

CEU COURSE DESCRIPTION

DISINFECTION PRINCIPLES CEU TRAINING COURSE – 16 Hours

Chlorine is still the most widely used disinfectant in the United States, but other areas of the world are beginning to use other methods of disinfection with increasing frequency. Since chlorine is still widely used, a thorough understanding of how it disinfects and is implemented is important to those interested in water treatment or food processing.

Chlorine is considered a powerful pesticide and we will focus upon chlorine utilization as a disinfectant. Chlorination has been proven to be an effective against bacteria and viruses. However, it cannot disinfect all waterborne pathogens. Certain pathogens, namely protozoan cysts, are resistant to the effects of chlorine. Chlorine is also powerful oxidant.

Course Purpose

The main purpose of this CEU course is to provide continuing education in understanding various chlorination and disinfection methods for disinfecting water and wastewater with an emphasis on hazard communication and regulations. We will also study some of the other disinfection methods like ozonation and ultraviolet radiation. We will also cover water chemistry, pH, EPA rules, sampling procedures, general water laboratory procedures and waterborne pathogens.

Course Focus

This course will focus upon gaseous, solid and liquid form of chlorine (Cl_2) which is a water additive used by municipal water/wastewater systems to control microbes. It is relatively inexpensive and has the lowest production and operating costs and longest history for large continuous disinfection operations. Conventional chlorination will be the primary focus ensuring the operator provides a proper residual to reduce the chance of pathogen regrowth in water storage tanks or distribution system or wastewater treatment process and does this in a safe manner.

Target Audience

The target audience for this course includes water distribution workers, well drillers, pump installers, water treatment operators, and wastewater operators. Also included are people interested in working in a water treatment/wastewater treatment or distribution facility and/or wishing to maintain CEUs for a certification license or to learn how to perform their job safely and effectively, and/or to meet education needs for promotion. There are no prerequisites, and no other materials are needed for this course.

Course Statement of Need

All water and wastewater operators need to be able to describe chlorination procedures, properly demonstrate proper, safe operation of various disinfectants for water and wastewater treatment and describe the need for to comply with regulatory standards regarding both sampling and OSHA safety regulations.

General Learning Objectives

At the conclusion of the class, each participant will take a written examination and complete a course evaluation. Participants will have the opportunity to acquire knowledge of the following concepts.

General Learning Objectives

Chapter 1- Revised Hazard Communication Standard

Describe the revised hazard communication standard.

Chapter 2 - Waterborne Pathogens

Describe commonly found waterborne organisms and diseases.

Chapter 3- Disinfection Rules

Describe disinfectant by-products and DBPRs regulations.

Chapter 4 - Water Chemistry

Describe basic water chemistry, halogens and pH.

Chapter 5 -Chlorine Section

Describe chlorination processes.

Chapter 6- Hypochlorites and Chloramines

Describe disinfection using hypochlorites and chloramines.

Chapter 7 - Chlorination Safety and Equipment Section

Describe chlorination safety and related equipment.

Chapter 8 - Alternative Disinfectants

Describe various alternative disinfectants, like chlorine dioxide, ozone and ultraviolet radiation. Many food processors will also utilize these alternative disinfectants.

Chapter 9- Respiratory Protection Section

Describe the need and rules regarding respiratory protection.

Chapter 10- Laboratory Analysis

Describe disinfection related testing and microbial examination techniques.

Specific Learning Objectives with Outcomes Section

Chapter 1- Revised Hazard Communication Standard

Section Focus: You will learn the basics of hazard communication. At the end of this section, you will be able to describe the revised hazard communication standard. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: The revised Hazard Communication Standard (HazCom 2012) requires employers disclose toxic and hazardous substances, to provide employees with unrestricted access to Safety Data Sheets (formerly referred to as Material Safety Data Sheets), and to provide health and safety training so employees understand risks.

Chapter 1 -Hazard Communication Learning Topics

Hazard Communication Introduction–TECH & SAFETY

Globally Harmonized System–TECH & SAFETY

United Nations System–TECH & SAFETY

Building Blocks–TECH & SAFETY

Hazard Classifications–TECH & SAFETY

GPS Physical Hazards–TECH & SAFETY

Explosives–TECH & SAFETY

Flammable Aerosols–TECH & SAFETY

Gases under Pressure–TECH & SAFETY

Flammable Solids–TECH & SAFETY

Pyrophorics–TECH & SAFETY

Organic Peroxides–TECH & SAFETY

Skin Irritation–TECH & SAFETY

Germ Cell Mutagenicity–TECH & SAFETY

Reproductive Toxicity–TECH & SAFETY

Aspiration Hazard–TECH & SAFETY

Chronic Aquatic Toxicity–TECH & SAFETY

Bridging Principles–TECH & SAFETY

Labels–TECH & SAFETY

SDS Standards–TECH & SAFETY

SDS Definitions–TECH & SAFETY

Post Quiz

Chapter 2 - Waterborne Pathogens

Section Focus: You will learn the basics of waterborne diseases and proper identification. At the end of this section, you will be able to describe commonly found waterborne organisms and diseases. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: Water/wastewater treatment operators, food/beverage workers, and agricultural food processors are committed to keeping the public water and food supply free of potential risks that lead to waterborne illnesses; investigating transmission of pathogens that may result in such illnesses; and implementing strategies that will reduce the spread of further sickness. Much of this work is done with chlorine as the primary disinfectant agent. The use of water chlorination to disinfect public water supplies and food processing facilities, which began in

the early 1900s, has had major impacts on the incidence of waterborne disease in the U.S. and worldwide.

Chapter 2- Waterborne Pathogens Learning Topics

Microbiological Contaminants– CRAO & WQ

Coliform Bacteria – M/O

TCR Provisions – CRAO & WQ

Related Microbes – CRAO & M/O

Bacteriological Monitoring – CRAO & M/O

Types of Samples – CRAO

Coliform Present – CRAO

Heterotrophic Plate Count – CRAO

Total Coliforms– CRAO

RTCR – CRAO & M/O

Pathogens – CRAO & M/O

Viral Diseases – CRAO

Cryptosporidiosis – CRAO& M/O

Sampling Procedures - CRAO& M/O

Chain of Custody– CRAO

Common Sample Questions– CRAO & WQ

Summary– CRAO & WQ

Post Quiz

Chapter 3- Disinfection Rules

Section Focus: You will learn the basics of water disinfection rules with an emphasis on Chlorine. At the end of this section, you will be able to describe disinfectant by-products and DBPRs regulations. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: Pathogens, such as *Giardia*, *Cryptosporidium*, and viruses, are often found in source water and unsanitary food processing/canneries, and wineries and can cause gastrointestinal illness. Illnesses include diarrhea, vomiting, cramps and other health risks. In many cases, water needs to be disinfected to inactivate (or kill) these microbial pathogens. However, disinfectants can react with naturally-occurring materials in the water to form byproducts including:

- Trihalomethanes (THM),
- Haloacetic acids (HAA),
- Chlorite, and
- Bromate.

EPA has developed the DBPRs to limit exposure to these disinfectant byproducts.

Chapter 3- Disinfection Rules Learning Topics

Safe Drinking Water Act Introduction- WQ & CRAO

Disinfection Rule Stages 1&2- DIST & CRAO

Bromate - CRAO

DDBPs- WQ & CRAO

Summary

Post Quiz

Chapter 4 - Water Chemistry

Section Focus: You will learn the basics of water chemistry with an emphasis on chemical compounds and Chlorine. At the end of this section, you will be able to describe basic water chemistry, halogens and pH. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: All treatment operators and food processing laboratory analysts at some time will either take lab samples or run lab analysis. All operators and agricultural food processors who take samples or run the facility should know the principles of pH, basic chemistry principles and understand simple treatment chemical compounds.

Chapter 4 – Water Chemistry Learning Topics

Halogens - TECH
Periodic Table- TECH
Bonding- TECH
Energy- TECH
Reactions- TECH
Acidity and Basicity- TECH
pH- TECH & O&M
Alkalinity- TECH & O&M
Fluorine- TECH
Bromine- TECH
Iodine- TECH
Astatine- TECH
Hard Water- TECH
Post Quiz

Chapter 5 -Chlorine Section

Section Focus: You will learn the basics of water disinfection with an emphasis on Chlorine. At the end of this section, you will be able to describe chlorination. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: Traditionally, the use of chlorine gas was the most common method of water disinfection. Chlorine gas itself is relatively inexpensive but is a highly toxic chemical that must be transported and handled with extreme caution. It is stored under pressure in large tanks and is released into the water or wastewater as a gas or food processing as a liquid.

Chapter 5 - Chlorine Learning Topics

Chlorine Timeline - TECH
Chlorine Diagrams # 1- TECH
Elemental Chlorine Introduction- TECH
Exposure Limits – DISN & SAFETY & O&M
Atomic Structure- TECH
Chlorine Disinfectant Qualities- TECH & O&M
Chlorine Gas Section- TECH & O&M
Pathophysiology – SAFETY
Chlorine Diagrams # 2- TECH & O&M
Chlorine's Effectiveness- TECH & DISN & O&M
Benefits of Chlorine- TECH & DISN & O&M
Amperometric Titration- TECH & O&M

DPD Method- TECH & O&M
Chlorine Residual Section- TECH & DISN & O&M
Chlorine Diagrams # 3- TECH & DISN & O&M
Chemistry- TECH & DISN & O&M
Summary
Post Quiz

Chapter 6- Hypochlorites and Chloramines

Section Focus: You will learn the basics of water disinfection with an emphasis on using hypochlorites, and chloramines. These two chemicals are commonly used in both food / beverage processing, wine production and water treatment. At the end of this section, you will be able to describe disinfection using hypochlorites and chloramines. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: Chloramines - Sodium or Calcium hypochlorite is a diluted liquid form of chlorine that is also commonly used for disinfection.

Chapter 6 - Hypochlorites and Chloramines Learning Topics

Chloramines- TECH & DISN & O&M
Chloramine Breakdown- TECH & DISN & O&M
Sodium Hypochlorite- TECH & DISN & O&M
Sodium Hypochlorite Solutions- TECH & DISN & O&M
Exposure- TECH & DISN & O&M
Troubleshooting- TECH & DISN & O&M
Well Maintenance- TECH & DISN & O&M
Calcium Hypochlorite- TECH & DISN & O&M
System Sizing- TECH & DISN & O&M
Chlorine Production- TECH & DISN & O&M
System Operation- TECH & DISN & O&M
Salt Addition- TECH & DISN & O&M
Summary- TECH & DISN & O&M
Post Quiz

Chapter 7 - Chlorination Safety and Equipment Section

Section Focus: You will learn the basics of disinfection equipment and safety requirements with an emphasis on Chlorine. At the end of this section, you will be able to describe chlorination safety and related equipment. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: You as a treatment operator or food processing worker will need to use safe working procedures when exposed to this dangerous chemical substance. You need to master chlorine safety training and safe work practices. This section teaches you about the chemical properties of chlorine, how they may be exposed, and the physical and health hazards of chlorine.

Chapter 7- Safety and Chlorination Equipment Learning Topics

Chlorine Containment- TECH & SAFETY & O&M
Health Hazards- TECH & DISN & O&M
Respiratory Protection- TECH & DISN & O&M
ABC Reminder- TECH & DISN & O&M
Equipment Requirements- TECH & DISN & O&M

Chlorine Diagrams # 4- TECH & DISN & O&M
Chlorine Diagrams # 5- TECH & DISN & O&M
Chlorine Leak- TECH & DISN & O&M & SAFETY
Chlorine Cylinder Safety Procedure- TECH & DISN & O&M & SAFETY
Chlorine Storage- TECH & DISN & O&M
Spill Procedure- TECH & DISN & O&M & SAFETY
Leak Procedure- TECH & DISN & O&M & SAFETY
Emergency Response Plan- TECH & DISN & O&M & SAFETY
Summary- TECH & DISN & O&M & SAFETY
Post Quiz

Chapter 8 - Alternative Disinfectants

Section Focus: You will learn the basics of water disinfection with an emphasis alternative disinfectants. At the end of this section, you will be able to describe various alternative disinfectants like Ozone. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: Traditionally, the use of chlorine gas was the most common method of water disinfection, however, Chlorine gas creates dangerous disinfection by-products. Therefore, we need to utilize alternative disinfectants, like chlorine dioxide, ozone and ultraviolet radiation. Many food processors will also utilize these alternative disinfectants.

Chapter 8 -Alternative Disinfectants Learning Topics

Chlorine Dioxide- TECH & DISN & O&M
Chlorine Dioxide Advantages- TECH & DISN & O&M
Phosphine- TECH & DISN & O&M
Chlorine Dioxide Testing Methods- TECH & DISN & O&M
Ultraviolet Radiation- TECH & DISN & O&M
Photoelectric Cell- TECH & DISN & O&M
Advantages and Disadvantages- TECH & DISN & O&M
Ozone - TECH & DISN & O&M
Advantages- TECH & DISN & O&M
Alternative Disinfectants Diagram #1- TECH & DISN & O&M
Alternatives Summary- TECH & DISN & O&M
Post Quiz

Chapter 9- Respiratory Protection Section

Section Focus: You will learn the basics of respiratory protection. At the end of this section, you will be able to describe the need and rules regarding respiratory protection. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: OSHA 1910.134 – Respiratory Protection

(c) - Respiratory protection program. This paragraph requires the employer to develop and implement a written respiratory protection program with required worksite-specific procedures and elements for required respirator use. The program must be administered by a suitably trained program administrator.

Chapter 9- Respiratory Protection Learning Topics

Introduction –TECH & SAFETY
Types of Respirators–TECH & SAFETY
Correct Fit–TECH & SAFETY
OSHA Overview–TECH & SAFETY
RP Responsibilities–TECH & SAFETY
Program Evaluation–TECH & SAFETY
RP Recordkeeping–TECH & SAFETY
Training Certificate–TECH & SAFETY
Fit Testing–TECH & SAFETY
Filter Identification–TECH & SAFETY
Program Checklist–TECH & SAFETY
Respiratory Protection Schedule–TECH & SAFETY
Medical Evaluation–TECH & SAFETY
Gas and Vapors–TECH & SAFETY
RP Cleaning–TECH & SAFETY
Respirator Storage–TECH & SAFETY
Personal Protective Equipment–TECH & SAFETY
Post Quiz

Chapter 10- Laboratory Analysis

Section Focus: You will learn the basics of water laboratory analysis with an emphasis on Chlorine and microorganisms. At the end of this section, you will be able to describe disinfection related testing and microbial examination techniques. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: Laboratory analysis of water quality refers primarily to the chemical, physical, biological, and radiological characteristics of water. It is a measure of the condition of water relative to compliance or process control requirements. Laboratory analysis is frequently used by reference to a set of standards against which compliance, generally achieved through treatment of the water, can be assessed

Chapter 10- Lab Analyst Section Learning Topics

Turbidity Testing - CRAO
Residual Chlorine- CRAO
Chlorine Residual Reagent- CRAO
DPD Titration Method- CRAO
Biological Procedure Introduction
Protozoan Pathogens- CRAO & M/O
Method 1623- CRAO & M/O
Method 1604- CRAO & M/O
Summary
Post Quiz

Topic Legend

This CEU course covers several educational topics, functions, purposes, objectives, requirements and theories of conventional disinfection, including safety, bacteriological monitoring and regulatory compliance. The topics listed below are to assist in determining which educational objective or goal is covered for a specific topic area:

CRAO: The regulatory and compliance component. May be a requirement of the SDWA or CWA act or State Regulations, i.e. Compliance, non-compliance, process control related sampling, food processing, wine production or other drinking water related requirement.

DISINFECTION (DISN): This area covers plant or food processing disinfection procedures. Part of O&M training for many employees: operators or applicators. May include alternative disinfection procedures, i.e. Chloramines, Ozone and Ultraviolet.

M/O: The biological component. The microorganisms that are specifically found in drinking water or associated with raw food/beverage processing. This section may be part of required sampling, i.e. Total Coliform Rule or other biological related sampling. O&M or laboratory training requirement for many employees; applicators or operators.

O&M: This area is for normal operation and/or maintenance of the plant, i.e. chlorination equipment. Part of O&M training requirement for many employees; applicators or operators.

SAFETY: This area is describing process safety procedures. O&M training requirement for many employees; applicators or operators.

TECHNICAL (TECH): The mechanical or physical treatment process/component. The conventional or microfiltration process including processes/ applications/ engineering/ theories. Part of O&M training for many employees; applicators or operators.

WQ: Having to do with water quality or pollutants, i.e., hard water to primary water standards. May be a requirement of the SDWA and/or water chemistry concerns. This along with the EPA information is to satisfy the regulatory portion of your training.

Task Analysis and Training Needs Assessment Process Information Gathering

Task Analysis and Training Needs Assessments have been conducted to determine or set Needs-To-Know for the basis of this continuing education course. TLC has primary used Training Provider Manual for the Pennsylvania Water and Wastewater System Operator Training Program for course goal setting and learning objectives for all three training formats; conventional classroom, distance paper based and web based training.

Specific Course Goals and Timed Outcomes (Beta Testing)

Initial Alpha Testing 2005. Chlorination 404, 303, 202, 101 Original Master Course

Originally, this assignment was in modules which allowed the specific breakdown for each specific course.

Twenty students were given a task assignment survey in which to track their times on the above learning objectives (course content-Section focus) and utilized a multiple-choice style answer sheet to complete their final assignment. All students were given 30 days to complete this assignment and survey. Twenty students were selected for this assignment. Thirteen of the students held water distribution or water treatment operator certification positions, and seven students were wastewater treatment operators. Fourteen out of twenty students were successfully tested. None of the test group received credit for their assignment. Six students failed the final examination. All of the students completed the reading assignment. All of the wastewater treatment operators passed the assignment. The average times were based upon the outcomes of the fourteen students who passed. Rusty Randall, Proctor, February 2005

Final Outcome

Over one hundred students have completed the current assignment with an average score of 86 percent in 16.4 hours, average educational age of 12th grade and 1.1 years of operational experience. Rusty Randall, Proctor, MACI July 2012

Final Assessment Conclusion

The average time for Disinfection Principles is 16.4 hours with an average score of 86 percent.

Accreditation Formula for Figuring CEU Credit

The results of beta testing were used in conjunction with a formula to determine average student time for accreditation purposes for intended audiences. This formula may not work for unintended audiences.

- 1 page of text = 2 minutes of student time.
- 1-word practice problem = 1 minute of student time.
- 1-word quiz/exam question = 1 minute of student time.

Course Page Count Total

1 page of text = 2 minutes of student time.

1 exam question = 1 minute of student time

575 pages (not including Assignment) times 2 equals 1150 divided by 60 minutes = 19.00 hours

150 questions equals 2.50 hours

Total time 21.50 hours We are asking for 16 hours of credit.

Beta Testing Survey Short Result

1. The difficulty of your course.

Very Easy 0 1 2 3 4 5 Very Difficult

2. Please rate the difficulty of the testing process.

Very Easy 0 1 2 3 4 5 Very Difficult

3. Please rate the subject matter on the exam to your actual field or work.

Very Similar 0 1 2 3 4 5 Very Different

Task Analysis and Training Needs Assessment Process Information Gathering

Task Analysis and Training Needs Assessments have been conducted to determine or set Needs-To-Know for the basis of TLC's continuing education courses. The following is a listing of some of those who have conducted extensive valid studies from which TLC has based the continuing education program upon: the Environmental Protection Agency (EPA), the Arizona Department of Environmental Quality (ADEQ), the Texas Commission of Environmental Quality (TCEQ), Pennsylvania Department of Environmental Protection (PDEP) and the Association of Boards of Certification (ABC).

TLC has primarily used Training Provider Manual for the Pennsylvania Water and Wastewater System Operator Training Program for course goal setting and learning objectives for all three training formats; conventional classroom, distance paper based and web based training.

The titles or names of subjects (Learning Objectives) may be changed for readability purposes. Some of the terms used in this document may be part of a copyrighted adult learning assessment process and in these cases, we utilize generic terminology. The needs assessment/survey maintains our training and education materials criteria. Assessments and changes are performed based on changes in technology, evaluations of the students, regulatory changes and editorial corrections. Most of this information is considered intellectual property and may not be owned by TLC but by third parties. All of TLC's information is proprietary.

ADDIE

TLC utilizes a five-phase instructional design model consisting of Analysis, Design, Development, Implementation, and Evaluation for our continuing education courses. Each course design step has an outcome that feeds into the next step in the sequence. The five phases of ADDIE are as follows:

ANALYSIS

During the Training Needs Assessment Process Information Gathering Analysis phase, the course designer(s) (see Subject Matter Experts and Contributing Editors) identifies the learning need, the goals and objectives, the student's needs, existing knowledge, Course Statement of Need, and any other relevant characteristics (State or Federal Need-to-Know) and to ensure that students are learning what is relevant for their job.

DESIGN

This is the systematic process of specifying learning objectives from the Training Needs with a focus on Bloom's Taxonomy. A detailed storyboard following the Needs Assessment/Survey and/or Course Statement of Need will determine the course content.

DEVELOPMENT

The actual creation (production) of the training content will begin based upon the Design phase using Bloom's Taxonomy. At this time, a decision is made to proceed or table the course.

IMPLEMENTATION

During implementation, the Alpha testing plan is put into action and a procedure for course and/or assessment revision is implemented. These course materials and assessments are delivered or distributed to the student group. After delivery, the effectiveness of the training materials is evaluated in Beta testing phase. All of our courses have extensive Alpha and Beta testing to ensure job relevancy, correct information and course learning objectives are met.

EVALUATION

This phase consists of (1) formative and (2) summative evaluation from Alpha and Beta testing. Formative evaluation is present in each stage of the ADDIE process. Summative evaluation consists of tests designed for criterion-related referenced items and providing opportunities for feedback from the students and proctor.

Administrative and instructional staff will collect all student concerns (verbal, written and surveys) and distribute these to TLC Administrative personnel for evaluation and course corrections. Course and/or Assessment revisions are made as necessary.

Precept-Based (Micro-Learning) Training Course

TLC's training courses are based upon a form of induction training, made of topical and technical precepts that are discovered in the Needs Assessment/Survey and/or Training Needs Assessment Process Information Gathering. The training topics or learning objectives are made up of "micro-content" or "precepts"— or small chunks of information that can be easily digested.

These bite-size pieces of technical information are considered to be one of the most effective ways of teaching students new or important information (regulatory or technical) because it helps the mind retain knowledge easier.

Micro-learning or precept-based training doesn't rely on the student to process a large amount of information before breaking it down. Our method includes short modules with clearly defined learning goals for each section. This method allows a student to hone in on a particular skill, then given the opportunity to exhibit their knowledge in the final assessment (assignment).

Course Training/Assessment Needs Methodology

Technical Learning College identified training/assessment needs by placing identifying them in two categories; internal and external.

Internal Methods include:

- ✓ Observation
- ✓ Interviews
- ✓ Instruments: Perception instruments and Knowledge based assessments
- ✓ Student records and reports
- ✓ Group problem analysis (Classroom or Seminars)
- ✓ Performance or Survey appraisals

External Methods include:

- ✓ Outside consultants (Completion)
- ✓ Government Certification Reviews (Training Needs)
- ✓ Records and reports from other agencies

The needs assessment/survey maintains our training and education materials criteria. Assessments and course material changes are performed based on changes in technology, evaluations of the participants and regulatory changes. Materials are assessed yearly or as needed to insure course integrity.

**Course Author
Melissa Durbin**

This course was co-authored by Melissa Durbin; she has over 25 years of wastewater treatment teaching experience as a college instructor. Melissa has written the several nationally accepted wastewater treatment manuals since 2001. This course has been accepted in most States for continuing education credit. Melissa has taught approximately 10,000 students about water/wastewater treatment, disinfection and related classes. She will be available to answer questions relating this course.

Extensive Academic Research

Technical Learning College's (TLC's) continuing education course material development was based upon several factors; field experience working in the water quality field, extensive academic research (teaching in the community college system), advice from subject matter experts (State officials and industry leaders), data analysis, task analysis and training needs assessment process information gathered from other states.

Both Melissa and Jeff Durbin are the two primary Instructors, Subject Matter Experts and Technical Writers have trained and/or certified more than ten thousand students. These two Instructors teach on a daily basis in a classroom setting throughout Arizona and on-line to students nationwide. See below for more information.

**Primary Course Designers Melissa and Jeff Durbin
Melissa Durbin**

This course was co-designed by Melissa Durbin; she has over 25 years of teaching water and wastewater treatment experience as a college instructor. Melissa has written the several nationally accepted water and wastewater treatment manuals. Melissa has taught approximately 20,000 students about water and wastewater treatment and related classes. She will be available to answer questions relating this course.

Jeff Durbin

This course was co-designed by Jeff Durbin, over 10 years of water and wastewater treatment experience as a backflow inspector for the City of Phoenix and 20 years of water and wastewater treatment experience. Jeff has taught approximately 20,000 students about water and wastewater treatment primarily in water distribution, and pollution control (water quality) related classes. Jeff will also be able to answer any question pertaining to disinfection or chlorination.

Advice from Subject Matter Experts

Both Melissa and Jeff Durbin are professional trainers and have been educated in current trends in professional education and continuing education needs.

Course Compiler

Peter Easterberg, Detail-oriented technical writer/technical editor/desktop publisher/copy editor. 20 years' experience editing and writing feasibility and trade-off studies, test procedures, specifications, user manuals, company policies, HR forms, and ISO-9000 documents. Exceptional grammatical/written communication skills. "Go-to" person for Microsoft Word, Outlook, and general computer questions. Internet Webmaster Certificate (including HTML)

Contributing Editors

James L. Six Received a Bachelor of Science Degree in Civil Engineering from the University of Akron in June of 1976, Registered Professional Engineer in the State of Ohio, Number 45031 (Retired), Class IV Water Supply Operator issued by Ohio EPA, Number WS4-1012914-08, Class II Wastewater Collection System Operator issued by Ohio EPA, Number WC2-1012914-94

Joseph Camerata has a BS in Management with honors (magna cum laude). He retired as a Chemist in 2006 having worked in the field of chemical, environmental, and industrial hygiene sampling and analysis for 40 years. He has been a professional presenter at an EPA analytical conference at the Biosphere in Arizona and a presenter at an AWWA conference in Mesa, Arizona. He also taught safety classes at the Honeywell and City of Phoenix, and is a motivational/inspirational speaker nationally and internationally.

James Bevan, Water Quality Inspector S.M.E. Twenty years of experience in the environmental field dealing with all aspects of water regulations on the federal, state, and local levels. Experience in the water/wastewater industry includes operation of a wastewater facility, industrial pretreatment program compliance sampling, cross-connection control program management, storm water management, industrial and commercial facility inspections, writing inspection reports for industry, and technical reports per EPA permit requirements. Teacher and Proctor in Charge for Backflow Certification Testing at the ASETT Center in Tucson for the past 15 years and possess an Arizona Community College, Special Teaching Certificate in Environmental Studies. Extensive knowledge and experience in college course and assignment/assessment writing.

Dr. Pete Greer S.M.E., Retired biology instructor, chemistry and biological review.

Jack White, Environmental, Health, Safety expert, City of Phoenix. Art Credits

Ongoing Course Evaluation

Administrative and instructional staff will collect all student concerns (verbal, written and surveys) and distribute these to the Course Editor or Copyeditors for evaluation and course corrections. Administrative and instructional staff will collect all student concerns (verbal, written and surveys) and distribute these to TLC Administrative personnel for evaluation and course corrections. Course and/or Assessment revisions are made as necessary.

Editor's Discretion

The Course Editor may change the course assessment (assignment), course text, objective, artwork and topical order as necessary for security, corrective, printing, readability or typesetting purposes. The assessment may be rotated for security purposes and the course material may be updated to reflect any regulatory updates and/or corrections. The overall course objective or topic guide may be in a different order than the course manual for the reason of typesetting or copy-editing purposes. Course materials, charts and artwork amendments, adjustments, modifications may be performed to reflect regulatory/safety text/artwork updates, Bloom's taxonomy changes, error adjustments and comprehension. These changes generally do not reflect major course material changes, but are minor in nature.

Course Procedures for Registration and Support

All of Technical Learning College correspondence courses have complete registration and support services offered. Delivery of services will include, e-mail, web site, telephone, fax and mail support. TLC will attempt immediate and prompt service.

When a student registers for a distance or correspondence course, he/she is assigned a start date and an end date. It is the student's responsibility to note dates for assignments and keep up with the course work.

If a student falls behind, he/she must contact TLC and request an end date extension in order to complete the course. It is the prerogative of TLC to decide whether to grant the request. All students will be tracked by a unique number will be assigned to the student.

Student's Identity, Attendance, and Participation Verification

A proctoring report and/or computer-tracking program validates proper identity, attendance and participation. The student shall submit a driver's license for signature verification and track their time worked on the assignment. The student shall also sign an affidavit verifying they have not cheated and worked alone on the assignment. We follow up with telephone confirmation and/or quiz review assessment. All student attendance is tracked on TLC's student attendance database.

Teaching Techniques and Assessment Tools

Our training courses are based upon a form of induction training, made of topical and technical precepts. The training topics are made up of "micro-content" or "precepts"—or small chunks of information that can be easily digested. These bite-size pieces of technical information are considered to be one of the most effective ways of teaching people new information because it helps the mind retain knowledge easier. Micro-learning or precept-based training doesn't rely on the student to process a large amount of information before breaking it down. Our method includes short modules with clearly defined learning goals for each section with a post quiz and a final assessment (quiz). This method of pre-quiz allows a student to hone in on a particular skill, then given the opportunity to exhibit their knowledge in the final assessment.

Educational Learning Objective Topics

The CEU course covers several educational topics/functions/purposes/objectives. The topics listed are to assist in determining which educational objective or goal is covered for a specific topic area. This information is available in the detailed beta-testing information and may be found in the course's table of contents. The titles or names of subjects may be changed for readability purposes.

Final Examination for Credit

Opportunity to pass the final comprehensive examination is limited to three attempts per course enrollment.

Required Texts

This course comes complete and does not require any other materials.

Environmental Terms, Abbreviations, and Acronyms

TLC provides a glossary in the rear of this manual that defines, in non-technical language, commonly used environmental terms appearing in publications and materials, as well as abbreviations and acronyms used throughout the EPA and other governmental agencies.

ADA Compliance

TLC will make reasonable accommodations for persons with documented disabilities. Students should notify TLC and their instructors of any special needs. Course content may vary from this outline to meet the needs of these particular students.

Student Verification

The student shall submit a driver's license for signature verification and track their time worked on the assignment. The student shall sign an affidavit verifying they have not cheated and worked alone on the assignment. All student attendance is tracked on the student attendance database.

TLC Contact Information

All instructors and administrative staff are obligated to respond within 1 day by email, snail mail or telephone providing proper guidance to successfully complete the assignment. Email and telephone inquiries are handled quickly, generally within 2 hours of the call. We encourage students to complete their work with less frustration and fewer delays by calling or e-mailing us for any concern. We attempt to provide direct interaction similar to conventional classroom training.

Security and Integrity

All students are required to do their own work. All lesson sheets and final exams are not returned to the student to discourage sharing of answers. Any fraud or deceit and the student will forfeit all fees and the appropriate agency will be notified. A random test generator will be implemented to protect the integrity of the assignment.

Student Information Personal Data Security Procedures

All information regarding the student is strict and privileged only. This information is held in secure databases and is not sold or provided to any one unless the student requests a copy or a State agency does an audit. Even during audits, we restrict confidential information unless the Agency can provide a legitimate excuse. Some of this security information and data is priority and details are not provided. Students are not provided with any passwords at this time.

Certificate of Completion

TLC will offer the student either pass/fail or a standard letter grading assignment. If TLC is not notified, the student will only receive a pass/fail notice. In order to pass your final assignment, you are required to obtain a minimum score of 70% on your assignment.

The certificate of completion will have all text in capital letters and there is a water mark of the Technical Learning College in three colors along with anti-counterfeiting security measures on the edge of the certificate. An electronic copy is assigned to the student's electronic record with issue date.

Disclaimer and Security Notice

The student shall understand that it their responsibility to ensure that this CEU course is either approved or accepted in my State for CEU credit. The student shall understand and follow State laws and rules concerning distance learning courses and understand these rules change on a frequent basis and will not hold Technical Learning College responsible for any changes.

The student shall understand that this type of study program deals with dangerous conditions and will not hold Technical Learning College, Technical Learning Consultants, Inc. (TLC) liable for any

errors or omissions or advice contained in this CEU education training course or for any violation or injury caused by this CEU education training course material.

Student Assistance

The student shall contact TLC if they need help or assistance and double-check to ensure the registration page and assignment has been received and graded.

Instructions for Written Assignments

The Disinfection Principles training CEU course uses multiple choice and true/false questions. Answers may be written in this manual or typed out on a separate answer sheet. TLC prefers that students type out and e-mail their answer sheets to info@tlch2o.com, but they may be faxed to (928) 468-0675.

Feedback Mechanism (Examination Procedures)

Each student will receive a feedback or survey form as part of his or her study packet. The student will be able to find this form in the front of the assignment or lesson(assessment). The student can e-mail, snail mail or telephone TLC for any concern at any time.

Student Concerns

Most of student/training course related concerns are generally answered within 2 hours but not more than 24 hours. TLC has three support staff administrators with computers and telephones and have excellent communication and computer skills and able to respond and track all students and obtain or submit required forms and assignments. TLC has a dedicated computer student tracking system database that is backed-up on a daily bases and this information is secured and stored at a secure offsite location in case of fire or security problems. All student website information is tracked and documented for security measures.

Recordkeeping and Reporting Practices

TLC keeps all student records for a minimum of five years. It is the student's responsibility to give the completion certificate and/or paperwork to the appropriate government agencies. If necessary, we will electronically submit the required information to any required state agency for your certification renewals.

TLC Record Storage

TLC's training records include the following elements:

1. Individual course training (assessment) and registration page (Customer Order Record) is recorded in Excel format and the hard copies are scanned and stored in a computer database for 5 years and include the following:
 - a. the instructor(s) who taught each session on that date the of the training session or grading was offered (in comments section registration page) as well as which instructor was considered to be the lead instructor(s) and by the Director.
 - b. the name of the instructor(s) and facilitator(s) who proctored and/or graded the examination for each training session if applicable (in comments section registration page);
 - c. the attendance sign-in sheet(s) (registration page) for each training course or session;
 - d. all graded and dated validated examination answer (Assessment) sheets for each examination attempt including an explanation (written in comments and/or Excel list) for any retests as well as a narrative explaining any assistance provided to the attendee before the re-test; and
 - e. session evaluation(survey)forms (in comments section registration page and or Excel list).

Grading Criteria

TLC offers students the option of either pass/fail or assignment of a standard letter grade. If a standard letter grade is not requested, a pass/fail notice will be issued. Final course grades are based on the total number of possible points. The grading scale is administered equally to all students in the course. Do not expect to receive a grade higher than that merited by your total points. No point adjustments will be made for class participation or other subjective factors. For security purposes, please fax or e-mail a copy of your driver's license and always call us to confirm we've received your assignment and to confirm your identity.

Final Assignment

The final examination assignment is determined by the examination administrator or the instructor and there are generally three versions that are readily available. There are also three levels of the examination from average, (5 Answers) Difficult (5 +All of the above) and very difficult (Six answers and All of the above). The student is provided the average rated examination unless there is a condition or concern that requires a more difficult examination. Example, two or more students at the same address or any suspicion of cheating or potential fraud. We try to ensure the security and learning experience. Assignments/answer keys are only accessible to instructors and administrative staff that have a need to know clearance.

Failure

If the student fails the examination, they are provided with two more chances to successfully pass the exam with a score of 70% or better. The student may receive a different and randomly generated exam. Upon failure of an exam, the student can submit their concerns in writing or submit a survey form and has the option to receive instructor assistance that would be equivalent to conventional classroom assistance in discovering the areas that are deficient. The instructor has the option in describing the assistance method or procedure depending upon the student's deficiencies.

Grading Criteria

TLC will offer the student either pass/fail or a standard letter grading assignment.

- A 900 – 1000 points
- B 800 – 899 points
- C 700 – 799 points
- D 600 – 699 points
- F <600 points

In order to successfully pass this course, you will need to have 70% on the final exam. The entire assignment is available on TLC's Website in a Word document format for your convenience.

Forfeiture of Certificate (Cheating)

If a student is found to have cheated on an examination, the penalty may include--but is not limited to--expulsion; foreclosure from future classes for a specified period; forfeiture of certificate for course/courses enrolled in at TLC; or all of the above in accordance with TLC's Student Manual. A letter notifying the student's sponsoring organization (State Agency) of the individual's misconduct will be sent by the appropriate official at TLC. No refund will be given for paid courses. An investigation of all other students that have taken the same assignment within 60-day period of the discovery will be re-examined for fraud or cheating. TLC reserves the right to revoke any published certificates and/or grades if cheating has been discovered for any reason and at any time. Students shall sign affidavit agreeing with all security measures. The student shall submit

a driver's license for signature verification and track their time worked on the assignment. The student shall sign an affidavit verifying they have not cheated and worked alone on the assignment.

Proctoring Instructions

Students enrolled in Technical Learning College's CEU courses that require proctored testing and **who do not live in the physical service area** of the Technical Learning College Test Center must nominate and gain prior approval of a proctor who will monitor course tests. A new proctor nomination form is required for each term and for each class.

PROCTORS, If Necessary...

A proctor is an individual who agrees to receive and administer a student's test(s) from Technical Learning College at the proctor's business email address. The test(s) will be ethically and professionally administered in a suitable testing environment (e.g., college/library or professional office). The proctor will return the test(s) to the Technical Learning College Test Center via fax immediately after administration, and the proctor will mail the exam within one (1) work day of administration to the Technical Learning College Test Center.

Proctors certify in writing to the Technical Learning College Test Center that the student completed the test according to all of the specific directions provided in the proctor guidelines letter. As the Proctor Nomination Form indicates, the student will identify the specific test(s) the proctor will monitor.

Any proctor the student nominates must be acting in the official capacity in one of the following positions:

- **College or University Personnel:** Dean, Department Chair, Student Records, Professional Staff Member of an adult/continuing education office or counseling center, Librarian, Professor, or any official testing center personnel if the tests are administered in the center.
- **Armed Forces Education Office Personnel**
- **Public or Private School Personnel:** Superintendent, Principal, Guidance Counselor, or Librarian.
- **Other:** Civil Service Examiner, Librarian for City/County, HR Professional, or Education/Training Coordinator.

The following persons do not qualify as proctors:

- **Co-workers, someone who reports to you or your immediate supervisor**
- **Friends**
- **Neighbors**
- **Relatives**

Nominating a Proctor

Students are responsible for identifying, nominating, and making all of the arrangements for the proctoring of their course tests, including the payment of any fees for services and the return of test materials to Technical Learning College Test Center (cost of FAX or postage). The proctor must be able to receive the student's test(s) via email as attachments. The Technical Learning College Test Center does not accept Yahoo, AOL, G-mail, Hotmail, or etc. email addresses.

If the student is unable to find a suitable proctor, they must contact the Technical Learning College Test Center for assistance immediately via email.

Proctor Nomination Form

Students will use the Proctor Nomination Form for nomination and approval of a proctor. The student will complete the top part of the form for each course s/he is taking, even if the same proctor is used for all tests. The student must click on the submit button for the data to be electronically transmitted to the Technical Learning College Test Center.

Disclaimer Notice

It is ultimately the student's responsibility to ensure that this CEU course is either approved or accepted in my State for CEU credit. The student shall understand State laws and rules change on a frequent basis and believe this course is currently accepted in their State for CEU or contact hour credit, if it is not, the student shall will not hold Technical Learning College responsible. The student shall also understand that this type of study program deals with dangerous conditions and that the student shall will not hold Technical Learning College, Technical Learning Consultants, Inc. (TLC) liable for any errors or omissions or advice contained in this CEU education training course or for any violation or injury caused by this CEU education training course material. The student shall will call or contact TLC if help or assistance is needed and double-check to ensure the registration page and assignment has been received and graded.

Affidavit of Exam Completion

The student shall affirm that they alone completed the entire text of the course. The student shall affirm that they completed the exam without assistance from any outside source. The student shall understand that it is their sole responsibility to file or maintain their certificate of completion as required by the state.

Refund Policy

We will beat any other training competitor's price for the same CEU material or classroom training. Student satisfaction is guaranteed. We will refund course fees if the course is not accepted for credit by the State. Otherwise, any other problem will be given an exchange credit towards an acceptable or approved course for the State. Once we are notified of the refund or exchange, we will generally issue a refund in 30 days of the problem and exchange within the same day.

When the Student finishes this course...

At the finish of this course, you (the student) will explain and describe chlorine and disinfection in relationship to proper water disinfection. You will also explain and describe related various hazard communication terms and conditions, including the revised Hazard Communication system and SDWA. The student will understand and explain the hazards of working with disinfectants, proper safety procedures, procedures, sampling techniques, general water biology and water chemistry.

Student shall be able to explain and describe...

1. Safe Drinking Water Act (SDWA).
2. Various conventional modern water/wastewater treatment disinfectants.
3. Various halogens and halides.
4. History of chlorination.
5. Waterborne diseases and viruses.
6. Chlorine gas.

7. Chlorine exposure limits, residuals and related information.
9. Sodium hypochlorite.
10. Calcium hypochlorite.
11. Chlorine-based disinfectants- Chloramines, and related oxidizers.
12. Chlorination equipment and safety requirements.
13. Chlorine health hazards.
14. Chlorine dioxide.
15. Water disinfection methods.
16. Alternative chlorination methods for water/wastewater disinfection.
17. Conventional bacteriological sampling and monitoring.

The student is required to submit the following information for assignment grading...

1. 70 PERCENT ON FINAL ASSESSMENT
2. DRIVER'S LICENSE
3. SCHEDULE OF TIME WORKED ON ASSIGNMENT
4. AFFIDAVIT OF EXAM COMPLETION
5. PROCTOR CERTIFICATION
6. TELEPHONE CONFIRMATION

Educational Mission

- *To provide TLC students with comprehensive and ongoing training in the theory and skills needed for the environmental education field,*
- *To provide TLC students with opportunities to apply and understand the theory and skills needed for operator certification,*
- *To provide opportunities for TLC students to learn and practice environmental educational skills with members of the community for the purpose of sharing diverse perspectives and experience,*
- *To provide a forum in which students can exchange experiences and ideas related to environmental education,*
- *To provide a forum for the collection and dissemination of current information related to environmental education, and to maintain an environment that nurtures academic and personal growth.*

CUSTOMER SERVICE RESPONSE CARD

NAME: _____

E-MAIL _____ PHONE _____

PLEASE COMPLETE THIS FORM BY CIRCLING THE NUMBER OF THE APPROPRIATE ANSWER IN THE AREA BELOW.

1. Please rate the difficulty of your course.

Very Easy 0 1 2 3 4 5 Very Difficult

2. Please rate the difficulty of the testing process.

Very Easy 0 1 2 3 4 5 Very Difficult

3. Please rate the subject matter on the exam to your actual field or work.

Very Similar 0 1 2 3 4 5 Very Different

4. How did you hear about this Course? _____

5. What would you do to improve the Course?

How about the price of the course?

Poor _____ Fair _____ Average _____ Good _____ Great _____

How was your customer service?

Poor _____ Fair _____ Average _____ Good _____ Great _____

Any other concerns or comments.