

IDEM Wastewater Operator Examination Study Guide Municipal Class 2 Exam

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As you prepare for the Municipal Class 2 exam, you will need to focus your efforts on Books 1, 2, 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 need to be able to answer.

Books 1 and 2 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

Book 14 is EPA's Introduction to the National Pretreatment Program, which can be found 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 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 by the Sacramento manuals and the approximate percentage of the examination questions comprised from that area are as follows:

Activated Sludge 15-20%

Clarifiers 5%

Disinfection 7-8%

Laboratory 10%

Maintenance 5%

Preliminary treatment 5%

Safety 6%

Solids Handling 10%

(NOTE: These percentages are approximate)

Operation of Wastewater Treatment Plants – Volume I

Questions on the Class II examination are taken from the following chapters:

Chapter 1 Introduction to Wastewater Treatment

Chapter 2 Safety

Chapter 3 Preliminary Treatment

Chapter 4 Primary Treatment

Chapter 5 Activated Sludge Systems

Chapter 6 Processes

Chapter 7 Disinfection

Chapter 9 Laboratory Procedures

Operation of Wastewater Treatment Plants – Volume II

Chapter 11 Activated Sludge (Operation of Conventional Activated Sludge Plants)

Chapter 12 Sludge Digestion and Solids Handling

Chapter 14 Plant Safety

Chapter 15 Maintenance

Chapter 16 Laboratory Procedures and Chemistry Mathematics 10 – 15 %

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 3-4%

Pretreatment questions are taken from the Introduction to the National Pretreatment Program manual.

Rules/Completing reports 20 – 25%

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 Wastewater Operator Certification Manual as Appendices A, B, C, and D to help you prepare 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.

Activated Sludge

- Discuss the use of package activated sludge plants.
- Describe the types of package plant treatment processes.
- Describe the aeration methods in the activated sludge process.
- Discuss wasting sludge from package extended aeration plants.
- Describe laboratory testing for package plants.
- Describe the flow path for oxidation ditch.
- Discuss plant start-up of oxidation ditch.
- Describe the normal operation of an oxidation ditch.
- Discuss the abnormal operation of an oxidation ditch.
- Describe the variation in activated sludge process.
- Discuss air filters for blowers in the activated sludge process.
- Describe blowers from the activated sludge process.
- Discuss air diffusers used in the activated sludge system.
- Describe safety in the operation of surface aerators.
- Consider safety in the use of air header and diffusers.
- Discuss the control of the activated sludge process.
- Discuss wasting activated sludge.
- Discuss plant changes in the activated sludge process.

Discuss sludge bulking.
Discuss septic sludge in the activated sludge process.
Describe rising sludge.
Discuss foaming/frothing in the activated sludge process.
Discuss troubleshooting of the activated sludge process.
Discuss the use of loading guidelines in the activated sludge process.
Describe the contact stabilization process.
Discuss the complete-mix type of activated sludge system.
Discuss the importance of microbiology in the activated sludge process.
Discuss the sampling location for routine microbiological tests.
Describe the procedures for preparing microbiological samples.
Describe the microorganisms of importance.
Describe the desirable and undesirable microorganisms.
Discuss three methods of RAS flow rate control.
Describe the purpose of wasting activated sludge.
Discuss the operational strategy for high organic waste loads.
Discuss methods to control the flow in the activated sludge process.
Discuss the need for effluent nitrification.
Describe the factors affecting biological nitrification.

Calculations

Given the dimensions of a clarifier and the flow rate, calculate the detention time.
Given the diameter of a trickling filter and the flow rate, calculate the hydraulic surface loading.
Given a flow rate and the pounds of chlorine being fed, calculate the chlorine dosage.
Given the residual chlorine concentration and the chlorine dosage, calculate the chlorine demand.
Given the average flow rate and the average effluent BOD concentration for the month, calculate the poundage of BOD discharged for the month.
Given the dimensions of a wet well and the drop of water level, calculate the pump capacity.
Given the D.O. of the receiving water and the saturation D.O. of the water at the temperature, calculate the percent saturation.
Given the desired sludge and the daily primary effluent suspended solids, calculate the desired poundage of suspended solids in the aeration tanks.
Given the diameter and stroke of a piston pump, calculate the volume delivered per stroke.
Given volume of sludge pumped to a digester and the total solids content, calculate the pounds

of dry solids subject to digestion.

Given the volume of an aeration tank and the concentration of MLSS, calculate the poundage of MLSS under aeration.

Given the total flow through an aerator and the return sludge flow ratio, calculate the return activated sludge rate.

Given the dimensions of an aerobic digester and the flow rate, calculate the detention time.

Given the influent and effluent phosphorus concentration, calculate percent removal of phosphorus.

Given the dimensions of a sludge drying bed and the depth of sludge applied, calculate the volume of sludge applied.

Disinfection

Discuss disinfection.

Describe the reaction of chlorine in wastewater.

Discuss the inorganic reducing material reacting with chlorine.

Describe the reaction of chlorine with ammonia.

Discuss the factors influencing disinfection.

Discuss collection system disinfection.

Describe plant chlorination.

Describe chlorinator control.

Discuss measurement of the chlorine residual.

Describe a chlorine safety program.

Describe chlorine hazards and why chlorine must be handled with care.

Discuss the handling of chlorine cylinders.

Discuss chlorine leaks.

Discuss the installation and maintenance of chlorination facilities.

Discuss the need for dechlorination.

Describe the properties of sulfur dioxide.

Understand how UV disinfection works.

Understand what kind of light is used in UV disinfection.

Laboratory, Sampling & Monitoring

Describe chemical names and chemical formulas.

Describe laboratory equipment.

Discuss the term "solutions".

What is the term "titration"?

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 preservation of samples.

Describe the tests for settleable solids.

Describe the suspended solids test.

How do you determine volatile solids?

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 COD test procedure.

Describe the term "buffer".

Describe the D.O. tests.

Describe the BOD tests.

Describe the pH tests.

Discuss the measurement of metals in wastewater.

Define a "standard solution".

Discuss the need for analyzing and presenting data.

Describe the causes of variation in laboratory test results.

Discuss the term "sampling".

Describe the terms "manometer" and "gage reading".

Discuss the importance of records.

Discuss annual reports.

Maintenance

Discuss preventive maintenance records.

Discuss the maintenance of chlorinators.

Describe centrifugal pumps and their maintenance rules.

Discuss the operation of piston pumps.

Describe progressive cavity pumps.

Compare mechanical seals and packing seals for a pump.

Discuss the maintenance of belt drives of a pump.

Describe the maintenance of chain drives.
Describe the maintenance of couplings for a pump.
Discuss the function of shear pins for a pump.
Describe the job of a dehumidifier for wastewater treatment units.
Discuss plugged pipelines.
Discuss the biological generation of odors.
Study glossary on solids removal from secondary effluent.
Discuss instruments and controls.
Describe the accuracy of instrumental measurement.
Describe pressure gages.
Describe water level measuring devices.
Describe the controllers in an instrument system.

Physical-Chemical Treatment

Discuss the need for odor control.
Describe the generation of hydrogen sulfide.
Discuss odor identification and measurement.
Describe remedies (solutions) to odor problems.
Discuss chlorination for odor control.
Describe masking, modification and counteraction.
Discuss good housekeeping relative to odor control.
Discuss the need to remove solids from secondary effluents.
Describe the use of alum.
Discuss the use of polymeric flocculants.
Describe jar tests.

Pretreatment

Describe the objectives of the National Pretreatment Program and its origin.
Define a Significant Industrial User (SIU).
When are Control Authorities required to inspect SIUs.
A POTW's requirement to develop and implement a pretreatment program is a condition of what?

Preliminary Treatment

Describe safety around bar screens and racks.

Discuss manually cleaned bar screens.
Describe mechanically cleaned screens.
Describe the function of comminutors.
Discuss the need for grit removal.
Describe grit channels.
Describe cyclone grit separators.
Discuss grit washing.
Discuss operational strategy of pretreatment treatment.

Safety

Describe the collection of wastewater.
Discuss the shutdown of surface aerators.
Discuss safety in operation of the floating cover of an anaerobic digester.
Describe the toxic and harmful chemicals encountered at a wastewater treatment plant.
Describe the dangerous and explosive gases encountered in sewer and at a wastewater treatment plant.
Discuss the hazard of electrical shock while working at a wastewater treatment plant.
Discuss the safety precautions necessary for operation of a biological-mechanical wastewater treatment plant.
Discuss water supplies for a wastewater treatment plant.
Discuss a Material Safety Data Sheet (MSDS).

Sedimentation

Discuss the purpose of sedimentation and flotation.
Discuss the start-up procedure of a clarifier.
Describe the operational strategy of clarifiers.
Discuss floating sludge in a clarifier.
Describe typical clarifier efficiencies.
Describe the response to poor clarifier performance.
Describe sludge and scum pumping.
Discuss primary clarifier operation.
Discuss the operation of trickling filter clarifiers.
Discuss the operation of activated sludge clarifiers.
Discuss safety while working with clarifiers.
Describe the flotation process.

Describe septic tanks.

Solids Treatment & Handling

Discuss the purpose of anaerobic sludge digestion.

Describe pipelines and values for anaerobic digesters.

Discuss digester mixing.

Compare anaerobic and aerobic digestion.

Discuss the operation of the aerobic digestion process.

Describe sludge drying beds.

Describe sludge disposal methods.

Discuss the purpose of sludge thickening.

Discuss the purpose of sludge stabilization.

Describe the factors affecting aerobic digestion.

Discuss the purpose of dewatering.

Describe a belt filter press.

Describe the factors affecting sand drying beds.

Discuss troubleshooting of the operation of sand sludge drying beds.

Describe composting.

Discuss the need for land disposal of sludge.

Discuss solids removal from the secondary effluent using microscreens.

Discuss the use of gravity rapid sand filters for effluent polishing.

Describe the backwashing process of rapid sand filters.

Discuss the filter media for rapid sand filters.

Describe the used backwash water holding tank.

Discuss phosphorus as a nutrient.

Describe the use of alum for nutrient and suspended solid removal.

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!