

# IDEM Wastewater Operator Examination

## Study Guide

### Municipal Class 3 and Class 4 Exams

September 2024

As you prepare for the Municipal Class 3 and Class 4 exams, you will need to focus your study on Books 1, 2, 3, 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, 2 and 3 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: <https://www.owp.csus.edu/courses/wastewater.php>

Book 10 is IDEM's Wastewater Operator Certification Manual which can be found at: [https://www.in.gov/idem/cleanwater/files/wastewater\\_cert\\_booklist\\_10\\_manual.pdf](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](https://www3.epa.gov/npdes/pubs/pretreatment_program_intro_2011.pdf)

While most of the reference material used for the Class 3 and 4 exams is the same, the higher-level exam will contain more specific and difficult questions.

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 do not need to study every chapter of these books, and since you have been working at a wastewater treatment plant for some time, much of this will already be familiar to you. **You can do this!** The breakdown of the distribution of those 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:

Activated Sludge	15-20%
Advanced Treatment	5%
Clarifiers	5%
Disinfection	6%
Laboratory	10%
Maintenance	5%
Preliminary treatment	5%
Safety	6%
Solids Handling	3%
(These percentages are approximate)	

## **Book 1: Operation of Wastewater Treatment Plants – Volume I**

**Chapter 1** Introduction to Wastewater Treatment

**Chapter 2** Safety

**Chapter 3** Preliminary Treatment

**Chapter 4** Primary Treatment

**Chapter 5** Activated Sludge Systems

**Chapter 7** Disinfection and Chlorination

**Chapter 9** Laboratory Procedures

**Appendix A** Introduction to Basic Math for Operators

## **Book 2: Operation of Wastewater Treatment Plants – Volume II**

**Chapter 1** Introduction to Wastewater Treatment

**Chapter 2** Nutrient Removal

**Chapter 3** Solids Removal from Effluent

**Chapter 4** Residual Solids Management

**Chapter 5** Plant Maintenance

**Appendix A** Introduction to Basic Math for Operators

## **Book 3: Advanced Waste Treatment**

**Chapter 1** Odor Control

**Chapter 2** Activated Sludge

**Chapter 3** Residual Solids Management

**Chapter 4** Solids Removal from Secondary Effluents

**Chapter 5** Phosphorus Removal

**Chapter 6** Nitrogen Removal

## **Mathematics: 10 – 15 %**

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.

## **Website for the Formula Sheet:**

[https://www.in.gov/idem/cleanwater/files/wastewater\\_cert\\_study\\_guide\\_formula\\_sheet.pdf](https://www.in.gov/idem/cleanwater/files/wastewater_cert_study_guide_formula_sheet.pdf)

## **Pretreatment: 5%**

Questions concerning the regulatory pretreatment program are derived from the Introduction to the National Pretreatment Program (Book 14).

## **Rules/Statutes/Completing Reports 20%**

The remainder of the examination questions will cover the applicable rules and completion of monthly reports. Practice questions on Rules are covered extensively in Chapter III, Section One, of the Wastewater Operator Certification Manual.

There will also be questions related to completion of the Discharge Monitoring Report (DMR) and the Monthly Report of Operation (MRO). A worksheet and necessary additional documents are incorporated into the Certification Manual as Appendices A, B, C, and D to help prepare you for the exam.

## **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**

How is an emergency operating plan developed?

Discuss safety in a confined space.

Discuss the safety hazards due to oxygen deficiency.

Describe the safety measures in the operation of anaerobic digesters.

Discuss "tailgate" safety meetings.

Discuss the paperwork which is important in developing your safety program.

What are amines?

Discuss the surface-active agents at a wastewater treatment plant.

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 always be detected by smell? If not, what is the reason?

Describe flammable/explosive gas.

Discuss the hazard of an oxygen deficient atmosphere.

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 during inspection and sampling?

What corrosive materials may be encountered at wastewater treatment plants?

Discuss the infection agents which can be found at a wastewater treatment plant.  
Describe the types of physical hazards encountered during sampling and inspection.  
Describe safety regulations and OSHA.  
Discuss the type of flammable material discharged to the sewer from industries. What is regulated under the general pretreatment regulations?  
What are categorical pretreatment standards?  
What is TTO and how should it be sampled?  
What is the general pretreatment regulation?  
Discuss emergency planning.  
Discuss the identification of spilled matter.  
Discuss the control of spilled matter in a sewer.  
Describe the 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?

## **MAINTENANCE**

What is water hammer?  
Describe centrifugal pumps.  
Describe progressive cavity pumps.  
Explain the methods to clean scum lines.  
Discuss maintenance of plant tanks and channels.  
Describe troubleshooting of malfunctioning meters.

## **PRELIMINARY TREATMENT**

Discuss the safety hazards around bar screens and racks.  
What is the function of grit channels?  
Discuss the basics of flow measurement.  
Describe the use of a float in the flow measurement of an open channel.  
How does a bubbler system work in flow measurement?  
Discuss electromagnetic flow meters.  
Discuss turbine and propeller type flow meters.  
Describe ultrasonic flow meters in a closed pipe.  
Describe open-channel flow measurement.  
Describe flow measurement by weirs.  
Explain the use of dipping probes in the flow measurement.  
Describe a capacitance probe in flow measurement.  
State methods of checking the accuracies of open channel flow meters. Explain the use of pitot tubes.  
What are velocity modified flow meters?

## **SEDIMENTATION**

Discuss troubleshooting of sedimentation tanks.  
Describe the principal and function of a primary clarifier.  
Discuss the secondary clarifiers for the activated sludge process.  
Describe the flotation processes.  
Discuss typical clarifier efficiencies.

Compare the loading rates of trickling filters with primary clarifiers.

## **ACTIVATED SLUDGE**

Discuss flow path for oxidation ditches.

Describe the types of package treatment plant processes.

Describe microorganisms of importance in the activated sludge process.

What are the desirable microorganisms in the activated sludge process?

Describe the term “endogenous respiration” in the aerobic biological process.

Discuss the wasting of activated sludge.

Describe the variations in the activated sludge process.

Explain the term “mean cell residence time” (MCRT).

Study the glossary for activated sludge.

Describe the activated sludge process

Study the design criteria for an oxidation ditch.

Describe the impact of various wastewater discharges to the POTW.

Explain the process changes necessary to meet an upset condition of activated sludge plant.

Discuss the problem of foaming in activated sludge plants.

Explain the rising sludge problems in an activated sludge plant.

Describe the rising sludge problems in an activated sludge plant.

Describe troubleshooting methods for the activated sludge process.

Describe the various modes of the activated sludge process.

Discuss the interpretation of microscopic study of the MLSS.

Compare the microscopic results with laboratory process data in an activated sludge plant.

Discuss process changes in an activated sludge plant.

Methods of RAS flow rate control.

Operational strategy for high organic waste loads.

Discuss ammonia removal by breakpoint chlorination.

Discuss nitrogen as a nutrient in a stream.

Describe the different types of nitrogen removal systems.

Describe nitrification.

Discuss denitrification.

Discuss ammonia removal by breakpoint chlorination.

Discuss the ion exchange method of nitrogen removal.

Discuss the overland flow system of nitrogen removal.

Discuss the equipment needed for nitrification.

Describe nitrification using suspended growth reactors.

Compare the five types of suspended growth nitrification processes.

Discuss the daily operation of the suspended growth denitrification system.

Describe the chemical reaction of the denitrification process.

Discuss the flow sheet of a nitrification – denitrification activated sludge.

Describe the operation of ammonia stripping from wastewater.

Describe the necessary controls for the breakpoint chlorination method of ammonia reaction.

Study the troubleshooting guide for nitrification systems.

## **DISINFECTION**

Describe the term chlorination requirements in wastewater disinfection.  
Discuss the effectiveness in microorganism removal by various treatment processes.  
Discuss the use of hypochlorite components for disinfection.  
Describe the chlorine solution discharge lines.  
Discuss the term compound loop control in wastewater disinfection by chlorine.  
Describe the installation and the maintenance routines of chlorination facilities.  
Describe seven basic methods of chlorination control.  
Discuss an operator's response to exposure to sulfur dioxide.  
Describe the sulfonator parts.  
Review the troubleshooting guide for a gas sulfonator system.  
Discuss the need of dichlorination.  
Describe the term disinfection.  
Describe the reaction of chlorine in wastewater.  
Discuss the use of chlorine dioxide in wastewater disinfection.  
Discuss the reaction of chlorine with inorganic reducing materials.  
Describe the reaction of chlorine with ammonia.  
Explain the factors influencing disinfection by chlorine.  
Describe a preventive maintenance program for chlorination hazards.  
Discuss the safe handling of chlorine cylinders.  
Discuss the operation of a chlorinator.  
Discuss chlorine injector water supply.  
Discuss the use of chlorine for odor control.  
Describe the chemical reaction of sulfur dioxide with wastewater.  
Discuss the method of detection of residual sulfur dioxide.  
Describe the term ultraviolet irradiation for disinfection.  
What variables affect the efficiency of ultraviolet (UV) disinfection?  
Describe the elements of a process control system available in UV disinfection.  
Discuss the equipment used in UV disinfection.  
Discuss the use of ozone for disinfection.

## **LABORATORY, SAMPLING & MONITORING**

Discuss the use of a spectrophotometer.  
Describe laboratory safety.  
Discuss personal hygiene in the laboratory.  
Describe accident prevention in a laboratory.  
Discuss representative sampling.  
Compare the types of samples.  
Discuss the preservation of samples (i.e., BOD, ammonia, solids, pH, and metal testing).  
Describe the testing method for settleable solids.  
Discuss the determination of total sludge solids.  
Compare the settleability test and the settleable solids test.  
Describe the determination of sludge age.  
Explain the determination of dissolved oxygen in an aerator.  
Discuss the determination of mean cell residence time (MCRT).  
Discuss the determination of volatile acids for anaerobic digesters.

Discuss the determination of total alkalinity for an anaerobic digester.  
Describe the determination of supernatant solids for an anaerobic digester.  
Describe the COD determination methods.  
Discuss the determination of coliform group bacteria.  
Discuss the D.O. measurement by the Winkler method and the D.O. probe.  
Describe the methods of BOD measurement.  
Discuss the measurement of pH.  
Describe the determination of metals in wastewater.  
Explain nitrogen in wastewater and its determination.  
Discuss the determination of ammonia nitrogen using an ion-selective electrode.  
Discuss the method of oil and grease determination.  
Discuss the determination of phosphorus in wastewater.  
Discuss the determination of surfactants.  
Describe the determination of total organic carbon (TOC).  
Discuss the terms solution and normality and glossary of laboratory terms.  
Discuss the importance of effluent disposal.  
Explain the treatment requirements of wastewater.  
Describe the monitoring D.O. in receiving waters.  
Describe types of receiving waters other than streams and rivers.  
Discuss the need for analyzing and presenting data.  
Describe the average or arithmetic mean of data.  
Describe the range of values of collected data.  
Discuss the geometric mean.  
Describe the terms variance, standard deviation, and mode.  
Explain how one decides how many samples need to be collected.  
Discuss who will analyze the samples after collection.  
Discuss what kind of sample containers will be used.  
Discuss the collection of a representative sample of an industrial wastewater source to public sewers.  
Describe three types of samples.

## **SOLIDS TREATMENT AND HANDLING**

Discuss the purpose of anaerobic sludge digestion.  
Explain how anaerobic digestion works.  
Describe the components of an anaerobic digester system.  
Explain the function of a floating cover on an anaerobic digester.  
Describe the function of flame arresters in an anaerobic digester system.  
Describe sedimentation traps in an anaerobic digester system.  
Discuss the waste gas burner in an anaerobic digester system.  
Describe the component parts of a floating cover for an anaerobic digester.  
Discuss the effect of raw sludge, waste activated sludge and scum on anaerobic digestion.  
Describe the start-up of an anaerobic digester.  
Explain foaming in an anaerobic digester.  
Describe gas production in an anaerobic sludge digestion system.  
Discuss digester supernatant and secondary digesters in an anaerobic digestion system.

Discuss anaerobic digestion control.  
Describe the operational strategy of an anaerobic digestion system.  
Discuss the need for cleaning an anaerobic digester.  
Discuss the need for cleaning an anaerobic digester.  
Compare aerobic and anaerobic digestion.  
Describe the operation of aerobic digesters.  
Describe the operation of sludge drying beds.  
Discuss blacktop drying beds.  
Describe sludge types and characteristics.  
Discuss sludge handling alternatives.  
Discuss the factors affecting gravity thickeners.  
Describe troubleshooting the operation of gravity thickeners.  
Discuss dissolved air flotation thickeners.  
Discuss factors affecting dissolved air flotation.  
Describe a centrifuge thickener.  
What factors will affect the performance of centrifuge thickeners.  
Describe the aerobic digestion process.  
Discuss troubleshooting of the aerobic digestion process.  
Discuss the chemical stabilization of sludge.  
Describe the chemical sludge conditioning.  
Discuss factors affecting the thermal conditioning of sludge.  
Discuss factors affecting wet oxidation.  
Describe a belt filter press.  
Describe the operation of vacuum filters or sludge dewatering.  
Describe factors affecting sand drying beds.  
Describe the composting of sludge.  
Describe factors affecting sludge composting.  
Discuss the troubleshooting of sludge composting operations.  
Describe the process of sludge incineration.  
Discuss disposal of screenings, girts and scum.  
Discuss vectors found in wastewater threatening the public health.

## **PHYSICAL -CHEMICAL TREATMENT**

Discuss the need to remove solids from secondary effluent.  
Describe polyelectrolytic flocculants.  
Describe the use of microscreens.  
Describe the use of ultraviolet lights for a microscreen.  
Discuss the operational strategy of the microscreening process.  
Describe a rapid sand filter system.  
Explain the backwashing process of a rapid sand filter.  
Discuss surface straining and depth filtration in a rapid sand filtration process.  
Discuss the selection of filter media in a rapid sand filter system.  
Describe the term scouring in regard to filter media in a rapid sand filter system.  
Discuss head loss in a rapid sand filter system.  
Discuss the phosphorus as a nutrient.



Discuss the types of phosphorus removal systems.

Describe the process of luxury uptake.

Describe a phosphorus stripping tank.

Discuss safety in the luxury uptake phosphorus removal system.

We at IDEM wish you success and hope to be seeing you out there working to protect Indiana's waters and the infrastructure investments in wastewater facilities. Now, go pass that test!