



COURSE OVERVIEW PE1100

Chlorine Dioxide (ClO₂) Plant Operation and Maintenance

Course Title

Chlorine Dioxide (ClO₂) Plant Operation and Maintenance

Course Date/Venue

Please refer to page 3

Course Reference

PE1100

Course Duration/Credits

Five days/3.0 CEUs/30 PDHs

Course Description



This practical and highly-interactive course includes real-life case studies where participants will be engaged in a series of interactive small groups and class workshops.

This course is designed to provide participants with a detailed and up-to-date overview of Chlorine Dioxide (ClO₂) Plant Operation and Maintenance. It covers the fundamentals of chlorine dioxide (ClO₂) technology, ClO₂ generation principles and chemical reactions; the ClO₂ plant architecture, system overview, process safety and hazard identification; the ClO₂ leak detection, emergency response, safe plant start-up and shutdown procedures; the ClO₂ generation system operation and ClO₂ dosing system operation and control; the ClO₂ applications in seawater reverse osmosis (SWRO); the ClO₂ applications in evaporator (EVAP) systems, process monitoring and operating parameters; the operational troubleshooting of generation and dosing systems; the pumps used in ClO₂ plants, valves, piping and chemical handling components; and the process instrumentation and field devices.

During this interactive course, participants will learn the ClO₂ analyzers, water quality monitoring, PLC/DCS interface and control philosophy; the alarm monitoring, control system troubleshooting and preventive maintenance of ClO₂ plant equipment; the inspection of mechanical equipment and components and instrument inspection, calibration and testing; the analyzer maintenance and performance verification; the diagnostics and systematic fault finding and corrective and breakdown maintenance; the routine maintenance planning, scheduling and reliability and equipment performance improvement; the advanced troubleshooting of ClO₂ plant problems; and the industry best practices for safe and reliable operation.



Course Objectives/Outcomes & Benefits for the Participants

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

- Apply and gain an in-depth knowledge on chlorine dioxide (ClO_2) plant operation and maintenance
- Discuss the fundamentals of chlorine dioxide (ClO_2) technology, ClO_2 generation principles and chemical reactions
- Describe ClO_2 plant architecture and system overview and apply process safety and hazard identification
- Carryout ClO_2 leak detection and emergency response and safe plant start-up and shutdown procedures
- Employ ClO_2 generation system operation, ClO_2 dosing system operation and control and ClO_2 applications in seawater reverse osmosis (SWRO)
- Carryout ClO_2 applications in evaporator (EVAP) systems, process monitoring and operating parameters, operational troubleshooting of generation and dosing systems
- Identify pumps used in ClO_2 plants, valves, piping and chemical handling components including process instrumentation and field devices
- Apply ClO_2 analyzers & water quality monitoring and discuss PLC/DCS interface and control philosophy
- Employ alarm monitoring and control system troubleshooting and preventive maintenance of ClO_2 plant equipment
- Implement inspection of mechanical equipment and components as well as instrument inspection, calibration and testing
- Carryout analyzer maintenance and performance verification, diagnostics and systematic fault finding including corrective and breakdown maintenance
- Apply routine maintenance planning and scheduling and reliability and equipment performance improvement
- Implement advanced troubleshooting of ClO_2 plant problems and industry best practices for safe and reliable operation

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 chlorine dioxide (ClO_2) plant operation and maintenance for water treatment engineers, process engineers, chemical engineers, chlorine dioxide plant operators, water and wastewater treatment operators, maintenance and reliability engineers, mechanical and electrical maintenance technicians, instrumentation and control engineers, process control and automation professionals, HSE and process safety professionals, water quality and laboratory personnel, plant supervisors and managers, utilities and operations professionals, professionals responsible for chlorine dioxide generation, plant operation, maintenance, troubleshooting, safety and process optimization.



Course Date/Venue

Session(s)	Date	Venue
1	November 02-06, 2026	TBA Meeting Room, Royal Rose Hotel, Abu Dhabi, UAE
2	November 16-20, 2026	
3	December 07-11, 2026	
4	December 14-18, 2026	

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

Haward's 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**. Haward's certificates are internationally recognized and accredited by the British Accreditation Council (BAC). 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.

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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. Henry Beer is a **Senior Process Engineer** with over **30 years** of indepth industrial experience within the **Petrochemical, Oil & Gas** industries specializing in **ClO₂ Plant** Architecture & System, **Chlorine Dioxide (ClO₂) Plant** Operation & Maintenance, **ClO₂ Dosing System** Operation & Control, **Hydrocarbon Process** Equipment, **DOX Unit** Operation & Troubleshooting, **Polyethylene & Polypropylene** Processing, **Oil Movement** Storage & Troubleshooting, **Power Plant Chemistry**, **Fuel Quality** Monitoring System Fundamentals, **Liquid Bulk Cargo Handling**, **Oil Refinery Cost Management**, **Flare & Blowdown** Operation, **Pressure Relief Systems** Maintenance & Troubleshooting, **Refinery SRU**, **Tail Gas** Treating, **Sour Water & Amine Recovery** Units, **Propylene** Compressor and Turbine, **Clean Fuel** Technology & Standards, **Principles of Operations Planning**, **Heat Exchangers & Fired Heaters** Operation & Troubleshooting, **Plastic Extrusion Technology** Operation & Troubleshooting, **Chemical Engineering** for Non-Chemical Engineers, **Process Plant** Troubleshooting, **Process Plant Optimization** Technology, **Engineering Problem Solving**, **Process Plant** Performance & Efficiency, **Process Plant** Start-up & Shutdown, **Process Plant** Commissioning, **Process Plant** Turn-around & Shutdown, **Pumps & Compressors** Troubleshooting, **Fired Heaters & Air Coolers** Maintenance, **Pressure Vessels & Valves** Repair, **Polymers**, **Plastics**, **Polyolefin & Catalysts**, **Polymerization**, **Thermal Analysis Techniques**, **Rheology**, **Thermoplastics**, **Thermosets**, **Coating Systems** and **Fibre Reinforced Polymer Matrix Composites**. Further, he is also well-versed in **Water Hydraulic Modelling**, **Efficient** Shutdowns, Turnaround & Outages, **Pump** Selection and Installation, Operation and Maintenance of **Pumps**, **Demand & Supply** Management, **Catalyst Manufacturing Techniques**, **Fuel Systems** Management, **Aviation Fuel**, **Diesel**, **Jet Fuel**, **Petrol** and **IP Octane**, **Cetane Control** and related Logistics, Road, Rail and Pipeline Distribution, **Process Design** and **Optimisation**, **Boiler Feed Water** Preparation, **Flocculation Sedimentation**, **Hot Lime Water Softening Processes**, **Desalination Processes**, **Reverse Osmosis**, **Molecular Sieves**, activated **Sludge** **Aerobic/Anaerobic**, **Sludge Removal** and **Incineration Process Control**, **Domestic Sewage Plants Optimisation**, **Process Cooling Water System**, **High Pressure** and **Low Pressure Tank Farm Management**, **Hydrocarbon** and **Chemical products** and **GTL (Gas to Liquids)**.

During his career life, Mr. Beer holds significant key positions such as the **Director**, **Global Commissioning Manager**, **Process Engineering Manager**, **Senior Business Analyst**, **Process Engineer**, **Chemical Engineer**, **Senior Technician**, **Technical Sales Engineer**, **Entrepreneur**, **Financial Consultant**, **Business Analyst**, **Business Financial Planner** and **Independent Financial Planner** to various international companies such as the **Sasol**, **SASOLChem**, **TAG Solvents**, **Virgin Solvent Products**, **SARS & SAPIA (South African Petroleum Industry Association)** and **RFS Financial Services (Pty) Ltd**.

Training Methodology

Our courses employ an interactive, learner-centred methodology that integrates theoretical knowledge with practical application. The training is delivered through a suitable combination of some or all of the following methods, selected according to the course content and learning objectives:

- Instructor-led presentations and facilitated discussions
- Practical workshops and participant presentations
- Hands-on exercises and real-world case studies
- Equipment demonstrations and technical drawings
- Hardware- and software-based simulations
- Gamification & Role Play in soft-skills courses only
- Virtual Reality (VR) and Augmented Reality (AR)
- Instructional videos and other relevant training resources

This blended approach encourages active participation, strengthens practical skills and supports the effective application of acquired knowledge in the workplace.

Learning Design & Customization

This course can be customized to the exact requirements of clients. Haward Technology is so proud of our huge capabilities in tailoring our courses to the training needs of our valued clients.

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 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	<i>Registration & Coffee</i>
0800 – 0815	<i>Welcome & Introduction</i>
0815 – 0830	<i>PRE-TEST</i>
0830 – 0930	<i>Fundamentals of Chlorine Dioxide (ClO₂) Technology</i> <i>Physical & Chemical Properties of Chlorine Dioxide • Oxidation, Disinfection & Biocidal Mechanisms • Comparison of ClO₂ with Chlorine & other Oxidants • Industrial Water Treatment Applications & Performance Considerations</i>
0930 – 0945	<i>Break</i>
0945 – 1030	<i>ClO₂ Generation Principles & Chemical Reactions</i> <i>Principles of On-Site Chlorine Dioxide Generation • Precursor Chemicals & Typical Generation Routes • Reaction Chemistry, Conversion Efficiency & Yield • Factors Affecting ClO₂ Generation Stability & Performance</i>



1030 – 1130	CIO₂ Plant Architecture & System Overview Generator, Chemical Storage & Feed System Configuration • Dilution Water, Mixing, Dosing & Distribution Systems • Piping, Valves, Pumps, Tanks & Ancillary Equipment • Process Flow Diagrams (PFDs) & Piping & Instrumentation Diagrams (P&IDs)
1130 – 1215	Process Safety & Hazard Identification Chemical Hazards Associated with CIO ₂ & Precursor Chemicals • Hazard Identification, Risk Assessment & Control Measures • Safe Chemical Storage, Transfer, Handling & Segregation • Personal Protective Equipment (PPE) & Safe Working Practices
1215 – 1230	Break
1230 – 1330	CIO₂ Leak Detection & Emergency Response Fixed & Portable CIO ₂ Gas Detection Systems • Alarm Levels, Detection Locations & Response Actions • Leak Isolation, Ventilation & Emergency Shutdown Procedures • Spill, Exposure, Evacuation & Emergency Response Procedures
1330 – 1420	Safe Plant Start-Up & Shutdown Procedures Pre-Start Inspection & System Readiness Verification • Chemical Line-Up, Priming & Controlled Start-Up • Normal Shutdown, Flushing & System Isolation • Emergency Shutdown, Lockout/Tagout (LOTO) & Restart Requirements
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	CIO₂ Generation System Operation Generator Operating Sequence & Process Parameters • Chemical Feed Rates, Concentration & Reaction Control • Generator Efficiency & Performance Monitoring • Recognizing Abnormal Generation Conditions
0830 – 0930	CIO₂ Dosing System Operation & Control Dosing Pumps, Injection Points & Distribution Arrangements • Dose Calculation & Chemical Feed Rate Adjustment • Residual CIO ₂ Monitoring & Dose Optimization • Controlling Under-Dosing, Over-Dosing & Process Variations
0930 – 0945	Break
0945 – 1100	CIO₂ Applications in Seawater Reverse Osmosis (SWRO) Biofouling Challenges in SWRO Pretreatment Systems • CIO ₂ Application for Microbiological Control • Dosing Locations, Contact Time & Residual Management • Operational Considerations for Membranes & Downstream Processes
1100 – 1215	CIO₂ Applications in Evaporator (EVAP) Systems Microbiological & Fouling Challenges in EVAP Systems • CIO ₂ Treatment Strategy for Evaporator Feed Water • Dosing Control, Monitoring & Treatment Optimization • Integration with Existing Water Treatment Processes
1215 – 1230	Break



1230 – 1330	Process Monitoring & Operating Parameters Flow, Pressure, Temperature & Chemical Concentration Monitoring • ClO ₂ Residual, ORP & Relevant Water Quality Parameters • Operating Trends, Baselines & Performance Indicators • Identifying Deviations Before Equipment or Process Failure
1330 – 1420	Operational Troubleshooting of Generation & Dosing Systems Low or Unstable ClO ₂ Generation Troubleshooting • Incorrect Dosing Rate & Residual Problems • Chemical Feed, Dilution Water & Mixing Problems • Systematic Troubleshooting Using Trends, Symptoms & Process Data
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 Two

Day 3

0730 – 0830	Pumps, Valves, Instrumentation, Analyzers & Control Systems 1. Pumps Used in ClO ₂ Plants Metering, Dosing & Chemical Transfer Pump Principles • Pump Components, Materials & Operating Characteristics • Priming, Flow Adjustment & Performance Verification • Troubleshooting Loss of Flow, Cavitation, Leakage & Pressure Problems
0830 – 0930	Valves, Piping & Chemical Handling Components Isolation, Check, Control & Pressure Relief Valves • Chemical-Compatible Piping, Fittings, Seals & Gaskets • Valve Inspection, Leakage Detection & Functional Testing • Troubleshooting Blockages, Leakage & Flow Restrictions
0930 – 0945	Break
0945 – 1100	Process Instrumentation & Field Devices Flow, Pressure, Level & Temperature Instrumentation • Transmitters, Switches, Sensors & Local Indicators • Signal Types, Wiring, Loops & Instrument Verification • Common Instrument Failures & Diagnostic Techniques
1100 – 1215	ClO₂ Analyzers & Water Quality Monitoring Principles of ClO ₂ Residual Measurement • Online Analyzers, Sensors & Sampling Systems • Inspection, Cleaning, Calibration & Verification • Troubleshooting Drift, Fouling, Erratic Readings & Measurement Errors
1215 – 1230	Break
1230 – 1330	PLC/DCS Interface & Control Philosophy PLC/DCS Architecture & ClO ₂ Plant Interface • Automatic Sequences, Interlocks & Permissives • Control Loops, Setpoints & Operating Modes • Local versus Remote & Manual versus Automatic Control
1330 – 1420	Alarm Monitoring & Control System Troubleshooting Alarm Classification, Priorities & Operator Response • Trips, Interlocks & Shutdown Logic • Diagnosing Field Signal & Communication Problems • Alarm History, Event Logs & Process Trends for Fault Finding
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	Preventive Maintenance, Inspection, Calibration & Fault Finding Preventive Maintenance of ClO ₂ Plant Equipment Equipment-Based Preventive Maintenance Requirements • Daily, Weekly, Monthly & Periodic Maintenance Tasks • Cleaning, Lubrication, Tightening & Condition Checks • Maintenance Checklists, Records & Equipment History
0830 – 0930	Inspection of Mechanical Equipment & Components Generator, Pumps, Tanks & Skid Inspection • Piping, Valves, Connections, Seals & Gasket Inspection • Corrosion, Chemical Attack, Leakage & Material Degradation • Acceptance Criteria & Identification of Repair Requirements
0930 – 0945	Break
0945 – 1100	Instrument Inspection, Calibration & Testing Calibration Principles & Reference Standards • Calibration of Flow, Pressure, Level & Other Instruments • Functional Testing of Switches, Alarms & Interlocks • Calibration Records, Tolerances & Out-of-Calibration Actions
1100 – 1215	Analyzer Maintenance & Performance Verification Analyzer Inspection & Preventive Maintenance Procedures • Sensor Cleaning, Consumables & Sampling System Maintenance • Zero, Span & Reference Verification Techniques • Diagnosing Analyzer Drift, Slow Response & Incorrect Readings
1215 – 1230	Break
1230 – 1330	Diagnostics & Systematic Fault Finding Symptom-Based Troubleshooting Methodology • Reading P&IDs, Electrical Diagrams & Control Logic • Mechanical, Electrical, Instrumentation & Process Fault Isolation • Root Cause Identification versus Symptom Correction
1330 – 1420	Corrective & Breakdown Maintenance Breakdown Assessment & Maintenance Prioritization • Safe Isolation, Repair & Component Replacement • Post-Maintenance Testing & Functional Verification • Return-to-Service, Documentation & Failure Reporting
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	Reliability, Maintenance Planning & Practical Troubleshooting Routine Maintenance Planning & Scheduling Developing ClO ₂ Plant Maintenance Plans • Maintenance Frequencies Based on Equipment Criticality • Planning Manpower, Tools, Consumables & Spare Parts • Coordination of Maintenance with Plant Operations
0830 – 0930	Reliability & Equipment Performance Improvement Critical Equipment Identification & Failure Modes • Reliability Indicators & Maintenance Performance Measures • Recurring Failure Analysis & Bad-Actor Identification • Improving Availability, Reliability & Maintainability
0930 – 0945	Break
0945 – 1100	Advanced Troubleshooting of ClO₂ Plant Problems Generator Failure & Poor Conversion Efficiency • Pump, Valve & Chemical Feed System Failures • Analyzer, Instrument & Control System Faults • Integrated Troubleshooting of Process & Equipment Problems



1100 – 1215	Industry Best Practices for Safe & Reliable Operation <i>Good Operating & Maintenance Practices for ClO₂ Systems • Chemical Management, Housekeeping & Contamination Prevention • Management of Change & Maintenance Quality Control • Lessons Learned from ClO₂ Plant Incidents & Equipment Failures</i>
1215 – 1230	<i>Break</i>
1230 – 1345	Practical Hands-On Maintenance & Troubleshooting Exercises <i>Inspection of Pumps, Valves, Instruments & Analyzers • Calibration & Functional Testing Exercises • Simulated Alarm, Interlock & Equipment Failure Diagnosis • Developing Corrective Actions from Observed Fault Conditions</i>
1345 – 1400	Course Conclusion <i>Using this Course Overview, the Instructor(s) will Brief Participants about the Course Topics that were Covered During the Course</i>
1400 – 1415	POST-TEST
1415 – 1430	<i>Presentation of Course Certificates</i>
1430	<i>Lunch & End of Course</i>

Practical Sessions

This practical and highly-interactive course includes real-life case studies and exercises:-



Course Coordinator

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