COURSE OVERVIEW TE0298
ClO_2 Disinfection Systems

Course Title
ClO_2 Disinfection Systems

Course Date/Venue
Session 1: May 26-30, 2025/Glasshouse Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE
Session 2: September 29-October 03, 2025/Glasshouse Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE

Course Reference
TE0298

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.

This course is designed to provide participants with a detailed and up-to-date overview of Chlorine Dioxide (ClO_2) Disinfection Systems. It covers the water disinfection technologies, chlorine dioxide (ClO_2) basics and mechanism of disinfection by ClO_2; the stability under various pH and temperature conditions, reactions with organic and inorganic substances, formation and control of by-products and influence of water quality on reactivity; the acceptable limits in drinking water, health effects of ClO_2 and byproducts, environmental impact of discharge and ecotoxicology and aquatic risk; the ClO_2 generation methods, ClO_2 generation equipment and technologies and storage and delivery considerations; the typical schematic of ClO_2 disinfection system, placement of sensors and injection points and design considerations; and the flow integration into water systems.

Further, the course will also the sizing and dosing calculations, material selection and compatibility and online monitoring and measurement; the PLC-based dosing control, feedback and feed-forward loops, alarm systems and interlocks and integration into plant DCS/SCADA; the process optimization techniques, residual management and compliance, alarm management and safety interlocks; the proper maintenance and calibration procedures and daily operation procedures; the low ClO_2 yield or dosing errors, sensor drift and calibration issues, pipeline scaling and corrosion; and the alarms and system malfunctions.

During this interactive course, participants will learn the root cause analysis of failures, process deviation and correction and maintenance logs and failure trends; the ClO_2 gas leak handling, chemical spill containment, system isolation protocols, emergency PPE and response kits; the operator safety and PPE requirements, training and competency development and integration with desalination and RO systems; the power plant water systems covering cooling tower disinfection, boiler feedwater applications, legionella control strategies and ClO_2 compatibility with power equipment; auditing and inspecting ClO_2 systems; and the regulations and documentation including advanced topics in ClO_2 disinfection.

Course Objectives

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

- Apply and gain an in-depth knowledge on ClO_2 disinfection systems
- Discuss water disinfection technologies, chlorine dioxide (ClO_2) basics and mechanism of disinfection by ClO_2
- Recognize stability under various pH and temperature conditions, reactions with organic and inorganic substances, formation and control of by-products and influence of water quality on reactivity
- Identify acceptable limits in drinking water, health effects of ClO_2 and byproducts, environmental impact of discharge and ecotoxicology and aquatic risk
- Carryout ClO_2 generation methods, ClO_2 generation equipment and technologies and storage and delivery considerations
- Describe typical schematic of ClO_2 disinfection system, placement of sensors and injection points, design considerations and flow integration into water systems
- Apply sizing and dosing calculations, material selection and compatibility and online monitoring and measurement
- Discuss PLC-based dosing control, feedback and feed-forward loops, alarm systems and interlocks and integration into plant DCS/SCADA
- Employ process optimization techniques, residual management and compliance and alarm management and safety interlocks
- Implement proper maintenance and calibration procedures and daily operation procedures as well as discuss low ClO_2 yield or dosing errors, sensor drift and calibration issues, pipeline scaling and corrosion and alarms and system malfunctions
- Apply root cause analysis of failures, process deviation and correction and maintenance logs and failure trends
- Carryout ClO_2 gas leak handling and discuss chemical spill containment, system isolation protocols, emergency PPE and response kits
- Recognize operator safety and PPE requirements and apply training and competency development and integration with desalination and RO systems
- Identify Power plant water systems covering cooling tower disinfection, boiler feedwater applications, legionella control strategies and ClO_2 compatibility with power equipment
- Audit and inspect ClO_2 systems and discuss regulations and documentation including advanced topics in ClO_2 disinfection

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**.*

Who Should Attend

This course provides an overview of all significant aspects and considerations of ClO_2 disinfection systems for water treatment plant operators, environmental engineers and technicians, health, safety and environmental (HSE) professionals, maintenance and utility engineers, facility managers, chemical engineers and technicians, public health officials and inspectors, industrial hygienists, project managers and supervisors and other technical staff.

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 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.

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. Karl Thanasis, PEng, MSc, MBA, BSc, is a **Senior Water Engineer** with over **45 years** of practical experience within the **Oil**, **Gas**, **Refinery**, **Petrochemical**, **Utilities** and related industries. His expertise widely includes in the areas of **Water Distribution** System, **Water Reservoir**, **Water Tanks**, **Water Pumping Station**, **Water Network** System, **Water Pipes & Fittings**, **Water Hydraulic** Modelling, **Water Network Hydraulic** Simulation Modelling, **Water Balance** Modelling, **Water Distribution Network**, **Water Network** System Design, **Water Network System** Analysis, **Water Forecasts** Demand, **Water Network** System Extension, **Water Network** System Replacement & Upgrade, **Water Networks** Optimization, **Water Distribution Systems & Pumping Stations**, **Reservoirs & Pumping Stations** Design & Operation, **Water Reservoirs & Pumping Stations**, **Water Storage Reservoir**, **Pumping** Systems, Interconnecting Pipelines, **Pump** Houses & Booster Pumping Stations, **Water Pipelines** Materials & Fittings, **Waste Water Effluent Treating** Facilities, **Sewage & Industrial Waste Water** Treatment & Environmental Protection Best Practices, **Oily Water Treatment Technology**, **Water Equipment** Selection & Inspection, **Effluent Treatment & Slurry Handling**, **Water Testing & Commissioning** Techniques, **Wastewater** Treatment, **Water Supply** Design, **Potable Water** Transmission, Districts Meters Areas (**DMA**s), **Water Supply & Desalination** Plants Rehabilitation, **Water Supply & Distribution Systems** Efficiency & Effectiveness, **Water Treatment** Technology, **Reverse Osmosis**, **MSF Plants**, **Industrial Water Treatment** in Refineries & Petrochemical Plants, **Piping System**, **Water Movement**, **Water Filtering**, **Mud Pumping**, **Sludge Treatment** and **Drying**, **Aerobic Process** of **Water Treatment** that includes **Aeration**, **Sedimentation** and **Chlorination Tanks**. His strong background also includes **Design** and **Sizing** of all **Waste Water Treatment Plant Associated Equipment** such as **Sludge Pumps**, **Filters**, **Metering Pumps**, **Aerators** and **Sludge Decanters**.

Mr. Thanasis has acquired his thorough and practical experience as the **Water Engineer**, **Project Manager**, **Plant Manager**, **Area Manager - Equipment Construction**, **Construction Superintendent**, **Project Engineer**, **Design Engineer**, **Mechanical Engineer**, **Maintenance Engineer** and **Senior Instructor/Lecturer**. His duties covered **Plant Preliminary Design**, **Plant Operation**, **Write-up** of **Capital Proposal**, **Investment Approval**, **Bid Evaluation**, **Technical Contract Write-up**, **Construction** and **Sub-contractor Follow up**, **Lab Analysis**, **Sludge Drying** and **Management** of **Sludge Odor** and **Removal**. He has worked in various companies worldwide in the **USA**, **Germany**, **England** and **Greece**.

Mr. Thanasis is a **Registered Professional Engineer** in the **USA** and **Greece** and has a **Master's** and **Bachelor's** degree in **Mechanical Engineering** with **Honours** from the **Purdue University** and **SIU** in **USA** respectively as well as an **MBA** from the **University of Phoenix** in **USA**. Further, he is a **Certified Instructor/Trainer**, a **Certified Internal Verifier/Trainer/Assessor** by the **Institute of Leadership & Management** (**ILM**) and delivered numerous courses, trainings, conferences, seminars and workshops internationally.

Course Program

The following program is planned for this course. However, the course instructor(s) may modify this program before or during the workshop 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	***Introduction to Water Disinfection Technologies*** *Overview of Common Disinfection Methods (Cl_2, UV, Ozone, ClO_2) • Comparison of Disinfection Efficacy and Byproducts • Advantages and Limitations of Each Method • Selection Criteria for Water Utilities*
0930 – 0945	*Break*
0945 – 1030	***Chlorine Dioxide (ClO_2) Basics*** *Molecular Structure and Physical Properties • Oxidizing Power and Reaction Pathways • Differences Between Cl_2 and ClO_2 • Applications in Potable and Industrial Water Systems*
1030 – 1130	***Mechanism of Disinfection by ClO_2*** *Microbial Inactivation Principles • Effectiveness Against Bacteria, Viruses, Protozoa • Impact on Biofilm and Biofouling • Kinetics of ClO_2 Disinfection*
1130 – 1215	***ClO_2 Stability & Reactivity*** *Stability Under Various pH and Temperature Conditions • Reactions with Organic and Inorganic Substances • Formation and Control of by-Products (Chlorite, Chlorate) • Influence of Water Quality on Reactivity*
1215 – 1230	*Break*
1230 – 1330	***Health & Environmental Considerations*** *Acceptable Limits in Drinking Water (WHO, EPA, EU) • Health Effects of ClO_2 and Byproducts • Environmental Impact of Discharge • Ecotoxicology and Aquatic Risk*
1330 – 1420	***Case Studies: Global Use of ClO_2*** *Municipal Water Treatment Plants • Industrial Cooling Systems • Power Plant Applications • Desalination Pre-Treatment*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day One*

Day 2

0730 – 0830	***ClO_2 Generation Methods*** *Sodium Chlorite-Based Generation • On-Site versus Off-Site Generation • 2-Chemical vs. 3-Chemical Generation • Reaction Efficiency and Yield Control*
0830 – 0930	***ClO_2 Generation Equipment & Technologies*** *Batch versus Continuous Systems • Reactors, Storage Tanks, Dosing Pumps • Instrumentation and Control Components • Manufacturer Comparisons (Grundfos, Evoqua, etc.)*
0930 – 0945	*Break*
0945 – 1100	***Storage & Delivery Considerations*** *ClO_2 Storage Limitations • Handling Sodium Chlorite Safely • Delivery Piping and Compatibility • Avoiding Losses and Ensuring Stability*

1100 – 1215	***System Layout & P&ID Review*** *Typical Schematic of ClO_2 Disinfection System • Placement of Sensors and Injection Points • Design Considerations for EWEC Plants • Flow Integration into Water Systems*
1215 – 1230	*Break*
1230 – 1330	***Sizing & Dosing Calculations*** *Determining Demand and Required ClO_2 Dose • Flow-Based Dosing vs. Residual Control • Contact Time and CT Values • Real-Time Dosing Control Systems*
1330 – 1420	***Material Selection & Compatibility*** *Corrosion Resistance of Piping and Tanks • Selection of Valves, Sensors and Seals • Polymer versus Metallic Options • Compatibility Charts and Guidelines*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & Day Two*

Day 3

0730 – 0830	***Online Monitoring & Measurement*** *ClO_2 Analyzers and Sensors • ORP and Residual Monitoring • Calibration Procedures • Real-Time versus Batch Sample Analysis*
0830 – 0930	***Automation & SCADA Integration*** *PLC-Based Dosing Control • Feedback and Feed-Forward Loops • Alarm Systems and Interlocks • Integration into Plant DCS/SCADA*
0930 – 0945	*Break*
0945 – 1100	***Process Optimization Techniques*** *Minimizing Chemical Usage • Optimizing Contact Time • Reducing Byproduct Formation • Balancing Disinfection with Cost*
1100 – 1215	***Residual Management & Compliance*** *Monitoring Residual Levels Post-Treatment • Meeting Regulatory Thresholds • Strategies for Controlling Chlorite and Chlorate • Use of Activated Carbon and Other Treatments*
1215 – 1230	*Break*
1230 – 1330	***Alarm Management & Safety Interlocks*** *High/Low Level Alarms • Emergency Shutdown Procedures • Remote Monitoring and Diagnostics • Interlock Logic for Safe Operation*
1330 – 1420	***Maintenance & Calibration Procedures*** *Routine Sensor Calibration • Generator and Pump Servicing • Troubleshooting Instrumentation • Spare Parts Management*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Three*

Day 4

0730 – 0830	***Daily Operation Procedures*** *Startup and Shutdown Sequences • Safety Checks and Logbooks • Routine Visual Inspections • Operator Responsibilities*
0830 – 0930	***Common Operational Challenges*** *Low ClO_2 Yield or Dosing Errors • Sensor Drift and Calibration Issues • Pipeline Scaling and Corrosion • Alarms and System Malfunctions*

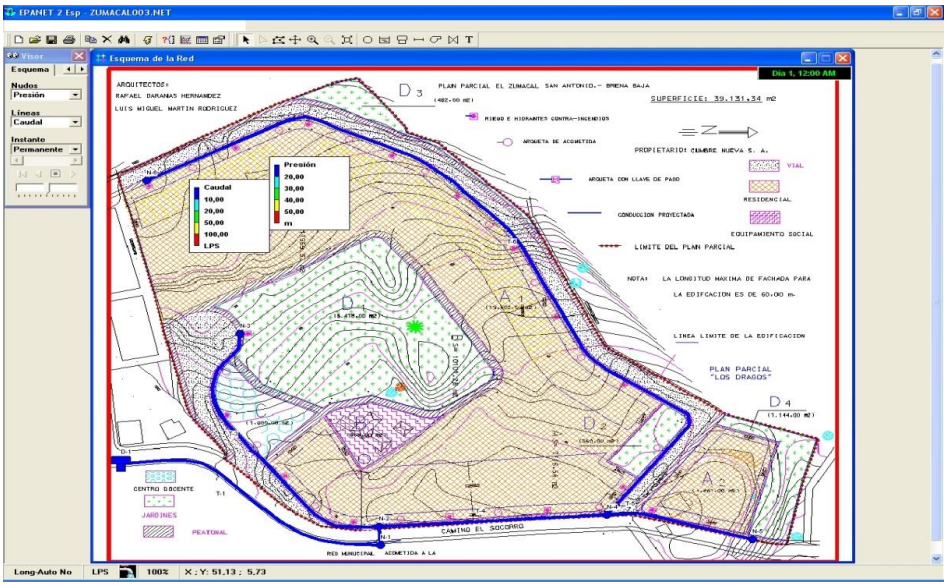
0930 – 0945	*Break*
0945 – 1100	***Troubleshooting Methodology*** *Root Cause Analysis of Failures • Process Deviation and Correction • Case Study Exercises • Maintenance Logs and Failure Trends*
1100 – 1215	***Emergency Procedures & Risk Scenarios*** *ClO_2 Gas Leak Handling • Chemical Spill Containment • System Isolation Protocols • Emergency PPE and Response Kits*
1215 – 1230	*Break*
1230 – 1330	***Operator Safety & PPE Requirements*** *Exposure Risks of ClO_2 and Sodium Chlorite • PPE: Gloves, Goggles, Respirators • Ventilation and Confined Space Protocols • First Aid and MSDS Review*
1330 – 1420	***Training & Competency Development*** *SOP and Work Instruction Development • Competency Matrices for Operators • Refresher and Certification Programs • Use of Simulation and Hands-on Practice*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Four*

Day 5

0730 – 0830	***Integration with Desalination & RO Systems*** *ClO_2 Use as Pre-Treatment in SWRO • Fouling Control and Biofilm Prevention • Compatibility with Membranes • Case Study: EWEC Desalination Plants*
0830 – 0930	***Power Plant Water Systems*** *Cooling Tower Disinfection • Boiler Feedwater Applications • Legionella Control Strategies • ClO_2 Compatibility with Power Equipment*
0930 – 0945	*Break*
0945 – 1100	***Auditing & Inspection of ClO_2 Systems*** *Checklists for Regulatory Compliance • Mechanical and Process Inspection • Performance Evaluation • Audit Reporting and Documentation*
1100 – 1215	***Regulations & Documentation*** *UAE, WHO, EPA and EU Standards • Record-Keeping and Traceability • Permitting and Chemical Inventory • Emergency Response Plans*
1215 – 1230	*Break*
1230 – 1345	***Advanced Topics in ClO_2 Disinfection*** *Advanced Oxidation Processes (AOPs) • ClO_2 in Wastewater Treatment • Emerging Technologies and Sensors • Green Alternatives and Future Trends*
1345 – 1400	***Course Conclusion*** *Using this Course Overview, the Instructor(s) will Brief Participants about t Topics that were Covered During the Course*
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

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