

IDEM Wastewater Operator Examination

Study Guide

Industrial Class B, Class C and Class D Exams

December 2025

As you prepare for the Industrial Class B, Class C and Class D exams, you will need to focus your study on Books 1, 4, 5, 10 and 14 as listed on the IDEM Wastewater Operator Certification Exam Book List web page. These references have been used in developing the examination questions which you will be required to answer.

Books 1, 4 and 5 are manuals prepared by and available through California State University, Sacramento College of Engineering and Computer Science, Office of Water Programs (Referred to hereafter as the Sacramento manuals), which can be purchased at: [Wastewater Courses \(csus.edu\)](http://www.csus.edu/water/water_courses/)

Book 10 is IDEM's Wastewater Operator Certification Manual found at: https://www.in.gov/idem/cleanwater/files/wastewater_cert_booklist_10_manual.pdf

Book 14 is EPA's Introduction to the National Pretreatment Program, which is available online at: https://www3.epa.gov/npdes/pubs/pretreatment_program_intro_2011.pdf

This document is designed to guide you to the subject matter that you will need to be familiar with in order to pass the test. While this covers a wide range of material, you should keep in mind that the exam consists of only 100 multiple choice questions. You can do this! The breakdown of the distribution of the questions is described below.

Categories of test questions which will be covered based on the three Sacramento manuals and the percentage of the examination questions comprised from each area are listed below:

	Class B	Class C	Class D
Activated Sludge	4%	4%	4%
Advanced Treatment	3%	3%	3%
Clarifiers	4%	4%	4%
Fixed Film	1%	1%	1%
Industrial Treatment	23%	23%	23%
Laboratory	11%	11%	11%
Maintenance	4%	3%	3%
Pollution Prevention	0%	3%	3%
Preliminary treatment	5%	4%	4%
Safety	3%	3%	3%
Solids Handling	7%	6%	6%

(These percentages are approximate)

Chapters to be studied from the Sacramento manuals:

Book 1: Operation of Wastewater Treatment Plants – Volume I, 8th Edition

Chapter 9 Laboratory Procedures

Appendix A Introduction to Basic Math for Operators

Book 4: Industrial Waste Treatment – Volume I, 4th Edition

All chapters except Chapter 7 - Instrumentation and Control

Book 5: Industrial Waste Treatment – Volume II, 4th Edition

All Chapters

Mathematics: 10 %

Mathematics problems given on the examination will have a corresponding formula listed on the Formula Sheet furnished with the exam on your test day. It is recommended that you look over the formula sheets and work the problems in the Appendices in Volumes 1 and 2 of the Sacramento manuals. Solving these problems involves plugging the numbers given in the problem into the correct formula and calculating the answer.

There are a few basic rules that apply to solving formulas:

1. Work from left to right
2. Do all of the multiplication and division above the line (in the numerator) and below the line (in the denominator); then do the addition and subtraction above and below the line.
3. Perform the division (divide the numerator by the denominator).
4. Parentheses () are used in formulas to identify separate parts of a problem. Work the arithmetic within the parentheses before working outside the parentheses. Use the same order stated in rules 1, 2, and 3 above when working inside of parentheses.

Web site for the Formula Sheet:

https://www.in.gov/idem/cleanwater/files/wastewater_cert_study_guide_formula_sheet.pdf

Pretreatment: Exams B = 5%, C = 5%, D = 5%

Questions concerning the regulatory pretreatment program are derived from Book 14, EPA's Introduction to the National Pretreatment Program and Book 4, Industrial Waste Treatment, Volume I, Chapter 1, Introduction to Industrial Waste Treatment

Rules/Statutes/Completing reports 20%

The remainder of the examination questions will cover Rules and permit requirements located in Chapter III, Section One, of the **Wastewater Certification Manual (Book 10)** and questions related to completion of the Discharge Monitoring Report (DMR) and the Monthly Monitoring Report (MMR). A worksheet and necessary additional documents are incorporated into the Certification Manual as Appendices A, B, C, and D.

Subject Matter Topics

The following is subject matter that an operator should be familiar with. You should be able to answer questions on the points presented below. Of course, not all of this will appear on any given test, but some of it will appear on all tests.

Safety:

Discuss safety equipment and supplies needed.

Discuss MSDS (now SDS).

Describe the atmospheric hazards of confined spaces.

Define confined space.

What toxic gases may be encountered in the wastewater field?

Can hydrogen sulfide gas be always detected by smell? If not, what is the reason?

Know hydrogen sulfide is heavier than air

Describe flammable/explosive gases.

Discuss the hazard of an oxygen deficient atmosphere.

Tool precautions for an anaerobic reactor

What precautions are needed in entering a confined space?

What hazardous materials may be encountered during inspection and sampling?

What corrosive materials may be encountered at wastewater treatment plants?

Discuss the infection agents which can be found in a wastewater treatment plant.

Describe the types of physical hazards encountered during sampling and inspection.

Describe safety regulations and OSHA.

Discuss safety procedures that an operator should observe when working in various areas and on various types of equipment in a wastewater treatment plant.

Describe collection system hazards.

Discuss laboratory safety.

Describe lockout/tagout procedures in detail.

Discuss the development and implementation of a safety training program.

List and discuss types of wastewater treatment plant hazards.

What are the most frequent injuries at a wastewater plant

Pretreatment:

Define a Significant Industrial User (SIU).

Define categorical pretreatment standards.

Define Control Authorities and when they are required to inspect SIUs.

Know what a Sewer Use Ordinance is and what it does.

What must a Wastewater Discharge Pretreatment Permit include.

Know the specific prohibitions of 40 CFR 403.5.

Know what significant noncompliance (SNC) is and what qualifies as SNC

Define slug discharge and notification requirements and handling

Define TOMP

Discuss conventional pollutants

Describe U.S. EPA's general pretreatment regulations as they pertain to the delegated POTW

What is regulated under the general pretreatment regulations?

What are the categorical pretreatment standards?

Define production based discharge standards

What is TTO and how should it be sampled?

What is the general pretreatment regulation and what is its objective?

Discuss emergency planning.

Discuss the identification of spilled matter.

Discuss the control of spilled matter in sewer.

Describe POTW process changes during an emergency spill.

Discuss the initial response procedures during an emergency spill.

What steps must be taken in reporting a spill or slug?

List and discuss types of wastewater treatment plant hazards.

What are the types of Categorical Standards?

How can Categorical Standards be modified?

Know that POTW's NPDES requires the POTW to create a pretreatment program

Define pass through

Define non-contact water

Define chain of custody

Discuss the scope of local ordinances.

What must an ERG (Enforcement Response Guide) provide guidance on

Discuss enforcement and penalties for non-compliance with environmental laws.

Pollution Prevention

Discuss pollution prevention techniques

What are the effects of industrial wastestreams?

Describe specific types of treatment and problems associated with different manufacturing processes.

Preliminary Treatment

Purpose and operation of an EQ tank

Define short circuiting

Define Oxidation-reduction potential (ORP)

Describe the basic concepts of flow measurement.

Discuss open channel flow measurement.

Discuss closed pipe flow measurement.

How are flow meters calibrated?

What types of flows should be measured?

What are primary elements of flow measurement

Discuss stilling wells

Define rotameter and its use

Discuss different screening equipment and their advantages/disadvantages

Define blinding

What are the types of solids removed from wastewater treatment system

Discuss flow meters:

Types

Sensor maintenance

Calibration Troubleshooting

Define conductivity

When do you need secondary containment

Industrial Treatment

How does coagulation/flocculation work?

Know common chemicals used in treatment.

Define polyelectrolytes/polymers

Define complexed metals

Define mercaptans

Define emulsion

Describe jar testing.

Discuss filtration and ultrafiltration methods and operation

Define batch treatment and what wastes are best treated in batches

What chemicals are used to improve settling?

Be able to recognize and interpret the precipitation of metal salts vs pH graph

Describe the types of equipment used in physical-chemical treatment processes.

What are typical operation, start-up, and maintenance procedures for physical-chemical treatment processes.

Know what factors affect chemical equilibrium

Know different components of dissolved air flotation unit, how it operates and be able to troubleshoot

Discuss ion exchange

Explain how to flow proportion composite samples.

Discuss the operation and maintenance of gravity filters in detail.

Discuss inert-media pressure filters.

Discuss continuous backwash, upflow, and deep-bed silica sand media filters.

Troubleshoot rapid sand filter

Discuss the types, operation and maintenance of cross flow membrane filtration in detail.

Discuss the air stripping of volatile organics and troubleshoot

Define adsorption

Describe the activated carbon adsorption process.

Define breakthrough

Discuss activated carbon regeneration.

Troubleshoot activated carbon

Compare and contrast types of metal wastestreams and their treatments

Know different types of metal treatment in detail.

Discuss water use and treatment by industries in general.

Describe the character of wastewater and types of wastewater treatment used by different industries.

Discuss the various types of industrial treatment facilities (e.g. – dairy, petroleum, metal finishing, brewery, meat packing, etc.) and key aspects of those treatment processes (advantages/disadvantages).

Discuss oily waste and its removal

Importance of pH in cyanide destruction

Discuss cyanide removal

Troubleshooting metal treatment

Troubleshooting spent plating baths

Preventative maintenance for inline pH meters

Define Chelation, chelants examples and why they are used

Describe sand filter operation

Describe backwashing of filters in detail

Describe the aspects of anaerobic treatment in detail

Discuss how toxicity affects the process

Compare and contrast types of anaerobic reactors and treatment systems

Discuss anaerobic phosphate stripping tank

Start-up and normal operating procedures

Troubleshooting

Laboratory tests and procedures Safety and maintenance

Define boiler blowdown and other dilution streams

Maintenance

What should a wastewater treatment plant maintenance program/safety plan include?

What is the purpose of a preventative maintenance plan?

Describe the troubleshooting and maintenance of an air stripping system.

Study proper maintenance, start-up procedures, and troubleshooting guides for wastewater treatment equipment.

Compare and contrast the various types of pumps, their preventative maintenance and troubleshooting.

Define cavitation

Define water hammer

Discuss electrical equipment safety and maintenance. Discuss motor safety, maintenance, and troubleshooting.

Detail preventing and mitigation of corrosion

Solids Handling

Describe several methods used to dewater sludges.

Describe several sludge drying methods in detail.

Describe anaerobic digestion process in detail.

Define hydrolysis and relationship to anaerobic process

Compare and contrast types of anaerobic reactors and treatment systems

Start-up and normal operating procedures

Troubleshooting

Discuss how toxicity affects the process

Laboratory tests and procedures Safety and maintenance

Compare, contrast, and troubleshoot the following types of sludge thickening in detail:

- Gravity thickening

- Dissolved air flotation

- Centrifuge

- Gravity belt filter

Discuss methods of sludge stabilization and conditioning.

Describe methods of sludge dewatering in detail and troubleshoot

Describe solids disposal options and government regulation.

Know the definition of flux.

Define biosolids

Define monofilling

Be familiar with land application procedures

Fixed Film

Advantages/disadvantages of fixed film

Compare and contrast the various fixed growth (or fixed film) processes such as trickling filter, biotower, etc.

Describe the function and maintenance of the primary equipment used in the various fixed growth processes.

Troubleshooting common problems associated with fixed film growth processes.

Discuss filter media in detail.

Define fluidized

Activated Sludge

Compare and contrast the various aeration systems used in the activated sludge process. RAS (Return Activated Sludge) – methods and process control in detail.

WAS (Waste Activated Sludge) – methods and process control in detail.

Troubleshoot operational problems

Discuss the following terms:

Settleability

F/M (Food to Microorganism Ratio) MCRT

(Mean Cell Residence Time)

SVI (Sludge Volume Index)

MLVSS (Mixed Liquor Volatile Suspended Solids)

OUR (Oxygen Uptake Rate)

Sludge Age

Discuss activated sludge microbiology:

Types of organisms

What the organisms generally indicate in relation to sludge quality

Troubleshooting the activated sludge process using microbiology

How chemical additives can affect microbiology

Nutrient requirement

Discuss heterotrophic bacteria

Discuss Sequencing Batch Reactors (SBRs):

Start-up

Process control Equipment

Operation and maintenance

Troubleshooting

Discuss biological nitrification process and troubleshoot

Discuss biological denitrification process and troubleshoot

Discuss Enhanced biological control processes

Discuss mixers and their purpose

Discuss Phosphorus removal

Discuss and troubleshooting different foams

Define Anionic polymer

Optimal environment and ratio of nutrients

Indicator of toxic environment

Clarifiers

Identify parts of a clarifier

Identify parts, advantages/disadvantages of a lamella clarifier

Ideal detention time in a clarifier

Define weir overflow rate

Discuss troubleshooting sludge denitrification in a clarifier

Discuss troubleshooting rise in sludge blanket

How can you measure sludge blanket

Define clarifier efficiency

Laboratory

Define ambient temperature

Describe chemical names and chemical formulas.

Describe laboratory equipment. (pipettes, flasks, spectrophotometer, desiccator,

Discuss the term solutions.

What is the term titration?

Define and discuss the use of a spectrophotometer.

Discuss the corrosive chemicals found in laboratories.

Describe the toxic chemicals found in a laboratory.

Discuss proper laboratory techniques.

Discuss the importance of sampling.

Describe the types of samples collected at a wastewater treatment plant.

Describe the proper holding times and preservation of samples and know where to find this information.

Describe the tests for settleable solids.

Describe the suspended solids test.

Define volatile solids and how you measure them.

Discuss the measurement of the sludge volume index.

Discuss the measurement of D.O. in the aeration tanks.

Describe the alkalinity test procedure.

Describe the C.O.D. test procedure.

Describe the term buffer.

Define specific gravity

Describe the D.O. tests.

Describe the B.O.D. tests.

Describe pH and its tests.

Define a blank

Define a standard

Discuss the measurement of metals in wastewater.

What does the term “TKN” stand for? What does it measure?

Discuss the need for analyzing and presenting data.

Describe the causes of variation in laboratory test results.

Discuss the term sampling.

Know acid safety

Define meniscus

Know which parameters must be grab samples

What are process control charts and their purpose

Why is E. Coli the indicator of fecal pollution

Define oxidation

Define reduction

Mathematics

Given membrane area and flow, calculate flux

Calculate hydraulic loading of a DAF given its flow and measurements

Calculate retention coefficient given permeate and retentate concentration

Given inlet pressure, outlet pressure, and permeate pressure of an ultrafiltration system, calculate transmembrane pressure in PSI.

Given surface area, flow, and percent solids in a DAF, calculate solids loading

Calculations for the area of a rectangle and circle and the volume of a rectangular tank and a cylinder tank will not be provided, you must know this information.

You must memorize the value of π .

You must know how to calculate an average (mean).

You must know that r = radius and that $r = \text{diameter}/2$.

Given the volume of a sedimentation tank and the flow rate, calculate the detention time of the sedimentation tank.

Given a flow rate in gpm, convert it into MGD.

Given the distance and time of travel of a stick in a grit channel, calculate the velocity of travel.

Given the influent and effluent TSS, calculate the TSS removal efficiency in percent.

Given the concentration of MLSS and the volume of an oxidation ditch, calculate the pounds of solids under aeration.

Given the influent BOD and the required percent removal, calculate the required maximum effluent BOD.

Given the dimensions of an aeration tank (circular), calculate the volume of the tank. Given the 30-minute settleable solids (%) and MLSS, calculate the sludge volume index.

Given the flow totalizer readings at the beginning and end of a month (30 days), calculate an average flow rate for the month.

Given the effluent BOD in mg/l and an effluent flow rate, calculate the BOD loading to a receiving stream in pounds per day.

Given the influent and effluent TSS of a wastewater plant, calculate the overall TSS removal efficiency.

Given the TSS of a primary effluent, the daily flow and the total solids (pounds) in an aeration tank, calculate the sludge age.

Given the estimated BOD of a sample, calculate the ml of sample to be added to a BOD bottle (300 ml).

Given the sample volume of a BOD test, the initial D.O. and the final D.O., calculate the sample BOD.

Given six BOD values in mg/l, calculate the mean BOD in mg/L.

Given the flow rate and the desired dosage of chlorine, calculate the chlorine feed rate in pounds per hour.

Given test results on the TSS determination using a Gooch crucible (sample volume, crucible weight w/ and w/o residue), calculate the TSS in mg/l.

Given the required chlorine feed rate and the strength of HTH (high test hypochlorite), calculate the pounds/day of HTH required.

Given the volume of water in liters, calculate its weight in grams.

Given dimensions of an aeration basin and % seed needed, calculate seed needed in gallons

Given desired MCRT, lbs solids in aeration, effluent TSS, and flow, calculate estimate wasting sludge rate in lbs/day

We at IDEM wish you success and hope to see you out there working to protect Indiana's waters and the infrastructure investments in wastewater facilities

Now, go pass that test!