



BAYWORK

Grade 4 – 5 Exam

Wastewater Certification Workshop

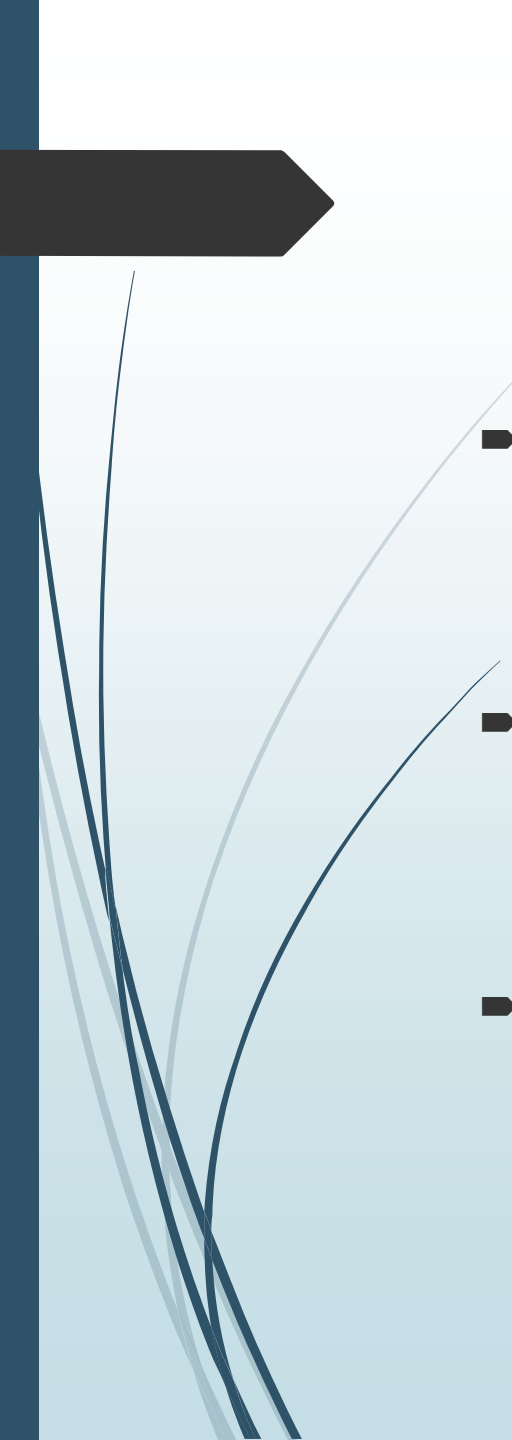
Regulations/Safety/Disinfection

Levi Fuller

Wastewater Treatment Plant Operations Supervisor

Dublin San Ramon Services District

fuller@dsrsd.com



Disclaimer

- Information purposes only the information presented here should not be construed to in anyway replace or be a substitute for adequate and updated training by an OSHA approved or otherwise competent person.
- This information is only provided “to assist” examinees in taking certification examinations. One should assume that additional information is required on all matters covered in this presentation.
- This information is not meant to be a substitute for a legal interpretation of the occupational safety and health regulations.

Key Wastewater Regulations

Dickey Water Pollution Control Act of 1949 – State Law. Established the **nine** California Regional Water Quality Control Boards.

Public Law 660 – Federal 1956 – Created regulations around water pollution control and provided grant funding to help agencies meet pollution control objectives.

The Porter-Cologne Act, State also known as the California Water Code, Section 7, was created in **1969** – Combined the State Water Rights Board and the State Water Resource Control Board.

The Clean Water Act of 1948 and 1972 – Federal- Required secondary treatment of wastewater.

Title 23. Waters Division 3. State Water Resources Control Board
and Regional Water Quality Control Boards

Chapter 26. classification of Wastewater Treatment Plants
and Operator Certification

Dickey Water Pollution Act (1949): Creation of State Water Pollution Control Board

- The Dickey Act **created a State Water Pollution Control Board consisting of nine gubernatorial appointees** representing specific interests Its duties included:
 - Setting statewide policy for pollution control
 - Coordinating the actions of those state agencies and political subdivisions in controlling water pollution.
 - The Legislature realized that California's water pollution problems were regional and depended on precipitation, topography, and population, as well as recreational, agricultural, and industrial development, all of which vary from region to region.
- The Dickey Act **established nine Regional Water Pollution Control Boards located in each of the major California watersheds.** The Regional Boards have responsibility for overseeing and enforcing the state's pollution abatement program. Nine gubernatorial appointees, representing water supply, irrigated agriculture, industry, and municipal and county government in that region, served on each Regional Water Board.

Public Law 660 - 1956

- "DECLARATION OF POLICY "SECTION 1. (a) In connection with the exercise of jurisdiction over the waterways of the Nation and in consequence of the benefits resulting to the public health and welfare by the prevention and control of water pollution, it is hereby declared to be the policy of **Congress to recognize, preserve, and protect the primary responsibilities and rights of the States in preventing and controlling water pollution, to support and aid technical research relating to the prevention and control of water pollution, and to provide Federal technical services and financial aid to State and interstate agencies and to municipalities in connection of with the prevention and control of water pollution.** To this end, the **Surgeon General of the Public Health Service** shall administer this Act through the Public Health Service and under the supervision and direction of the Secretary of Health, Education, and Welfare. "(b) Nothing in this Act shall be construed as impairing or in any manner affecting any right or jurisdiction of the States with respect to the waters (including boundary waters) of such States.

Public Law 660 - 1956

70 STAT.]

PUBLIC LAW 660—JULY 9, 1956

41

may deem desirable for making effective such agreements and compacts. No such agreement or compact shall be binding or obligatory upon any State a party thereto unless and until it has been approved by the Congress.

“RESEARCH, INVESTIGATIONS, TRAINING, AND INFORMATION

“SEC. 4. (a) The Surgeon General shall conduct in the Public Health Service and encourage, cooperate with, and render assistance to other appropriate public (whether Federal, State, interstate, or local) authorities, agencies, and institutions, private agencies and institutions, and individuals in the conduct of, and promote the coordination of, research, investigations, experiments, demonstrations, and studies relating to the causes, control, and prevention of water pollution. In carrying out the foregoing, the Surgeon General is authorized to—

“(1) collect and make available, through publications and other appropriate means, the results of and other information as to research, investigations, and demonstrations relating to the prevention and control of water pollution, including appropriate recommendations in connection therewith;

“(2) make grants-in-aid to public or private agencies and institutions and to individuals for research or training projects and for demonstrations, and provide for the conduct of research, training, and demonstrations by contract with public or private agencies and institutions and with individuals without regard to sections 3648 and 3709 of the Revised Statutes;

“(3) secure, from time to time and for such periods as he deems advisable, the assistance and advice of experts, scholars, and consultants as authorized by section 15 of the Administrative Expenses Act of 1946 (5 U. S. C. 55a);

“(4) establish and maintain research fellowships in the Public Health Service with such stipends and allowances, including traveling and subsistence expenses, as he may deem necessary to procure the assistance of the most promising research fellowships: *Provided*, That the total sum authorized to be appropriated for any fiscal year for fellowships pursuant to this subparagraph shall not exceed \$100,000; and

“(5) provide training in technical matters relating to the causes, prevention, and control of water pollution to personnel of public agencies and other persons with suitable qualifications.

“(b) The Surgeon General may, upon request of any State water pollution control agency, or interstate agency, conduct investigations and research and make surveys concerning any specific problem of water pollution confronting any State, interstate agency, community, municipality, or industrial plant, with a view of recommending a solution of such problem.

“(c) The Surgeon General shall, in cooperation with other Federal, State, and local agencies having related responsibilities, collect and disseminate basic data on chemical, physical, and biological water quality and other information insofar as such data or other information relate to water pollution and the prevention and control thereof.

“GRANTS FOR WATER POLLUTION CONTROL PROGRAMS

“SEC. 5. (a) There are hereby authorized to be appropriated for the fiscal year ending June 30, 1957, and for each succeeding fiscal year to and including the fiscal year ending June 30, 1961, \$3,000,000 for grants to States and to interstate agencies to assist them in meeting the

Among Other things established federal grants to assist State and Local governments to prevention and control of water pollution.

31 USC 529;
USC 5.

60 Stat. 810.

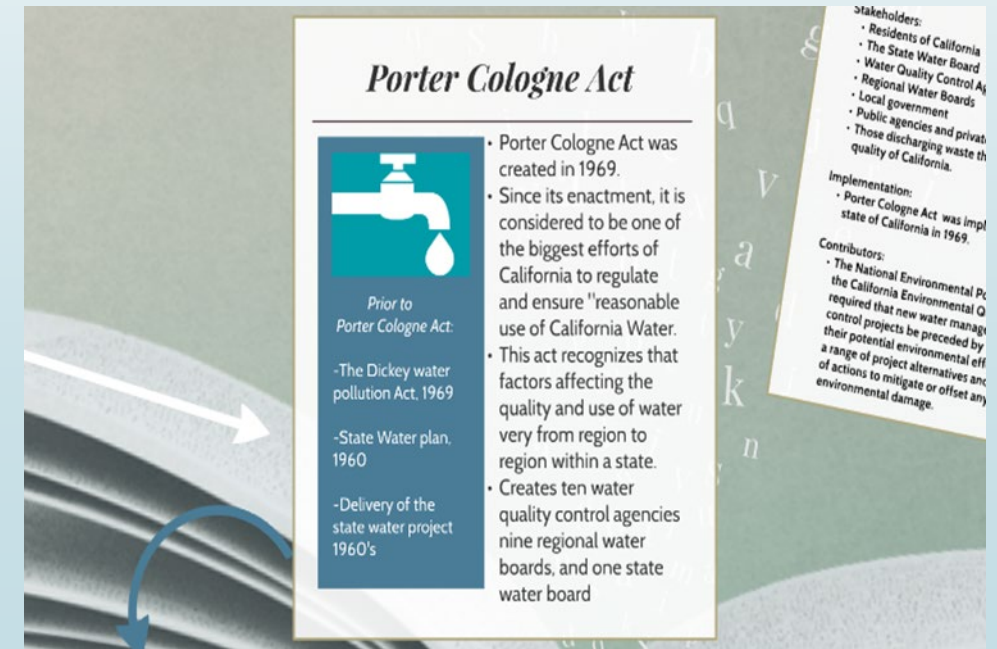
The Porter-Cologne Act

“Porter-Cologne Water Quality Control Act, the cornerstone of today's water protection efforts in California.”

“The ... state law was so influential that Congressional authors used sections of Porter-Cologne as the basis of the Federal Water Pollution Control Act Amendments of 1972, known as the Clean Water Act.”

the enforcement of Waste Discharge Requirements (WDRs) include

- **cease and desist orders**
- **clean up and abatement orders**
- **administrative civil liability orders**
- **civil court actions**
- **criminal prosecutions**



STATE - The Porter-Cologne Act, also known as **the California Water Code, Section 7**, was created in **1969** and is the law that governs water quality regulation in California. ... This act applies to surface water, groundwater, wetlands and both point and nonpoint sources of pollution.



- Expanded the authority of the State Water Resources Control Board and the 9 Regional Water Quality Control Boards
- uses the National Pollutant Discharge Elimination System (NPDES) permits for point source discharges and waste discharge requirements (WDRs) in order to keep people from degrading the water quality of the State.



Fact Sheet

STATE WATER RESOURCES CONTROL BOARD | 1001 I Street, Sacramento, CA 95814 | Mailing Address: P. O. Box 100, Sacramento, CA 95812-0100 | www.waterboards.ca.gov

The Nine Regional Water Quality Control Boards in California

The State Water Resources Control Board has jurisdiction throughout California. Created by the State Legislature in 1967, the Board protects water quality by setting statewide policy, coordinating and supporting the Regional Water Board efforts, and reviewing petitions that contest Regional Board actions. There are nine regional water quality control boards that exercise rulemaking and regulatory activities by basins. This organization is a result of the landmark Porter-Cologne Act* (*see page 2*).

Region 1 -- North Coast Regional Water Quality Control Board:

Del Norte, Glenn, Humboldt, Lake, Marin, Mendocino, Modoc, Siskiyou, Sonoma, and Trinity counties.

Region 2 -- San Francisco Regional Water Quality Control Board:

Alameda, Contra Costa, San Francisco, Santa Clara (north of Morgan Hill), San Mateo, Marin, Sonoma, Napa, Solano counties.

Region 3 -- Central Coast Regional Water Quality Control Board:

Santa Clara (south of Morgan Hill), San Mateo (southern portion), Santa Cruz, San Benito, Monterey, Kern (small portions), San Luis Obispo, Santa Barbara, Ventura (northern portion) counties.

Region 4 -- Los Angeles Regional Water Quality Control Board:

Los Angeles, Ventura counties, (small portions of Kern and Santa Barbara counties).

Region 5 -- Central Valley Regional Water Quality Control Board:

Modoc, Shasta, Lassen, Plumas, Butte, Glen, Colusa, Lake, Sutter, Yuba, Sierra, Nevada, Placer, Yolo, Napa, (N. East), Solano (West), Sacramento, El Dorado, Amador, Calaveras, San Joaquin, Contra Costa (East), Stanislaus, Toulumne, Merced, Mariposa, Madera, Kings, Fresno, Tulare, Kern. (Very small portions of San Benito, San Luis Obispo) counties.

Fresno Office: Fresno, Kern, Kings, Madera, Mariposa, Merced, and Tulare counties.

Redding Office: Butte, Glen, Lassen, Modoc, Plumas, Shasta, Siskiyou, and Tehama Counties.

Region 6 -- Lahontan Regional Water Quality Control Board:

Modoc (East), Lassen (East side and Eagle Lake), Sierra, Nevada, Placer, El Dorado, Alpine, Mono, Inyo, Kern (East), San Bernardino, Los Angeles (N/E corner) counties.

Region 7 -- Colorado River Regional Water Quality Control Board:

Imperial, San Bernardino, Riverside, San Diego counties.

Region 8 -- Santa Ana Regional Water Quality Control Board:

Orange, Riverside, San Bernardino counties.

Region 9 -- San Diego Regional Water Quality Control Board:

San Diego, Imperial, Riverside counties.

*The Porter-Cologne Water Quality Control Act took effect on January 1, 1970. It combined the State Water Rights Board and the State Water Resources Control Board and created the nine Regional Water Boards.

The Porter-Cologne Act built on institutions established 20 years earlier in the Dickey Water Pollution Act of 1949. Planning was to become a critical focus of the 20-year-old water boards. The planning mandates looked to protect beneficial uses, but also acknowledged that the boards should consider all of the significant factors that affect water quality. These plans were to contain a consideration of competing interests, but the study panel noted that "Conservatism in the direction of high quality should guide the establishment of objectives both in water quality control plans and in waste discharge requirements. A margin of safety must be maintained to assure protection of all beneficial uses."

In designing the planning requirements, the study panel expected the water boards to be proactive and to look on a 40- to 50-year horizon. "Problems must be anticipated, the necessary information and data obtained and plans formulated in advance." In many respects the study panel recognized the magnitude of the planning challenge it expected under the Porter-Cologne Act. It also recognized that the information feeding the planning process would expand and that the plans themselves would need regular review and updating.

Coupled with the underlying plans, the Porter-Cologne Act significantly expanded the enforcement authority of the water boards. Water quality control plans to protect beneficial uses would do little good if they could not be enforced. The Porter-Cologne Act strengthened the authorities available for the water boards so they could issue waste discharge requirements and remedial orders fashioned to implement the water quality control plans. It also included a suite of new administrative and judicial enforcement tools to compel compliance with board orders.

The Porter-Cologne Act was a cutting edge water quality law. Portions of it became the model for the 1972 amendments that invigorated the Federal Water Pollution Control Act. In many respects Porter-Cologne still surpasses the federal act, because it allows the water boards to comprehensively regulate surface and ground waters. It also allows the water boards to establish requirements for nearly any source of waste discharge, including nonpoint sources and certain other sources exempted from the federal act's permitting requirements.

Importantly, the Porter-Cologne Act was crafted in a way that would allow the water boards to plan for the long-term, but also to respond as our understanding of factors affecting water quality improved and as new challenges (such as storm water) emerged. In its strong foundations and flexible framework, the Porter-Cologne Act is different than its predecessors.

The Porter-Cologne Act began with an exchange in which the Legislature invited the State Board to initiate a comprehensive review of water quality control laws. All the work and negotiation by various stakeholders, the legislature and a study group established to review contemporary rulemaking (during 1969) crafted a law that at bottom was designed to accommodate and respond to a changing California.

(This narrative was edited from a longer historical treatise put together in July 2009, by SWRCB Chief Counsel Michael Lauffer)

(Fact sheet last updated June 12, 2013)

Federal Clean Water Act

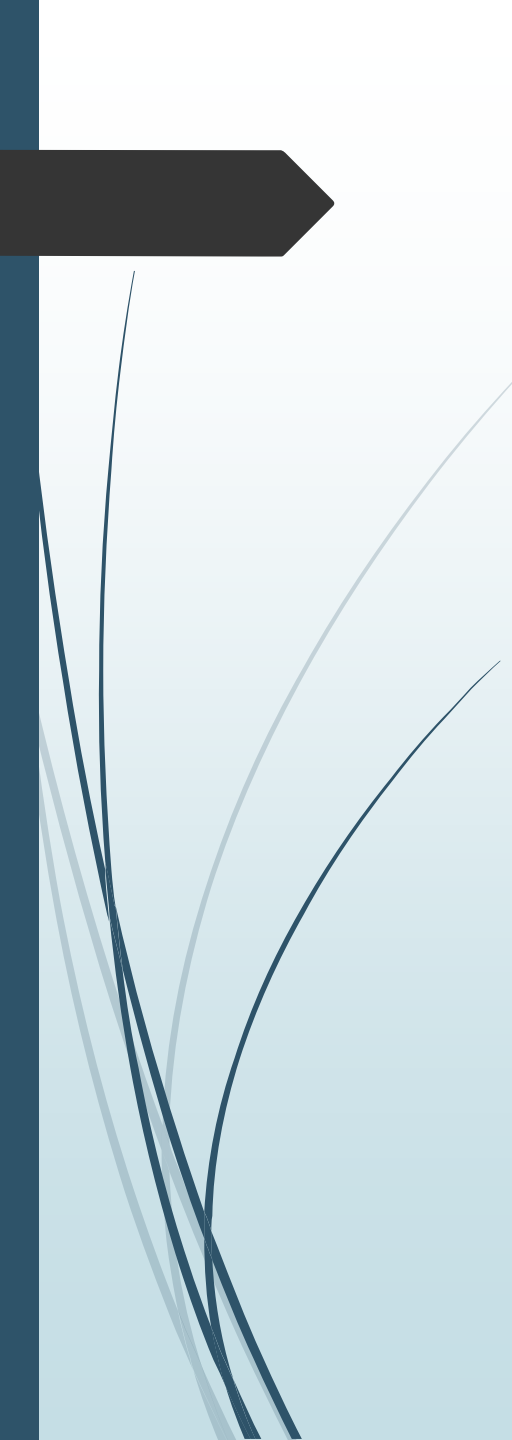
Federal Water Pollution Control Act first enacted in 1948

“Major” overhaul with Federal Water Pollution Control Act Amendments of 1972 (33 U.S.C. § 1251 et seq.)

- ***Commonly referred to as the Clean Water Act***
- Established national goals
- Various titles
 - Established research program
 - Created massive grant program
 - Standards program (both water quality and technology-based)
 - Permitting/license program

Federal Clean Water Act

- **Made it unlawful to discharge any pollutant from a point source to waters of the United States without a NPDES permit**
- **1972 amendments enormous shift**
 - From reliance on violations of ambient water quality
 - Standards as the primary enforcement tool, to
 - Establishment of specific technology-based effluent
 - Limitations that are enforceable as permit conditions



NPDES Permits

The NPDES permit program, created in 1972 by the Clean Water Act (CWA), helps address water pollution by regulating point sources that discharge pollutants to waters of the United States. The permit provides two levels of control: **technology-based limits** and **water quality-based limits** (if technology-based limits are not sufficient to provide protection of the water body).

Under the CWA, EPA authorizes the NPDES permit program to state, tribal, and territorial governments, enabling them to perform many of the permitting, administrative, and enforcement aspects of the NPDES program. In states authorized to implement CWA programs, EPA retains oversight responsibilities. Currently 46 states and one territory are authorized to implement the NPDES program.

Technology-based Effluent Limitations (TBELs)

Technology-based effluent limitations (TBELs) in NPDES permits require a minimum level of treatment of pollutants for point source discharges based **on available treatment technologies**, while allowing the discharger to use any available control technique to meet the limits.

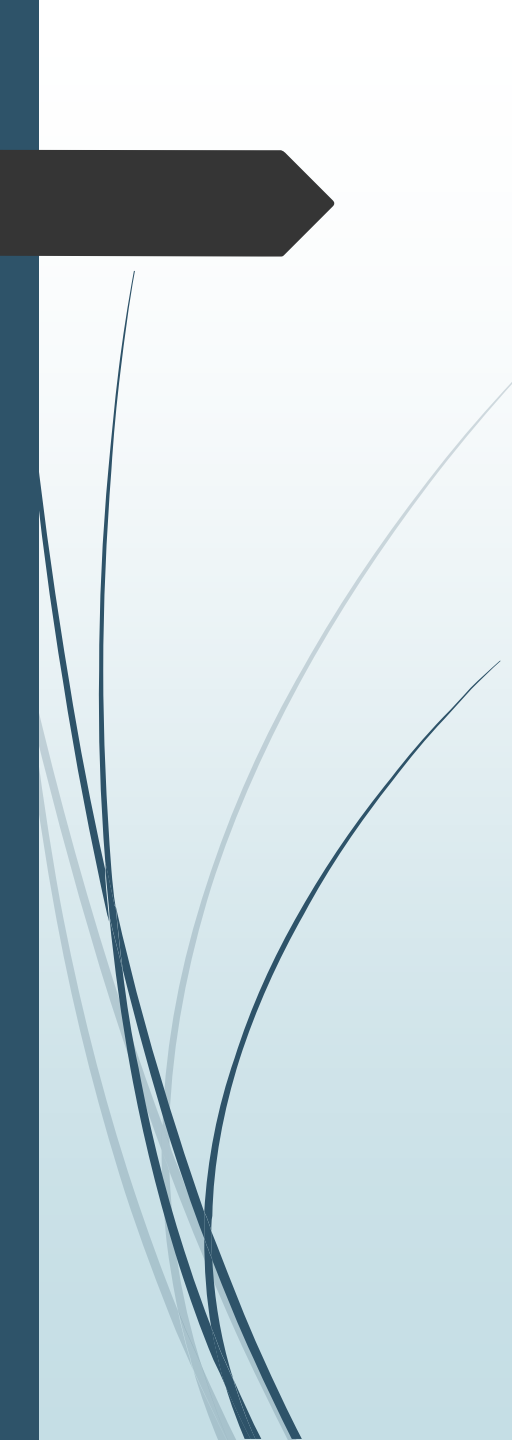
Water Quality-based Effluent Limitations (WQBELs)

Section 303(d) of the Clean Water Act (CWA) establishes a process for states to identify waters within their boundaries where **implementing technology-based controls is inadequate to achieve water quality standards**. States establish a priority ranking of these waters and, for the priority waters, develop **total maximum daily loads (TMDLs)**. **A TMDL identifies the amount of a specific pollutant or property of a pollutant, from point, nonpoint, and natural background sources, including a margin of safety, that may be discharged to a water body and still ensure that the water body attains water quality standards.** The allocations of pollutant loadings to point sources are called wasteload allocations.

NPDES Permit

The Clean Water Act prohibits anybody from discharging "**pollutants**" through a "**point source**" into a "**water of the United States**" unless they have an NPDES permit. The permit will contain limits on what you can discharge, monitoring and reporting requirements, and other provisions to ensure that the discharge does not hurt water quality or people's health. In essence, the permit translates general requirements of the Clean Water Act into specific provisions tailored to the operations of each person discharging pollutants.

The term **point source** is also defined very broadly in the Clean Water Act because it has been through 25 years of litigation. It means any discernible, confined and discrete conveyance, such as a pipe, ditch, channel, tunnel, conduit, discrete fissure, or container. It also includes vessels or other floating craft from which pollutants are or may be discharged. By law, the term "point source" also includes concentrated animal feeding operations, which are places where animals are confined and fed. By law, agricultural stormwater discharges and return flows from irrigated agriculture are not "point sources"



Operator Certification

The State Water Board adopted regulations to **define the experience and training requirements** necessary to meet the minimum levels of competence to administer this responsibility, **the State Water Board established the Office of Operator Certification in the Division of Financial Assistance.**

Effective July 1, 2014, the responsibility for California's operator certification program for operators of public water systems was transferred from the CDPH to the State Water Resources Control Board (State Water Board). The transfer was accomplished by means of the addition of new **Section 116271 to the Health and Safety Code.** However, no changes were made to the operator certification program statutes or regulations.

Title 23. Waters

Division 3. State Water Resources Control Board
and Regional Water Quality Control Boards
Chapter 26. classification of Wastewater Treatment Plants
and Operator Certification
Article 1. General Provisions

§ 3670. Purpose.

The primary purpose of the Wastewater Treatment Plant Classification, Operator Certification, and Contract Operator Registration Program is to protect public health and the environment by providing for the effective operation of wastewater and water recycling treatment plants through the certification of wastewater treatment plant operators.

§ 3670.1. Certification Requirements for Operation of Wastewater Treatment Plants.

No person shall operate a wastewater treatment plant within the meaning of these regulations unless that person has been certified by the division as a wastewater treatment plant operator or operator-in-training at a grade appropriate for the class of plant being operated.

§ 3670.2. Certification Requirement for Operation of Water Recycling Treatment Plants.

(a) Except as provided in subsection (b) below, no person shall operate a water recycling treatment plant unless

that person has been certified by the division as a wastewater treatment plant operator or operator-intraining at a grade appropriate for the class of plant being operated.

(b) A person certified by the Department of Health Services as a water treatment plant operator may operate a water recycling treatment plant at a grade appropriate for the class of plant operated.

(c) The State Board may refuse to approve use of a certificate issued by the Department of Health Services or suspend or revoke its approval of the use of the certificate if the operator commits any of the prohibited acts described in Article 7 (commencing with section 3710) of Chapter 26 of Division 3 of the California Code of Regulations.

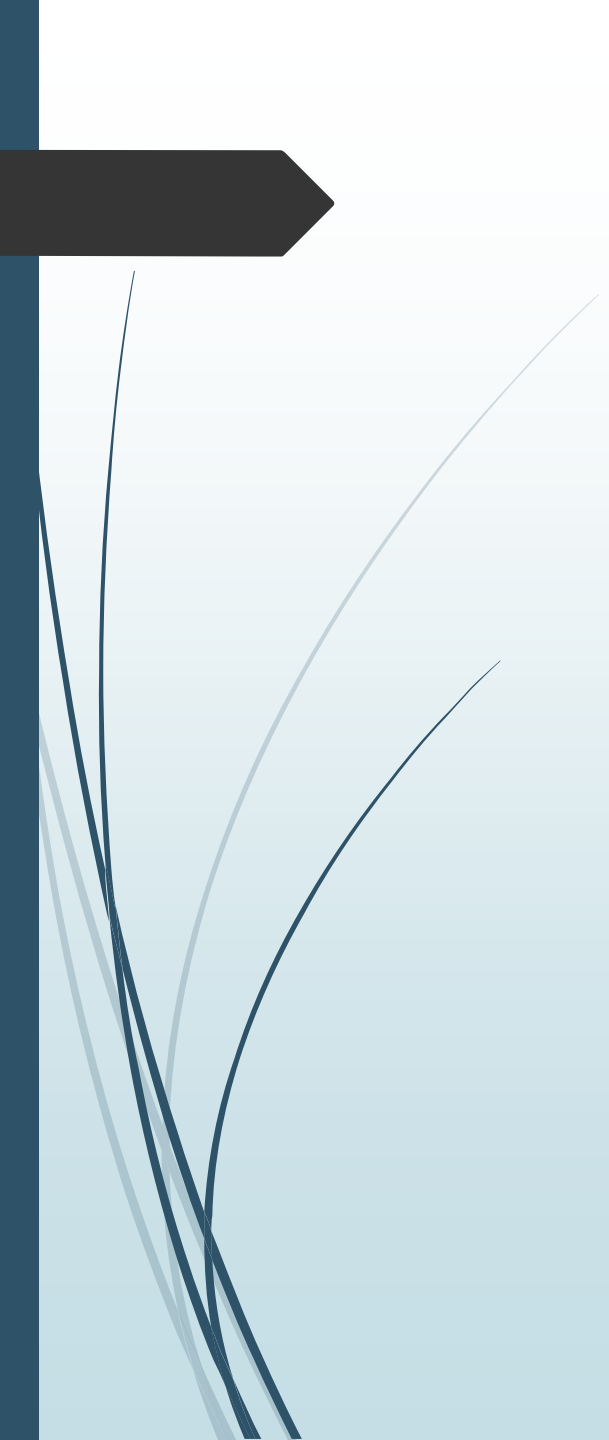
WW Certification Requirements Table

OPERATOR CERTIFICATION REQUIREMENTS TABLE (Effective April 1, 2013)

Note: Applicants must take and pass the Office of Operator Certification Wastewater Treatment Plant Operator Examination before applying for Certification:

PATH	EXAMINATION EDUCATION REQUIREMENTS		CERTIFICATION QUALIFYING EXPERIENCE REQUIREMENTS
GRADE I			
1	High school diploma or equivalent and 6 educational points	and	1 year of full-time qualifying experience
GRADE II			
1	High school diploma or equivalent and 9 educational points	and	18 months of full-time qualifying experience as a Grade I operator
2	High school diploma or equivalent and 12 educational points	and	2 years of full-time qualifying experience
3	Associate's degree, a higher degree, or a minimum of 60 college semester units, including a minimum of 15 semester units of science courses	and	1 year of full-time qualifying experience
GRADE III			
1	High school diploma or equivalent and 12 educational points	and	3 years of full-time qualifying experience as a Grade II operator
2	High school diploma or equivalent and 18 educational points	and	4 years of full-time qualifying experience
3	Associate's degree or a minimum of 60 college semester units, including a minimum of 15 semester units of science courses	and	2 years of full-time qualifying experience
4	Bachelor's degree or a higher degree, including a minimum of 30 semester units of science courses	and	1 year of full-time qualifying experience

GRADE IV			
1	High school diploma or equivalent and 32 educational points	and	6 years of full-time qualifying experience
2	Associate's degree or a minimum of 60 college semester units, including a minimum of 15 semester units of science courses	and	4 years of full-time qualifying experience
3	Bachelor's degree or a higher degree, including a minimum of 30 semester units of science courses	and	3 years of full-time qualifying experience
4	Valid registration as a chemical, civil, or mechanical engineer issued by the California Board for Professional Engineers and Land Surveyors or by another state, territory, or Indian tribe	and	2 years of full-time qualifying experience
GRADE V			
1	High school diploma or equivalent and 48 educational points	and	10 years full-time qualifying experience
2	Associate's degree or a minimum of 60 college semester units, including a minimum of 15 semester units of science courses	and	6 years of full-time qualifying experience
3	Bachelor's degree or a higher degree, including a minimum of 30 semester units of science courses	and	5 years of full-time qualifying experience
4	Valid registration as a chemical, civil, or mechanical engineer issued by the California Board for Professional Engineers and Land Surveyors or by another state, a territory, or an Indian tribe	and	4 years of full-time qualifying experience



GRADE IV WWTP OPERATOR EXAMINATION INFORMATION

The Grade IV examination contains questions regarding the following subjects: safety practices, hazards encountered during operations, sampling and analysis of wastewater constituents, operation and maintenance procedures in preliminary, primary and secondary treatment unit processes, anaerobic sludge digestion and disinfection.

It also includes operation and maintenance of wastewater stabilization ponds and state regulations regarding the classification of wastewater treatment plants and operator certification. Questions may deal with sludge handling and evaluation of wastewater unit processes as well as overall plant performance.

In addition, the Grade IV examination includes questions on process control, activated sludge process modifications and tertiary treatment, requirements and practices for water reclamation and reuse, supervision/management responsibilities such as energy management, safety program development, operator training and budget development and control. Examinees will be asked to write essay answers to some questions.

The Grade IV examination also contains mathematical questions. Examinees may be asked to write essay answers and calculate problems including heat value/gas generation from an anaerobic digester, BOD/nitrogenous BOD calculations, effects of process adjustments/changes, polymer usage/dose, efficiency and loading of solids thickening processes, disinfection options/dose/residual/cost, use/calculation of process control variables, hydraulic or organic loading rates, pumping efficiency/cost, nitrification and effects on plant operations and infiltration and inflow. The examinee should be familiar with typical calculations related to the subject matter listed in paragraph 1. Examinees must work out the math problems. Answers to math questions that are not supported by calculations will **NOT** receive credit.

Examinees are given 4 hours to complete the examination. The question format is as follows:

25 Multiple Choice Questions	@	2 point each
5 Math Problems	@	8 points each
1 Mandatory Essay Question	@	15 points each
4 Essay Questions (Work 4 of 6)	@	10 points each

TOTAL POINTS 145

Passing Score: To pass, you must achieve:

(a) a minimum total score of 101.5 points (70 percent), AND
a score of at least 20 points (50 percent) on the Math Questions.



GRADE V WWTP OPERATOR EXAMINATION INFORMATION

The Grade V examination contains questions regarding the following subjects: safety practices, hazards encountered during operations, sampling and analysis of wastewater constituents, operation and maintenance procedures in preliminary, primary and secondary treatment unit processes, anaerobic sludge digestion and disinfection.

It also includes operation and maintenance of wastewater stabilization ponds and state regulations regarding the classification of wastewater treatment plants and operator certification. Questions may deal with sludge handling and evaluation of wastewater unit processes as well as overall plant performance.

In addition, the Grade V examination includes questions on process control, activated sludge process modifications and tertiary treatment, requirements and practices for water reclamation and reuse, supervision/management responsibilities such as energy management, safety program development, operator training and budget development and control. Examinees will be asked to write essay answers to some questions.

The Grade V examination contains some of the most complex mathematical questions asked at Grades I-IV. Examinees may be asked to write essay answers and calculate problems including heat value/gas generation from an anaerobic digester, BOD/nitrogenous BOD calculations, effects of process adjustments/changes, polymer usage/dose, efficiency and loading of solids thickening processes, disinfection options/dose/residual/cost, use/calculation of process control variables, hydraulic or organic loading rates, pumping efficiency/cost, nitrification and effects on plant operations and infiltration and inflow. The examinee should be familiar with typical calculations related to the subject matter listed in paragraph 1. Examinees must work out the math problems. Answers to math questions that are not supported by calculations will **NOT** receive credit.

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Wastewater Operator Certification program (WWOCP)

The Wastewater Operator Certification program (WWOCP) administers Wastewater Treatment Plant Certification examinations, certifications (grades I to V), and certification renewals.

Additionally, the WWOCP classifies Wastewater Treatment Plants.

Currently, there are approximately 6,000 active certified wastewater treatment plant operators.

Since 1972, the State Water Board examines and certifies wastewater treatment plant (WWTP) operators for competency to operate WWTPs. Since 1994, the State Water Board has registered contract operators to operate WWTPs.

As of April 2013, all classified privately owned Wastewater Treatment Plants must have certified wastewater treatment plant operators and now have the same requirements as publicly owned WWTPs.

Wastewater Operator Certification program (WWOCP)

- **Chief Plant Operator (CPO)** is the operator responsible for the overall operation of the WWTP and must be certified at the same grade of, or higher than the level of the classification of the WWTP.
- **Designated Operator-in-Charge (DOIC)** is a certified operator appointed by the CPO to be responsible for the overall operation of a WWTP, including compliance with the applicable water discharge requirements when the CPO is unable to carry out the responsibilities of the position. The DOIC reports directly to the CPO.

Wastewater Operator Certification program (WWOCP) determines plans classification

WWTP Classification	Mini Grade for CPO	Mini Grade for DOIC
I	I	I
II	II	I
III	III	II
IV	IV	III
V	V	III

Supervision and Regulations Questions

- SWRCB administers funds for the Clean Water Grant Program?
 - **True**
- The local cost of new wastewater facilities is often financed by revenue bonds?
 - **True**
- When writing reports, the simplest and most direct way of focusing the readers attention to the topic under discussion is to:
 1. Place all important items in italics
 2. Underline key phrases
 3. **Use simple language**
 4. Put the topic idea in the 1st sentence
 5. All of the above
- How many RWQCB are there in California?
 - **9**
- What is the name of the State agency directed responsible for the protection of water quality?
 - **SWRCB**

Supervision and Regulations Questions

- The federal legislation which permits the federal government to grant municipalities funds for construction of treatment plants is called:
 1. The Porter-Cologne Act
 2. The Urban Redevelopment Project
 3. The Urban Renewal Program
 4. The model cities Program
 5. **Public Law 660**

- The California legislative bill which made operator certification mandatory is known as:
 1. PL 660
 2. PL 550
 3. **Porter-Cologne Act**
 4. Federal Water Quality Act
 5. AB 1691

Supervision and Regulations Questions

You are superintendent of a facility located ten miles upstream from a domestic water supply intake. One day your plant experiences a major equipment failure resulting in a bypass of your plant's raw wastewater, unchlorinated, discharge to a stream. A. Discuss what are the effects of this discharge on water quality and public health. B. Discuss what actions you would take?

A. Effects of water quality - Discuss

- A. Bacteria and viruses in stream's water threatens domestic water plant, as well as, people and aquatic life at the stream.
- B. Dissolved oxygen concentration in stream could be impacted (lowered) by BOD in wastewater
- C. Floatable material and grease impact water clarity and serve as a breeding ground insects
- D. Odor in stream could be impacted.

B. What Actions should be taken - Discuss

- A. Call Agency Spill Respond Crew
- B. Call Office of Emergency Services (Typically they will contact Fish and Game)- 2 hour notification
- C. Contact RWQCB
- D. Make sure Utility that manages domestic water supply is notified
- E. Contact Public Health so public is notified about health hazards associated with coming in contact with stream and spilled sewage
- F. Try to minimize spill ASAP (shutdown pipe, turn on back up pumps, attempt to return as much of spill to plant as possible etc...)
- G. Record all pertinent information (spill volume, start and stop time, cause, personnel on site, etc...)
- H. Post signs at stream to notify public
- I. Try to mitigate impact to stream (damming stream, pumping water into a collection system)
- J. Estimate spill volume
- K. Clean up at spill site
- L. Fill appropriate
- M. Complete - 3 Day SSO report – 15 Day Certification – 45 day Technical Report



You are supervisor at a plant that has been issued a "Cease and Desist" order by the RWQCB. What is the significance of this order? Compare this to a "Cleanup and Abatement" order.

Cease and Desist Order

CDOs are adopted pursuant to California Water Code sections 13301-13303. **CDOs may be issued to dischargers violating or threatening to violate WDRs or prohibitions prescribed by the RWQCB or the SWRCB. CDOs are often issued to dischargers with chronic non-compliance problems.**

When the board determines that any **entity is violating, or threatening to violate, any requirement described in subdivision (d), the board may issue an order to that person to cease and desist from that violation.**

The cease and desist order **shall require that person to comply forthwith or in accordance with a time schedule set by the board.**

The board may issue a **cease and desist order only after notice and an opportunity for hearing pursuant to Section 1834.**



You are supervisor at a plant that has been issued a "Cease and Desist" order by the RWQCB. What is the significance of this order? Compare this to a "Cleanup and Abatement" order.

Clean-up and Abatement Order (CAO)

- CAOs are adopted pursuant to California Water Code section 13304. CAOs may be issued to any person who has discharged or discharges waste into the waters of this state in violation of any waste discharge requirement or other order or prohibition issued by a regional board or the state board, or who has caused or permitted, causes or permits, or threatens to cause or permit any waste to be discharged or deposited where it is, or probably will be, discharged into the waters of the state and creates, or threatens to create, a condition of pollution or nuisance (discharger). **The CAO requires the discharger to clean up the waste or abate the effects of the waste, or, in the case of threatened pollution or nuisance, take other necessary remedial action, including, but not limited to, overseeing cleanup and abatement efforts.**



Discuss the operator-in-training classification in wastewater certification regulations: Include fees, expiration, duties assigned, supervisor, intent.

- OITs must complete at least **1,800 hours** in wastewater operations to become certified.
- Meet the educational requirements based on the requirements table in **Title 23, Chapter 26**.
- As of January 1, 2017, OIT certificates are good for **three years** from the date of issuance and can be renewed.
- In order to renew an OIT certificate an applicant must have taken and passed a Wastewater Exam within the last four years.
- **Yes**, an OIT can work at multiple WWTPs if he/she submits a complete application including additional pages completing sections IV and V for each WWTP that the OIT is applying for. The CPO for each plant must sign the OIT application
- According to the State Water Board regulation Section 3682, an OIT is required to work under the **direct supervision** of an operator with a certificate of equal or higher grade.
- **“Direct supervision”** means the supervising operator oversees and inspects the work performed by the OIT and provides training to ensure the safe and proper execution of the OIT's duties.
- The supervising operator must be present at the WWTP or otherwise available to consult with; and provide assistance to the OIT in order to ensure the safe and proper execution of the OIT's duties.
- An OIT **cannot** work as the only operator at a WWTP. It is illegal for an OIT to operate without the direct supervision of a certified operator.
- An OIT **cannot** supervise other OIT's.
- An OIT **cannot** work a shift alone under any circumstance.

Other Regulations

- **Title 8**, California Code of Regulations Division 4, Chapter 3, article 108 – “**Confined Spaces**”.
- **Title 8**, California Code of Regulations, Division 1, Chapter 4, Section 3203 – “**Injury Illness Prevention Program**”
- **Title 22**, California Code of Regulations, Division 4, Chapter 3, “**Reclamation Criteria**”
- **Title 23**, California Code of Regulations, Division 3, Chapter 26 “**Wastewater Plant Classification**”

Safety



Major Safety Programs to be familiar with

- Injury and Illness Prevention Program
- Confined Space
- Hearing Conservation
- Bloodborne Pathogens
- Lock and Tagout
- Hazard Communications

An IIPP must be a written plan that includes all of the following elements: Management commitment and assignment of responsibilities. Someone with the authority and responsibility for the program must be identified and given management's full support to implement the program.

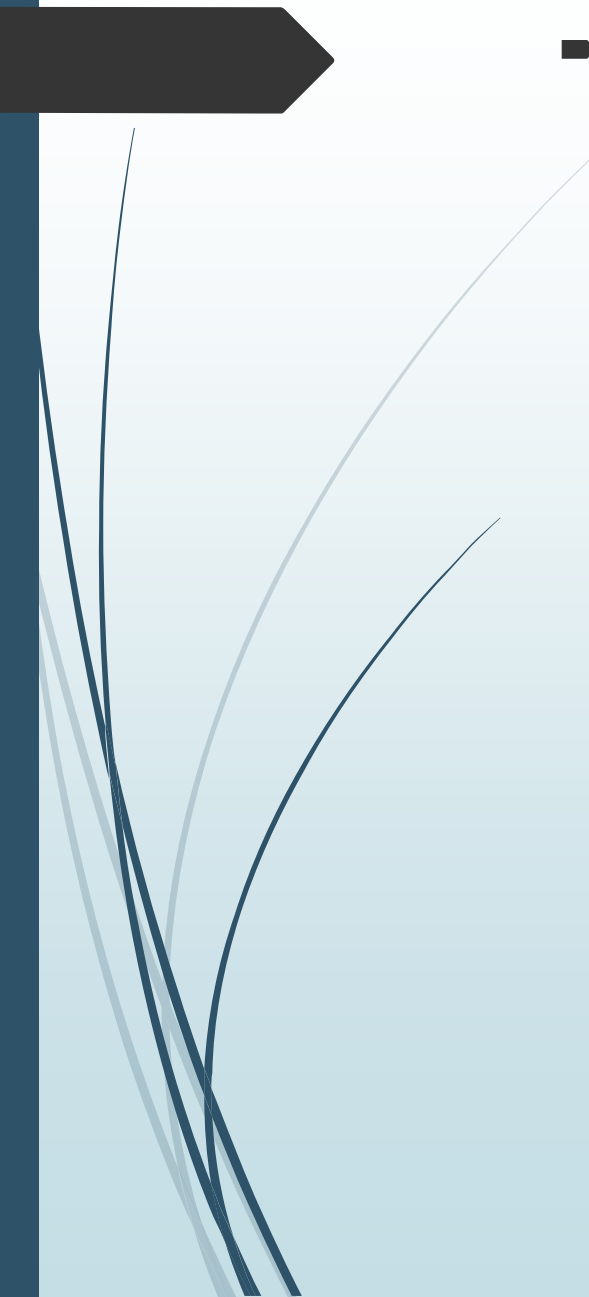
- What is an IIPP and How It Works
- The Injury and Illness Prevention Program (IIPP) is a basic written workplace safety program. Title 8 of the California Code of Regulations (T8CCR) section 3203, requires every employer to develop and implement an effective IIPP. An effective IIPP improves the safety and health in your workplace and reduces costs by good management and employee involvement. The 8 required Injury and Illness Prevention Program elements are:
 - Responsibility
 - Compliance
 - Communication
 - Hazard Assessment
 - Accident/Exposure Investigation
 - Hazard Correction
 - Training and Instruction
 - Recordkeeping
- To be effective your IIPP must:
 - Fully involve all employees, supervisors, and management
 - Identify the specific workplace hazards employees are exposed to
 - Correct identified hazards in an appropriate and timely manner
 - Provide effective training

Injury Illness Prevention Program – example questions

- Although most accidents are caused by unsafe acts rather than exposure to unsafe conditions, the unsafe conditions should be remedied first?
- **False**
- A supervisor's responsibility has ended when the proper safety devices have been provided for the protection of his men?
- **False**
- The most important factor in accident investigation is
 1. Determining fault
 2. Check for unsafe conditions
 3. **Preventing a reoccurrence**
 4. Remind employees of safety rules
 5. Create new rules with fines and penalties
- OSHA stays for _____ ?

IIPP Example Questions

- In the event that a victim is unconscious and not breathing, you may elect to try mouth to mouth resuscitation. Among the steps are **1.** cover the victim's mouth with yours, pinch their nose, and blow vigorously into the mouth **2 times**, **2.** tip the victims head back with the chin up, **3.** loosen the victim's clothing, **4.** check the victim's mouth for obstructions, **5.** move the victim to a comfortable place and cover them to keep them warm. The proper order of the steps are:
 1. 3.4.1.2.5
 2. 4.3.2.1.5
 - 3. 4.2.1.3.5**
 4. 5.4.2.1.3
 5. 5.3.4.2.1
- Which of the following conditions should be given 1st consideration when administering first aid?
 - Skull fracture
 - **Asphyxiation**
 - Tibia fracture
 - Serious bleeding
 - infection

- 
- As a plant manager which of the following would you consider most appropriate to be that plant's Safety Supervisor?
 1. Rotate the responsibility so I feel that it is important.
 - 2. Pick a permanent individual for continuity and follow up**
 3. Appoint whomever has the most accidents to date because he will be able to provide the best insights to solutions
 4. Do it yourself, because you have the most authority
 5. Ask for a volunteer, there is no substitute for passion

Confined Space

- ▶ OSHA's standard for confined spaces (**29 CFR 1910.146**) contains the requirements for practices and procedures to protect employees in general industry from the hazards of entering permit spaces. Employers in general industry must evaluate their workplaces to determine if spaces are permit spaces.



1. **Large Enough for a person to enter**
2. **Has limited or restricted means for entry or exit**
3. **Not designed for continuous occupancy**

In addition Confined Spaces may:

- ▶ Have atmospheric hazards
- ▶ Engulfment hazards (wastewater, soil)
- ▶ Asphyxiation Hazards
- ▶ Other



- Entry requires a permit signed by a qualified site supervisor.



DANGER

**CONFINED SPACE
PERMIT ONLY**

PREPARE FOR ENTRY

- Identify hazards of permit space
- De-energize & lock out all energy source
- Drain, clean & ventilate confined space
- Isolate confined space - disconnect fill & drain lines

TEST ATMOSPHERE

- Oxygen level between 19.5 % & 23.5%
- Flammable gases/vapors less than 10% of LEL
- All substances below established PEL

PREPARE PERSONNEL PROTECTIVE DEVICES

- Respirator, protective clothing, life-line & harness

ATTENDANT & RESCUE EQUIPMENT IN PLACE
REVIEW COMMUNICATION PROCEDURES
OBTAIN AUTHORIZED PERMITS



ENCLOSED SPACES

ARE ANY CONFINED AREA THAT MAY CONTAIN LITTLE OR NO OXYGEN, OR MAY HAVE FLAMMABLE, CORROSIVE, OR TOXIC FUMES.

IS DINNER READY YET?

EVEN A RECENTLY CLEANED SPACE MAY BE HAZARDOUS! ENTRY PERMITS MUST BE OBTAINED BEFORE ENTERING ANY DESIGNATED ENCLOSED SPACE.

3C

Have Respect For The Dangers Of Enclosed Spaces

AMERICAN CLUB
LOSS PREVENTION

- 60 % of confined spaces deaths are rescue persons

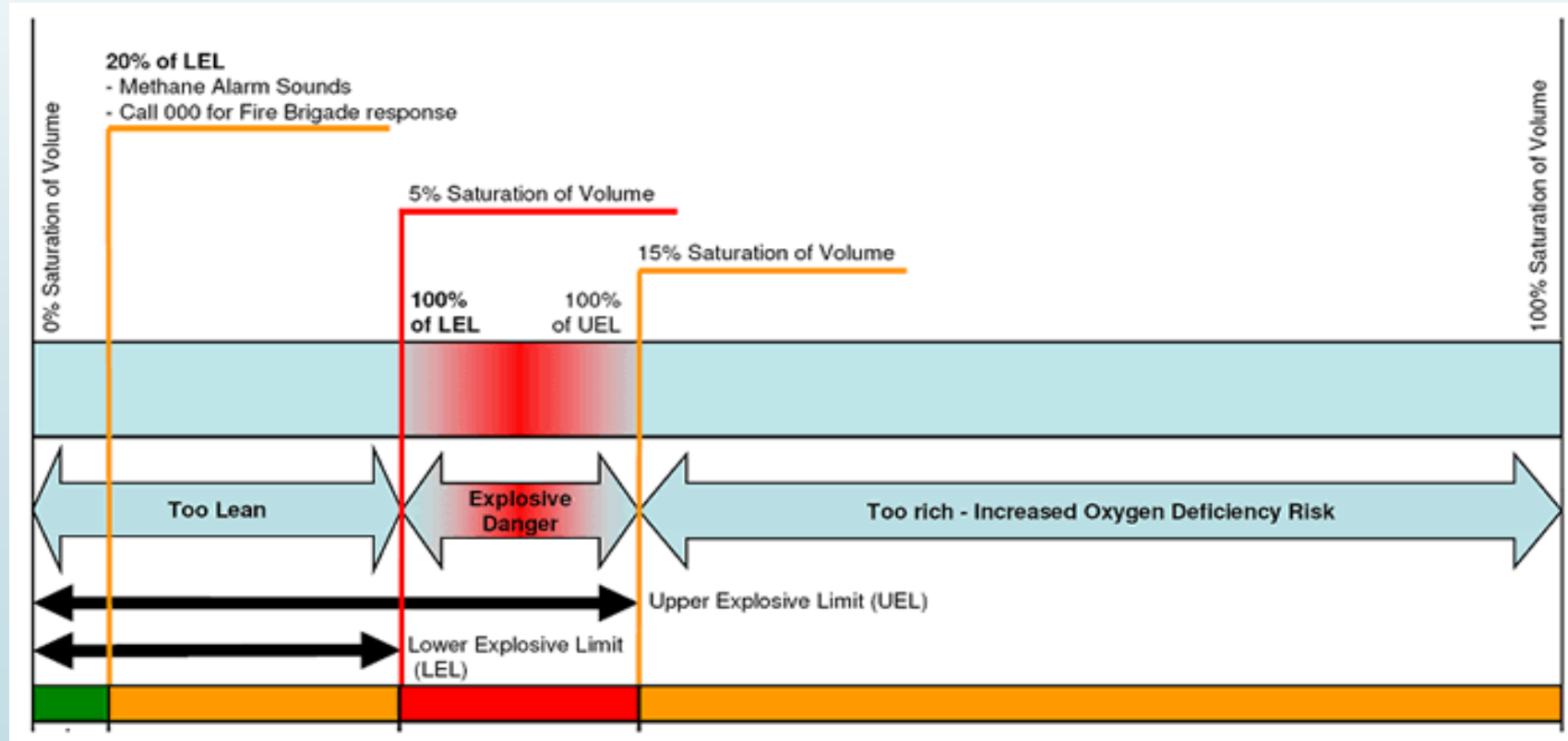
- ➡ Test air at all levels
- ➡ Test Air continuously
- ➡ Record readings every 15 minutes

[illegible]

Atmospheric Hazards

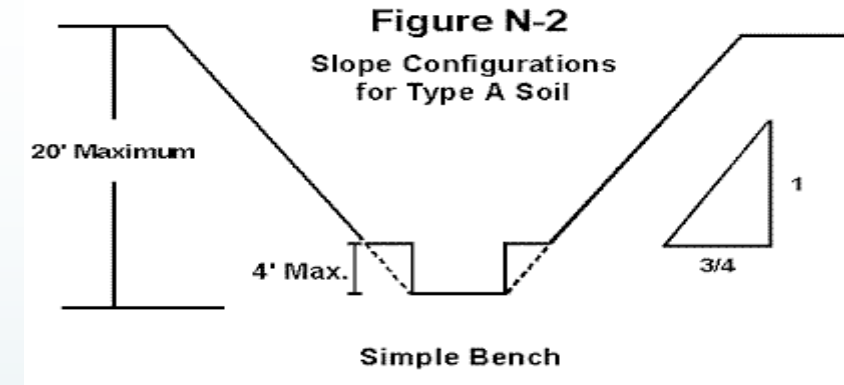


1. Explosive or Flammable
(Flammable vapor of mist above 10% Lower Explosive Limit (LEL))
2. Toxic Atmosphere
(Any substance above permissible exposure limits; example H₂S)
3. Oxygen Depletion or Enrichment
(Oxygen below 19.5 or above 23.5)



Confined Spaces

Trenches:



- Cave in protection > 5 feet
- Atmospheric monitoring > 4 feet
- Trench slope should be 1 to 1
- Soils should be placed at least 2 feet from the trench



Confined Space Questions

- To test for the presence of a safe level of oxygen, in an enclosed space, an oxygen-deficiency indicator equipped with an aspirator, sampling hose and intake tube can be used?
 - **True**
- Carbon dioxide given off by the decomposition of wastewater solids is dangerous in poorly ventilated areas because it is poisonous and corrosive?
 - **True**
- As a supervisor you must be familiar with confined spaces. Discuss Confined spaces. In your discussion include the following:
 - Definition
 - Four examples found in wastewater plants and collection systems
 - List four dangerous gases or conditions one may encounter in a confined space
 - Four precautions to take when entering a manhole
 - Four precautions to take when working in a manhole

As a supervisor you must be familiar with confined spaces. Discuss Confined spaces. In your discussion include the following:

■ **Definition**

- Large Enough for a person to enter
- Has limited or restricted means for entry or exit
- Not designed for continuous occupancy

■ **Four Examples**

- Digesters, Aeration Basins, Clarifiers, Manholes , Pump Wetwells, Pipes, Contact tanks, trenches, etc...

■ **Four Dangerous Gases or conditions**

- Hydrogen Sulfide, Carbon Monoxide, Methane Gas, Carbon Dioxide, Chlorine, potential for engulfment, traffic control

■ **Four precautions before entering a manholes**

- Traffic Control, Atmospheric Check, Retriever equipment and harnesses, Personal protective equipment

■ **Four Precautions regarding manholes**

- Atmospheric, Physical Injury (slips, falls, falling objects, bumps, structural failure), Infection and disease, Insects and biting critters, toxic exposure, drowning)

Hearing Conservation

- Noise Conservation is also called the Noise Standard and is regulated by OSHA (Occupational Safety and Health Administration)
- OSHA Regulation (29 CFR 1910.95)
- Goal - prevent hearing loss associated with high noise levels at work



Effects of exposure to loud noise



- Exposure to loud noise will inevitably cause hearing loss over time.
- Once the nerves of the inner ear are destroyed or damaged from exposure to excessive noise, the damage is permanent
- Loud noise damages or destroys the nerves in the inner ear.
- Another effect can be “tinnitus” or permanent ringing in the ear.

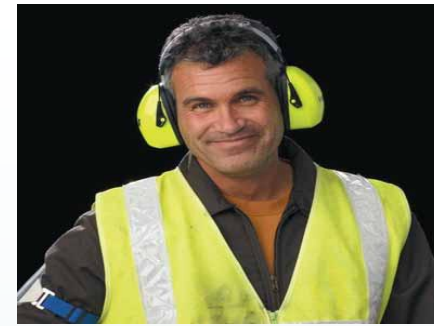
Hearing Conservation

- What is the OSHA standard for hearing protection?
- The Occupational Safety and Health Administration's (OSHA's) Noise standard (**29 CFR 1910.95**) requires employers to have a **hearing conservation program** in place if workers are exposed to a time-weighted average (**TWA**) **noise level of 85 decibels (dBA) or higher over an 8-hour work shift.**



Hearing Protection

Employers are required to have a hearing conservation if work place noise exceeds “85 dBs”



Noise Level	Exposure Limit
90 dBA	8.0 hours
92 dBA	6.0 hours
95 dBA	4.0 hours
97 dBA	3.0 hours
100 dBA	2.0 hours
102 dBA	1.5 hours
105 dBA	1.0 hours
110 dBA	30 minutes
115 dBA	15 minutes

Table 1. OSHA's Permissible Noise Exposure Limits.

163dB	Hunting rifle
120dB	Snowmobile
110dB	Chainsaw
105dB	Snowblower
90dB	Lawnmower
80dB	Traffic noise
60dB	Normal conversation
40dB	Refrigerator humming
20dB	Whispered voice

Hearing Conservation Questions

- Hearing protection is required for noise levels higher than **90 dBs** You should not be exposed to noise levels over **100 dB** for over 8 hours?
 - **False 85dB and 90 dB**
- Maximum allowable exposure to a noise level of 115 dB is 15 minutes?
 - **True**
- Single use ear plugs are made of waxed cotton, foam, silicone rubber or fiberglass wool?
 - **True**
- In the work environment, machinery often produces noise levels below 85 dB?
 - **False, most often above 85 dBs**
- The hearing-loss consequences of noise exposure can depend upon:
 1. The loudness of the noise
 2. The duration of the noise
 3. Whether you move between work areas with different noise levels
 4. Whether there are multiple noise sources
 5. **All of the above**
- Any Earmuffs you have will provide the required level of noise protection?
 - **False, Earmuffs provide different levels of protection the user should know how much protection is needed.**

Bloodborne Pathogens

On December 6, 1991, the Occupational Safety and Health Administration (OSHA) promulgated the Bloodborne Pathogens standard. This standard is designed to protect workers from the risk of exposure to bloodborne pathogens, such as the Human Immunodeficiency Virus (HIV) and the Hepatitis B Virus (HBV)

OSHA standards for **bloodborne pathogens (BBP, 29 CFR 1910.1030) and personal protective equipment (PPE, 29 CFR 1910 Subpart I)** require employers to protect workers from occupational exposure to infectious agents.

Bloodborne Pathogen Standard

- Exposure Control Plan
- Universal Precautions
- Engineering & Work Practice Controls
- Personal Protective Equipment (PPEs)
- Housekeeping
- Hepatitis B Vaccination
- Labels & Signs
- Record Keeping



- **Bloodborne Pathogens** means pathogenic microorganisms that are present in human blood and can cause disease in humans. These pathogens include, but are not limited to, hepatitis B virus (HBV) and human immunodeficiency virus (HIV).

BLOODBORNE PATHOGENS			
UNIVERSAL PRECAUTIONS FOR THOSE EXPOSED TO BLOOD OR OTHER POTENTIALLY INFECTIOUS MATERIALS IN THEIR OCCUPATION			
PROTECT YOURSELF ALL BLOOD AND BODILY FLUID MUST BE TREATED AS IF THEY WERE INFECTED WITH: ● HUMAN IMMUNODEFICIENCY VIRUS (HIV) WHICH FREQUENTLY LEADS TO AIDS. ● HEPATITIS B VIRUS (HBV). ● OTHER BLOODBORNE PATHOGENS (MICROORGANISMS FOUND IN HUMAN BLOOD WHICH CAN CAUSE DISEASE).	KNOW THE RULES BE FAMILIAR WITH YOUR ORGANIZATION'S EXPOSURE CONTROL PLAN.  MAKE SURE YOU KNOW: ● VACCINATION REQUIREMENTS ● PROCEDURES ● PRACTICES ● PROPER REPORTING REQUIREMENTS FOR INCIDENTS OF EXPOSURE.	KNOW YOUR COLORS ● RED BAGS OR CONTAINERS DON'T NEED TO BE LABELED - THEIR COLOR INDICATES THEY MAY CONTAIN BIOHAZARDS. ● FLUORESCENT ORANGE-RED LABELS AND SIGNS WITH CONTRASTING LETTERING OR SYMBOLS ARE APPROPRIATE READ ALL LABELS AND SIGNS	WEAR THE RIGHT EQUIPMENT       LAB COATS, APRONS, GOWNS SHOE COVERS FACE MASKS SPLASH GOGGLES FACE SHIELDS GLOVES
PROPER PROCEDURE CAN REDUCE YOUR RISK OF INFECTION TO ZERO			
WASH HANDS  AND FOLLOW SAFE HYGIENE AND WORK PRACTICES.	DISPOSE OF NEEDLES IN APPROPRIATE CONTAINERS.   NEVER RECAP, BEND, OR BREAK NEEDLES.	FOLLOW PROPER DISPOSAL PROCEDURES. CONTAMINATED LAUNDRY AND PERSONAL PROTECTIVE EQUIPMENT SHOULD BE DISPOSED OF IN PROPERLY DESIGNATED AREAS.  	KEEP IT CLEAN CLEAN WORKSITE AND DECONTAMINATE EQUIPMENT. FOLLOW ALL SAFE HANDLING PROCEDURES. DON'T FORGET ALL BODY FLUIDS SHOULD BE HANDLED AS IF POTENTIALLY INFECTIOUS.

Bloodborne Pathogen Questions

- Blood and other potentially infectious materials (OPIM) can cause AIDS, hepatitis and numerous other serious and potentially fatal diseases?
 - **True**
- Dried blood left at an accident scene can't contain bloodborne pathogens, when it has been outside of the body for more than 12 hours?
 - **False (up to 7days)**
- When helping an injured person you should encourage as much self care as possible?
 - **True**
- In which situation should you wear gloves?
 - When administering first aid
 - When cleaning up blood or OPIMs
 - When throwing out first aid supplies contaminated with blood
 - **All of the above**
- When cleaning up blood, pour a disinfectant solution over towels and leave them in place for at least 5 minutes?
 - **False 10 minutes**
- Wear protective goggles whenever blood could splash, splatter or spray in your face.
 - **True**

Lock and Tagout



Disclaimer

- This information is not meant to be either a substitute for or legal interpretation of the occupational safety and health regulations. Readers must refer directly to **title 8 of the California Code of Regulations** for details regarding the regulation's scope, specifications, and exceptions and for other requirements that may apply to their operations.
- The requirements for lockout/tag-out/block out are set in **Title 8, California Code of Regulations, section 3314 (The Control of Hazardous Energy for the Cleaning, Repairing, Servicing, Setting-Up, and Adjusting Operations of Prime Movers, Machinery and Equipment, Including Lockout/Tag-out)**.
 - **The tailgate meeting** needs to address any machines that meet the exceptions and how employees will be protected, as per section 3314.
 - This document only covers section 3314. Article 3 of the **Low-Voltage Electrical Orders** and Article 36 of the **High-Voltage**
 - **Electrical Safety Orders** contain additional work and operating procedures.

Lock out and tag out questions

- Which of the following should be operated with a machine guard:
 1. Centrifugal pump
 2. Forced fan cooler
 3. Belt driven blower
 4. Screw conveyor
 5. **All of these**
- OSHA labeled “authorized” employees as those trained in specific procedures for locking out and tagging out machines and equipment?
 - **True**
- “Affected” employees are those who operate machines and equipment but are not authorized to service or repair them?
 - **True**
- “Other” employees are those whose work nearby the equipment and assist in the lockout tagout process?
 - **False “other” employees do not assist with LOTO**
- You only need to lock out one energy source when locking out equipment?
 - **False, all sources must be locked out.**
- After a piece of equipment is locked out it must be determined that there is no stored energy in the equipment before it is safe to work on?
 - **True**

Hazard Communications(Right to Know Law)

Key Elements



Hazard Communications

- As supervisor you are tasked to design a hazard communication program. **What are the elements you would include?**



1. A written program- must be developed if your company makes use of or produces hazardous chemicals. The plan should include steps to ensure that all workers are familiar with the risks involved in chemical handling and understand the labeling and symbols associated with each type of chemical hazard.

2. Training - All employees who may be exposed to hazardous chemicals in the workplace must be trained to identify and work safely with hazardous materials before their initial assignment and whenever the hazard changes.

Hazard Communications

- As supervisor you are tasked to design a hazard communication program. What are the elements you would include?



3. Material Inventory - This is a list of the hazardous materials present in your work area.

4. Labelling- Containers of hazardous materials must have labels which identify the material and warn of its potential hazard to employees

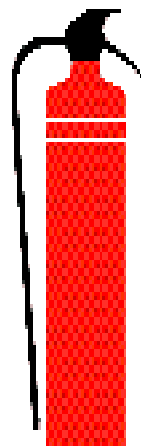
5. Safety Data Sheets (SDS) - This is a detailed description of each hazardous material listed in the Materials Inventory.

Hazard Communications - Questions

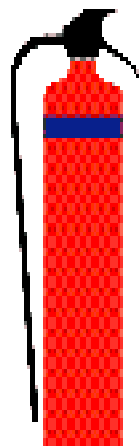
- The majority of hazardous material exposures occur through breathing vapors or fume?
 - **True**
- Always read the SDS before working with a chemical to find out what personal protective equipment is required?
 - **True**
- Required personal protective equipment can be:
 1. Gloves
 2. Glasses, goggles and face shields
 3. Respirators and dust masks
 4. **All of the above**
- Rubbing your eyes without washing your hands after working with chemicals won't expose you to hazardous chemicals since the eyes are not a route of exposure?
 - **False the eyes are a primary route of exposure.**

TYPES OF FIRE EXTINGUISHERS

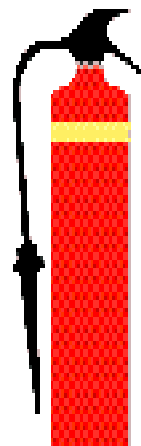
their uses and their colour coding according to BS EN 3: 1996



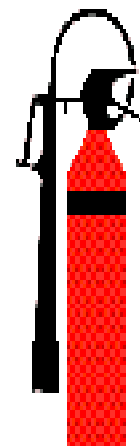
WATER



POWDER



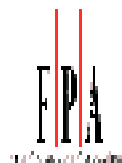
FOAM



**CARBON DIOXIDE
(CO₂)**

For wood, paper, textile and solid material fires	For liquid and electrical fires	For use on liquid fires	For liquid and electrical fires
DO NOT USE on liquid, electrical or metal fires	DO NOT USE on metal fires	DO NOT USE on electrical or metal fires	DO NOT USE on metal fires

The contents of an extinguisher is indicated by a zone of colour on the red body of the extinguisher



The Fire Protection Association

Bastille Court 2 Paris Garden London SE1 8ND

Tel: 020 7902 5300 • Fax: 020 7902 5301

E-mail: fpa@thefpa.co.uk • Web: <http://www.thefpa.co.uk>

Halon extinguishers are not
shown since no new halon
production is permitted in the UK

Fire Extinguishers

1. Visual Inspection
Monthly
2. Maintenance Inspections
Yearly
3. Hydrostatic testing 5
Years

What is the Fire Triangle



What are the classes of fire extinguishers?

CLASSES OF FIRES	TYPES OF FIRES	PICTURE SYMBOL
A	Wood, paper, cloth, trash & other ordinary materials.	
B	Gasoline, oil, paint and other flammable liquids.	
C	May be used on fires involving live electrical equipment without danger to the operator.	
D	Combustible metals and combustible metal alloys.	
K	Cooking media (Vegetable or Animal Oils and Fats)	

Fire Prevention Questions

- Class “A” fire extinguishers are for items like wood, paper and trash?
 - **True**
- Class “B” fire extinguisher should be used on or near electrical equipment?
 - **False, Class B are for flammable liquids**
- Class “C” extinguishers are used for fires and involve liquids such as oil, paint and grease?
 - **False, Class C is for electrical equipment**
- Class “D” extinguishers are for combustible metal fires?
 - **True**
- ABC or AB extinguishers can be used when a fire combines one or more of the listed types of fire?
 - **True**
- What does PASS technique stand for?
 - Pull pin, Arrange extinguisher, Squeeze trigger and Slowly Move
 - Pull pin, Aim low, squeeze trigger and slowly Move
 - **Pull pin, Aim low, Squeeze trigger, and sweep for side to side**
 - Pull pin, Arrange extinguisher, squeeze trigger, and sweep side to side

Disinfection



- Pathogenic Organisms are in wastewater. They come from homes, hospitals, and other facilities.
- Wastewater plants must remove pathogens in order to produce an effluent that is safe for the environment.
 1. **Protect Water Supplies**
 2. **Protect receiving waters for recreational purposes**
 3. **Protect shellfish growing areas**
 4. **Protect all aquatic dependent organisms**

Disinfection

Disinfection is the process designed to kill or inactivate most microorganisms in **wastewater**, including essentially all pathogenic organisms. ... Pathogenic organisms are bacteria, viruses, or cysts that can cause disease in a host

Major Forms

- Chlorination (Most Common)
- Ultraviolet Light
- Ozone



Chlorine is the most popular form of disinfection because

1. Easy to obtain
2. Inexpensive to manufacture
3. Effective oxidizing agent at relatively low dosages

The exact method disinfection is not clear. Some believe that Chlorine exerts a direct action on bacteria cells, others believe it is toxic and inactivates critical enzymes that bacteria need for metabolism and growth.



Health Effects of Chlorine Exposure

Concentration (ppm in air)	Health Effects
1-3 ppm	Mild mucous membrane irritation
5-15 ppm	Upper respiratory tract irritation
30 ppm	Immediate chest pain, vomiting, shortness of breath (dyspnea) and cough
40-60 ppm	Inflammation of lung tissues (toxic pneumonitis) and fluid accumulation (pulmonary edema)
430 ppm	Death within 30 minutes
1,000 ppm	Death within a few minutes

Disinfection

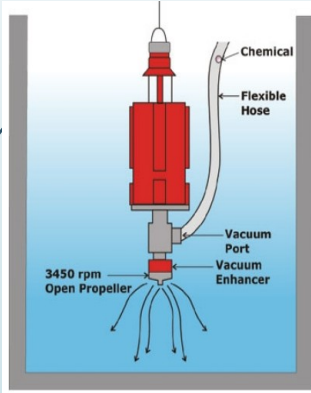
Reaction of chlorine in wastewater

- *Since chlorine is very reactive side reactions occur which use up a major portion of the chlorine being dosed before chlorine is available for disinfection*
 1. Chlorine reacts with **inorganic reducing agents** such as hydrogen sulfide (1 part H_2S will react with 8.5 parts chlorine)
 - Ferrous Iron
 - Manganese
 - Nitrite
 2. The reaction demand of inorganic salts must be satisfied before Cl_2 residual can exist.

Disinfection



Factors that affect chlorination effectiveness



1. **Injection point** – Good, quick mixing
2. **Contact Time** – minimum 90 minutes in general > contact time is better than higher residual.
3. **pH** – the lower the pH the better disinfectant
4. **Contact Tank Design** – no short circuiting
5. **Temperature** – Warmer the better
6. **Quality of the Effluent-** Lower turbidity the better
7. Bacteria cells are killed easily spores are tougher to kill

What are the different types of chlorine?

19

- Free chlorine – residual comprised of hypochlorite and hypochlorous acid
 - HOCL and OCL⁻
- Combined chlorine – chlorine combined with other water quality constituents
 - Chloramines
- Total chlorine – sum of free and combined chlorine

Free Chlorine + Combined Chlorine = Total Chlorine



Disinfection Questions

- Typhoid is not known to be spread by improperly disinfected wastewater being discharged to surface waters?
 - **false**
- It is illegal to ship leaking chlorine cylinders, whether full or partially empty?
 - **true**
- Since chlorine gas is heavier than air, air should be withdrawn from the lower portion of the room in which chlorine cylinders are kept?
 - **true**
- If a small amount of chlorine is added to effluent containing hydrogen sulfide, ferrous iron, or cyanide, little or no disinfection will occur?
 - **true**
- Human fecal matter is the only source of coliform organisms?
 - **false**
- The presence of coliform does not always mean there is fecal pollution?
 - **true**
- The presence of coliform organisms guarantees the presence of pathogenic organisms.
 - **false**
- The most common form of pathogen is the parasite?
 - **false**

Disinfection Questions

- Most pathogens are more resistant to disinfecting agents than nonpathogens?
 - false
- Sterilization of secondary effluent cannot be achieved by a normal chlorine contact time of 25 minutes?
 - true
- One pound of chlorine in 130,000 gallons of wastewater is approximately equivalent to one part-per-million?
 - true
- Chlorination alone is sufficient to prevent H₂S damage to concrete structures?
 - false
- Chlorination can aid in grease removal by breaking emulsions, permitting grease to float?
 - true
- *The maximum amount of gaseous chlorine feed per 150# cylinder should never be greater than which rate:*
 1. 35 lbs/day
 2. 70 lbs/day
 3. 17 lbs/day
 4. Function of daily flow and demand
 5. **None of the above (40 lbs per day for each cylinder)**
- **Effective chlorination is mainly dependent upon:**
 1. **Contact time**
 2. Temperature
 3. Pressure
 4. Purity
 5. None of the above

Disinfection Questions

- The SWRCB's "Water Quality Control Plan for Ocean Waters of California" limits fecal coliform organisms in ocean outfalls to a geometric mean not to exceed_____ in a calendar month:
 1. 10 per ml
 2. 23 per ml
 3. 240 per ml
 4. **500 per ml**
 5. 1000 per ml

- The SWRCB's "Water Quality Control Plan for Ocean Waters of California" limits enterococcus organisms in ocean outfalls to a most probable number (MPN) not to exceed_____ (MPN/100ml):
 - 10 per ml
 - 23 per ml
 - 500 per ml
 - 1000 per ml
 - **240 per ml**

Disinfection

- ▶ Chlorine acts with water to produce:

1. HCl and HOCl
2. H₂SO₄
3. ClCO₂
4. FeCl₂
5. H₂Cl₃ + O₂

- ▶ Gaseous Chlorine is

1. Light blue-green
2. Milky white
3. Light green
4. Yellow
5. **Greenish yellowish**

- ▶ Minor Chlorine leaks may be detected with ammonia vapors?

- ▶ **TRUE**

- ▶ Chlorine room fans should be able to change room air:

1. 1 time / minute
2. 16 times / minute
3. 4 times / hour
4. None of the above
5. **4 times per minute**

Disinfection

- If a person eyes are splashed with chlorine the eyes should be:
 1. **Flushed with water for 10 minutes**
 2. Flushed with boric acid
 3. Flushed with small amount of water
 4. Keep patients eyes closed
 5. None of the above
- The most effective and cheapest way to dechlorinate water sulfur dioxide?
 - **YES**
- Chlorine gas is fatal after a few breathes at 1000 ppm?
 - **Yes**
- Point where maximum chlorine demand has been achieved beyond which residual rises in proportion to dose is _____?
 - **BreakPoint**
- Chlorine is most effective at pH above 7?
 - **No**
- Flushable plugs in chlorine cylinders melt at?
 - **158 to 165 degrees**

- The completed coliform test consists of a presumptive phase where fermentation takes place in lactose broth generating gas, and a confirmed phase, where a positive results indicate the ability to grow coliform in a media (brilliant green bile) which suppresses the growth of other organisms?
 - **True**
- If the results of a laboratory test for wastewater are expressed in median tolerance limit (TLM) values, the test was called:
 1. COD
 2. Membrane filter
 3. Most probable number
 4. Precipitation number
 - 5. Bioassay test**
- In membrane filter test for coliform bacteria, the only colonies counted are:
 1. Blue-black
 2. White-grey
 - 3. Green-yellow-green**
 4. Violet-blue
 5. Brown

- Term “available chlorine” means:
 1. Total amount of chlorine in the compound
 2. Concentration of hypochlorous acid liberated in acid solution
 3. Total molecular chlorine liberated by a compound
 - 4. Total oxidizing power of a chlorine compound**
 5. Total free chlorine in an acidified solution of molar concentration

- Sodium hypochlorite typically is purchased in what concentration?
 - **5-15%**

- Water sample is “Fixed: in the field by adding chemicals to keep water quality from changing?”
 - **True**

- Coliform organisms are only found in intestinal tract mammals?
 - **False**

- Standard coliform concentrations are less stringent for shellfish harvesting areas than for ocean bathing areas?
 - **False**

Disinfection

Disinfection, by chlorination, one day total coliform count is extremely high. A check of chlorinating equipment shows the following:

Chlorine gas pressure low, chlorine lines cold and icing, considerable cooling at one point in the chlorine header system between cylinder and chlorinator

What is the problem?

What Corrective actions should be taken?

► What is the problem - Discuss

- Use of chlorine was extremely high and exceeded cylinder withdrawal limits, perhaps due to high flow and not enough cylinders in line, errors in chlorine residual analyzers, or partial nitrification in secondary effluent, leak in the delivery lines, failed chlorine heating system etc...
- Chlorine freezing in line preventing flow to chlorine injection point therefore low disinfection rate and high coliform count.

► What is the corrective actions - Discuss

- Safely get more chlorine on line (add more cylinders)
- Allow the on line cylinders to defrost
- Examine system for leaks
- Begin to resolve partial nitrification is that is the issue
- Divert final effluent to equalization basins and hold effluent if possible until chlorination problems are corrected.

Disinfection

- Chlorinator set at 43 lbs per day. Wastewater flow at 0.64 MGD and after 30 minutes contact time a chlorine residual of 0.5 mg/l is measured. Determine chlorine demand.

- A. Chlorine Dose = Chlorine Demand + Chlorine Residual
- B. Chlorine Dose = 43 Lbs Per Day
- C. Chlorine Residual = 0.5 mg/l

$$\text{Cl}_2 \text{ Residual} = 0.64 \text{ MGD} * 0.5 \text{ mg/l} * 8.34 \text{ lbs/gal} = 2.6688 \text{ lbs/day}$$

$$\text{Chlorine Dose} = \text{Chlorine Demand} + \text{Chlorine Residual}$$

$$43 \text{ lbs/day} = \underline{\hspace{2cm}} + 2.6688 \text{ lbs/day}$$

$$43 - 2.6688 = \text{Chlorine Demand of } 40.3312 \text{ lbs/day}$$

$$\begin{aligned} \text{Demand} &= 0.64 \text{ MGD} * ? * 8.34 \text{ lbs/gal} = 40.3312 \text{ lbs/day} \\ &= ? * 5.3376 = 40.3312 \text{ lbs/day} \\ &= ? = 40.3312 / 5.3376 \\ &= \mathbf{7.566 \text{ mg/l}} \end{aligned}$$

Disinfection

Chlorination of wastewater, the HOCl molecule reacts with ammonia nitrogen to form chloramines. The extent to which the various chloramines are formed depends on the Ph, temperature, contact time and concentration of each reacting substance. Discuss below the effect on the formation of chloramines that each of the above-mentioned factors has and their relative effect on disinfection efficiency

Factors that affect chlorination effectiveness

- 1.Injection point** – Good, quick mixing
- 2.Contact Time** – minimum 90 minutes in general > contact time is better than higher residual.
- 3.pH** – the lower the pH the better disinfectant
- 4.Contact Tank Design** – no short circuiting
- 5.Temperature** – Warmer the better
- 6.Quality of the Effluent-** Lower turbidity the better
- 7.Bacteria cells are killed easily spores are tougher to kill

Disinfection

Chlorination of wastewater, the HOCl molecule reacts with ammonia nitrogen to form chloramines. The extent to which the various chloramines are formed depends on the Ph, temperature, contact time and concentration of each reacting substance. Discuss below the effect on the formation of chloramines that each of the above-mentioned factors has and their relative effect on disinfection efficiency

Impact of PH



Disinfection

Reaction with Ammonia

- Ammonia is present in wastewater
- Ammonia reacts with hydrochlorous acid to form
 1. mono-chloramine – good disinfectant (1B)
 2. di-chloramine - good disinfectant (1A)
 3. tri-chloramine -
- Which of the three forms is determined by pH

pH = 4.0	pH < 5.5	pH 6.5 to 7.5 Normal for wastewater
Trichloramine-only	Dichloramine-only	Monochloramine and Dichloramine exist together

Chloramines are formed during a reaction between chlorine) and ammonia (NH₃). Chloramines are amines which contain at least one chlorine atom, which is directly bond to nitrogen atoms (N). Inorganic chloramines are formed when dissolved chlorine and ammonia react.

Chlorination of wastewater, the HOCl molecule reacts with ammonia nitrogen to form chloramines. The extent to which the various chloramines are formed depends on the Ph, temperature, contact time and concentration of each reacting substance. Discuss below the effect on the formation of chloramines that each of the above-mentioned factors has and their relative effect on disinfection efficiency

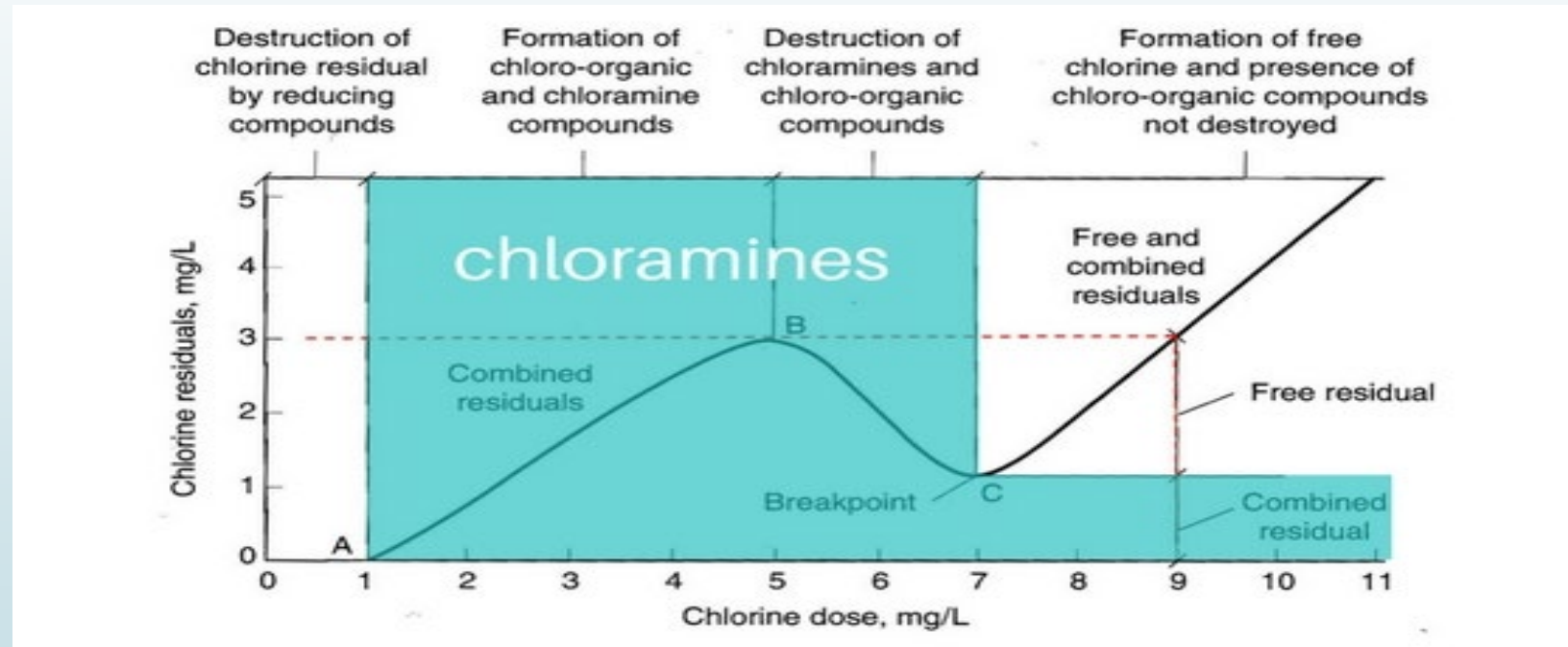


appearance	name	molecular weight	preferred pH value	biocidating effect
NH_2Cl	monochloramine	52	> 7	good
$NHCl_2$	dichloramine	85	4 - 7	tolerable
NCI_3	trichloramine	119	1 - 3	average
$RNHCl$	organic chloramines	varies	unknown	bad

Disinfection

Chlorination of wastewater, the HOCl molecule reacts with ammonia nitrogen to form chloramines. The extent to which the various chloramines are formed depends on the Ph, temperature, contact time and concentration of each reacting substance. Discuss below the effect on the formation of chloramines that each of the above-mentioned factors has and their relative effect on disinfection efficiency

Impact of concentration



Ammonia levels are so high in wastewater (20 to 35MG/l) it is rare to achieve a free residual in wastewater effluent unless nitrification has occurred in the secondary process

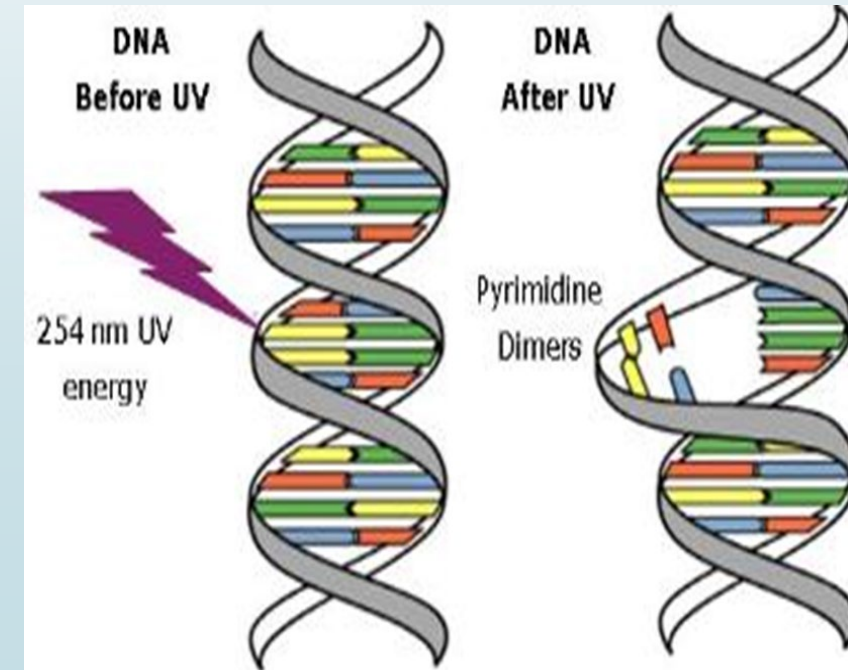
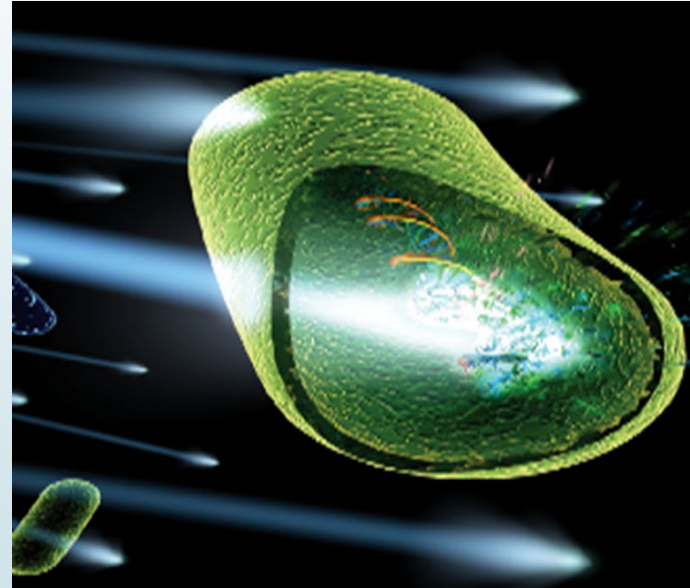
Disinfection

How many pounds of chloride of lime with 15% available chlorine are needed to treat a flow of 1.3 MGD of treated wastewater. Assume at 4 mg/l desired dosage

- $1.3 \text{ MGD} * 4 \text{ mg/l} * 8.34 \text{ lbs/gal} = 43.368 \text{ lbs desired}$
- 43.368lbs is equal to 15% of how many pounds?
- $43.368 \text{ lbs} = 15\% * ?$
- $43.386 \text{ lbs} = 0.15 * ?$
- $43.386 \text{ lbs} / 0.15 = ?$
- 289.12 lbs/day

Disinfection Ultraviolet Radiation

- When UV is absorbed by microorganisms it damages their genetic material (ends growth and production).
- Becoming more popular because of the safety concerns and health effects associated with Chlorine by products.



Disinfection

Ultraviolet Radiation (3 types) of bulbs

1. Low-pressure, low intensity
2. Low-pressure, high intensity
3. Medium-pressure, high-intensity

- Power to UV bulbs must be consistent, **ballast** serves this purpose. Ballast limit current to a bulbs
- UV lamps contain “**mercury vapor**” handle with care and they must be properly disposed of.
- Ballast – a electrical transformer which limits current to a UV Lamp. Without a ballast to limit current lamps would destroy themselves.



UV Dosage = Intensity x Time

Intensity

Factors that affect intensity

- **Water Quality** - Water quality refers to the clarity of the water to be treated and the degree to which it allows ultraviolet light to pass through it unobstructed. For optimum performance, it is recommended to have Filter before the UV Reactor to remove suspended solids, dissolved organics, etc., and generate water with acceptable transmission qualities.
- **Lamp Output** - Proper lamp output is easily maintained by regular cleaning of the quartz sleeve that encases the lamp and by lamp replacement once per year. Ultraviolet level monitoring and alarm/shutoff equipment can also be placed on the unit to provide a fail-safe indication of lamp output.

Time

- The time of exposure to ultraviolet light is directly related to the flow rate of water passing through the disinfection chamber. By changing the retention time for a given ultraviolet intensity, the dosage can be increased or decreased as needed. That is, higher or lower dosage rates can be achieved by either decreasing or increasing the flow rate. The longer the water is in the ultraviolet disinfection chamber the higher the dosage, and vice-versa.

Fundamental Principle of UV disinfection

$$\text{UV Dose} = \text{intensity} \times \text{time}$$

joule/ m²

watt/m²

sec

The larger the **Dose**,
the more alterations to the DNA,
leading to **Sterilization**

Formula

$$\text{Dosage} = \text{Intensity} \times \text{Time}$$

$$\text{Ws/m}^2 \text{ or } \text{J/m}^2 = \text{W/m}^2 \times \text{s}$$

$$= \text{Ws/ m}^2 \quad \text{W} \times \text{s} = \text{J}$$

$$= \text{J/m}^2$$

W – Watt, m² - Surface Area, s – time in seconds, J – Energy joules

$$E = hc/\lambda$$

E – Energy in Joules, h – Planck's constant = 6.63×10^{-34}

c – speed of light = 3×10^8

λ = wavelength in meter

UV Questions

- What are the three types of electrode-type lamps used to produce UV radiation or UV light?
 1. **Low-pressure, low intensity**
 2. **Low-pressure, high intensity**
 3. **Medium-pressure, high-intensity**
- What is a ballast?
 - **an electrical transformer which limits current to a UV Lamp. Without a ballast to limit current lamps would destroy themselves.**
- Give a general explanation of how a PLC controls insures that minimum UV intensity is reached?
 1. **PLC receives a “minimum UV intensity” which is field adjustable**
 2. **PLC receives “target UV intensity” which is field adjustable**
 3. **Compares “target UV intensity” with the actual UV intensity (lowest intensity of running banks)**
 4. **Makes an adjustment to the output power of all ballast cards in in operation.**
- The UV light intensity that reaches the pathogens in water is affected by what two factors?
 - **Condition of UV lamps**
 - **Quality of the water**
- UV units automatically adjust UV does based on what two factors?
 - **Light transmission**
 - **Effluent flow**

UV Questions

- ▶ The service life of UV lamps depends on what factors?
 - ▶ **The quality/clarity of the effluent to be disinfected and the fecal coliform level to be achieved.**
 - ▶ **The frequency of on/off cycles**
 - ▶ **The operating temperature of the lamp electrodes**
- ▶ What band of electromagnetic radiation is used for the disinfection of wastewater effluent?
 - ▶ Mesophillic
 - ▶ 125 NM
 - ▶ 212 NM
 - ▶ **254 Nm**
 - ▶ X-Ray
- ▶ UV dose is expressed in what units
 - ▶ **Mj/sq cm**
 - ▶ Kwh
 - ▶ 230 MPN
 - ▶ MGL
 - ▶ mW/ sq cm

UV Questions

- ▶ UV intensity is expressed in what units
 - ▶ Mj/sq cm
 - ▶ Kwh
 - ▶ 230 MPN
 - ▶ MGL
 - ▶ **mW/ sq cm**
- ▶ What is the formula to calculate UV Dose
 - ▶ $X \text{ mgd} \times \text{conc mg/l} \times 8.34 \text{ lbs/gal}$
 - ▶ $0.785 \times D^2 \times H$
 - ▶ $VA/1000 \times pF$
 - ▶ $\ln - (\ln - \text{Out}) \times 100$
 - ▶ **mW/sq cm * sec**