *Membrane Fouling & Scaling Effects ● Fouling Control*
1130 - 1230	***Flow Configuration*** *System Components ● Concentrate Staging and Pyramid Design ● Concentrate Recirculation*
1230 – 1245	*Break*
1245 – 1420	***Flow Configuration (cont'd)*** *Concentrate Staging ● Flow Distribution ● Permeate Staging*
1420 – 1430	***Recap***
1430	*Lunch & End of Day Four*

Day 5

0730 – 0930	***Membrane Performance Normalization*** *What is Membrane Performance Normalization? ● Membrane Fouling & Scaling Effects ● Fouling Control ● RO Cleaning in Place (CIP) System*
0930 – 0945	*Break*
0945- 1130	***Membrane Performance Normalization (cont'd)*** *NF/RO Processes, Pre-Treatment ● RO Processes ● Electrodialysis ● Electrodialysis Reversal*
1130 – 1230	***Cleaning of MF & UF Systems*** *Data Monitoring ● Cleaning System Specifications ● Cleaning Procedures ● List of TSB's ● Storage TSB's*
1230 – 1315	*Break*
1315 – 1345	***Troubleshooting RO Plant*** *How to Avoid Trouble ● Identifying a Problem ● Questions to Ask ● RO Troubleshooting Matrix*
1345 – 1400	***Course Conclusion***
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

Simulator (Hands-on Practical Sessions)

Practical sessions will be organized during the course for delegates to practice the theory learnt. Delegates will be provided with an opportunity to carryout various exercises using the latest revision of "EPANET" simulators.



EPANET Simulator

Course Coordinator

Mari Nakintu, Tel: +971 2 30 91 714, Email: mari1@haward.org