Wastewater Collections and Treatment
2-Day ABC Licensure Exam
Preparatory Course
Sept 7-8, 2026

"Levels 1-4"

OESAC # 9429

1.6 CEUs

Dr. Matthew J. La Force
Engineering Science Department
Clackamas Community College
503-594-3148
laforce@clackamas.edu

Water & Environmental Technology CLACKAMAS COMMUNITY COLLEGE

Agenda

Mon Sept 7, 2026	
8:00-9:00 am	Overview of Wastewater and Collections systems, ABC exam taking tips and suggestions
9:00-9:45am	Mathematical wastewater dimensional analysis
9:45-10am	Break
10:00-11:00 am	ABC Need To Know Criteria: Wastewater Characteristics Needed for both collection system and the operations
11:00-12:00 pm	ABC Need To Know Criteria: Wastewater collection system maintenance
12:00-1:30 pm	Break
1:30 – 2:45	Mathematical wastewater dimensional analysis/flow conversions

Mon Sept 7, 2026	
2:45 -3:00 pm	Break
3:00-4: 00 pm	ABC Need To Know Criteria: Wastewater collection system/treatment operations PUMPS!!
4:00-5:30 pm	ABC Need To Know Criteria: Wastewater secondary treatment plant processes

Agenda

Tues Sept 8, 2026	
8:00-9:00 am	Mathematical wastewater conversions
9:00-9:45am	ABC Need To Know Criteria: Wastewater collection system operations and cleaning
9:45-10am	Break
10:00-11:00 am	ABC Need To Know Criteria: Wastewater collection system maintenance
11:00-12:00 pm	ABC Need To Know Criteria: Wastewater treatment plant maintenance
12:00-1:00 pm	Lunch Break
1:00 – 2:45	ABC Need To Know Criteria: Wastewater treatment plant operations and solids handling

Tues Sept 8, 2026	
2:45 -3:00 pm	Break
3:00-4: 00 pm	ABC Need To Know Criteria: Wastewater collection system operations and cleaning
4:00-5:00 pm	ABC Need To Know Criteria: Wastewater treatment plant analytical procedures.. Award Certificates

Course Title:	Wastewater Collections and Treatment 16 hours, 4-day ABC Licensure Exam Preparatory Course ***"Levels 1-4"*** **1.6 CEUs**
CEU's Requested:	1.6 WW
Dates	Various, 2026
Location:	Clackamas Community College, Oregon City, Oregon
Sponsor:	Clackamas Community College, Oregon City, Oregon
Sponsor Contact:	Matt LaForce
Contact Phone Number	503-594-3148
Contact Email:	laforce@clackamas.edu
OESAC Course Number:	
Course Summary:	Our ABC Licensure Wastewater Collections and Treatment preparatory exam review. Upon successful completion of this workshop, students, levels 1 through 4, will understand the ABC need-to-know criteria as applied to the certification exam questions.

Wastewater Collections and Treatment
2-Day ABC Licensure Exam Preparatory Course
Sept 7-8, 2026

"Levels 1-4"

OESAC # 9429

1.6 CEUs

Dr. Matthew J. La Force
Engineering Science Department
Clackamas Community College
503-594-3148
laforce@clackamas.edu

Water & Environmental Technology — Clackamas Community College

Agenda

Mon Sept 7, 2026		Mon Sept 7, 2026	
8:00-9:00 am	Overview of Wastewater and Collections systems, ABC exam taking tips and suggestions	2:45 -3:00 pm	Break
9:00-9:45am	Mathematical wastewater dimensional analysis	3:00-4: 00 pm	ABC Need To Know Criteria: Wastewater collection system/treatment operations PUMPS!!
9:45-10am	Break	4:00-5:30 pm	ABC Need To Know Criteria: Wastewater secondary treatment plant processes
10:00-11:00 am	ABC Need To Know Criteria: Wastewater Characteristics Needed for both collection system and the operations		
11:00-12:00 pm	ABC Need To Know Criteria: Wastewater collection system maintenance		
12:00-1:30 pm	Break		
1:30 – 2:45	Mathematical wastewater dimensional analysis/flow conversions		

Agenda

Tues Sept 8, 2026		Tues Sept 8, 2026	
8:00-9:00 am	Mathematical wastewater conversions	2:45 -3:00 pm	Break
9:00-9:45am	ABC Need To Know Criteria: Wastewater collection system operations and cleaning	3:00-4: 00 pm	ABC Need To Know Criteria: Wastewater collection system operations and cleaning
9:45-10am	Break	4:00-5:00 pm	ABC Need To Know Criteria: Wastewater treatment plant analytical procedures.. Award Certificates
10:00-11:00 am	ABC Need To Know Criteria: Wastewater collection system maintenance		
11:00-12:00 pm	ABC Need To Know Criteria: Wastewater treatment plant maintenance		
12:00-1:00 pm	Lunch Break		
1:00 – 2:45	ABC Need To Know Criteria: Wastewater treatment plant operations and solids handling		

DAY 1-AM

- **Exam materials and tips**
- **Reference materials**
- **How to **attack** math problems**
- **Treatment questions that show up in Collections exams (their peanut butter can get into your chocolate)**

- **Clickers…..Assess your strengths and weaknesses**

Course Objectives

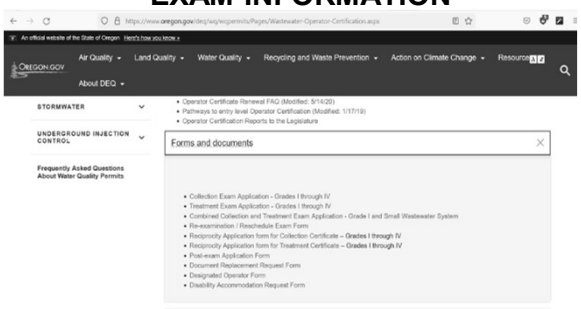
General Knowledge>>>ABC exam like Questions as possible in a four day time frame (ABC Need to Know % Criteria)!

Take home knowledge level practice exams

Math practice problems to be done at home (will give tips and suggestions)

Know your strengths and weaknesses

Oregon
ABC LICENSURE
EXAM INFORMATION



"Takes about 6 weeks for paperwork to process checks cashed within a week."

Treatment or Collections ABC LICENSURE EXAM INFORMATION

ABC Exams Study Resources Link

- 2019 version standardized treatment and collection exams now include 110 questions, which include 100 pre-determined questions to be scored, plus 10 unidentified questions being "beta tested" for future use. Time allotted for the exam is three (3) hours, in compliance with ABC's testing recommendations.
- Exam formula sheets are included with the exam. ABC Formula sheets : http://www.abccert.org/pdf_docs/abcwwtfctable.pdf
- ABC scores all Provisional/1 through 4 exams.

Treatment or Collections ABC LICENSURE EXAM INFORMATIO N

ABC Exams Study Resources Link

- Oregon DEQ is scheduled to switch to the 2019 version exams, on Jan. 1, 2022
- ABC says that there will be 25-30% new content.
- The new content is based on the additional 10 un-scored questions that were scattered throughout the 2017 exams.
- The passing rates have generally decreased with the two more recent periods.

OR DEQ OPS CERT UPDATE INFORMATION

ABC Exams Study Resources Link

- OR Op Cert Program exam information
- You get 2.0 CEUs from OR DEQ for passing your ABC certification exams!
- You can get CEUs for being a tour host for your facility.

Computer Testing Centers

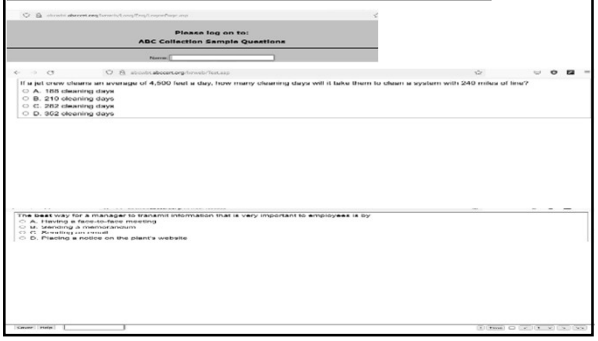
- Locations: http://online.goamp.com/CandidateHome/displayTCList.aspx?pExamID=21253
- Allowed
  - Non-programmable calculator
  - Glasses (if needed)
- Provided
  - One sheet of scratch paper
  - Pencils
  - Formula sheet\

CANNOT USE YOUR IPHONE!!!!!

ABC PSI TESTING CENTER

- VIDEO

http://www.abccert.org/testing_services/sample_exam_questions.asp



Treatment or Collections Exam Prep Tips

DON'T WAIT TILL THE LAST MINUTE -(You are ahead of the curve!)

Know your strengths and weaknesses

Pack a lunch if your taking 2 exams (snacks and food keep in car)

Bring a few # two pencils (glasses) and all exam materials

You must *bring* a non-programmable *calculator.*

Now where you are going-directions to testing center on psi webpage!

Get a good nights sleep

Exam Resources

- **ABC Recommended**
- **State Recommended**
- **Matt Recommended "Free" Study Guides**
- **Math Guides**
- **Laboratory Guides**
- **YouTube Online Video help channels**
- **Practice Exams**
- **Online College Courses**
- **Textbooks**

ABC Cert Study Guides Materials

Wastewater Treatment, Collection and Wastewater Lab
Water Environment Federation Bookstore Phone (800) 666-0206

WEF/ABC/C_2EP Wastewater Operators' Guide to Preparing for the Certification Examination

WEF/ABC/C_2EP Collection Systems Operators' Guide to Preparing for the Certification Examination

WEF/ABC Wastewater Laboratory Analysts' Guide to Preparing for the Certification Examination

WEF/ABC Wastewater Treatment Fundamentals I - Liquid Treatment Guide to Preparing for the Certification Examination

Wastewater and Laboratory practice questions developed by WEF are available in the Skills Builder section of WEF's website.

State Specific Study Recommendations & Materials

NEW AWWA WWT and Collection (500?) APP—
https://www.awwa.org/Publications/Books/Water-System-Operations/AWWA-Opcert-Exam-Prep-App

- American Water Works Association (AWWA)
- California State University at Sacramento
- EPA Small and Rural Wastewater Systems Tools, Training, and Technical Assistance
- National Environmental Service Center
- Indigo Water Group, LLC
- Sewergeek.com (collections)
- WaterOperator.org
- WEF Skills Builder (log-in required)

Matts Free Study Guides of Interest

Treatment and Collection Courses:

Michigan DEQ OP Cert Study Guide and Modules!

DEQ Pennsylvania Water and Wastewater Training Modules

New Mexico Wastewater and Collections Study Guide

New Mexico Lab Cert Study Guide

Illinois EPA Wastewater State Certification Guide.

Texas Water Utilities Study Guides and Questions

Wisconsin Department of Natural Resources Wastewater Study Guide

New York Water and Wastewater study guide

TPOMAG Study Questions
https://www.tpomag.com/online_exclusives/2014/06/exam_study_guide_resources

Math Help

http://www.dem.ri.gov/programs/benviron/water/licenses/wwoper/pdfs/mathsamp.pdf

http://dca.ky.gov/certification/Documents/wwmathproblemsquestions110withanswers[1].pdf

https://eec.ky.gov/Environmental-Protection/Compliance-Assistance/operator-certification-program/Test%20Preparation%20Documents/CollectionMathStudyGuide.pdf

http://www.tpomag.com/editorial/2014/03/the_secret_to_wastewater_math

https://www.indigowatergroup.com/math-workbooks/

https://www.indigowatergroup.com/wp-content/uploads/2021/04/Selected-Problems-for-Water-and-Wastewater.pdf

https://files.dep.state.pa.us/Water/BSDW/OperatorCertification/TrainingModules/both28_basic_math_wb.pdf

Wastewater Laboratory Help

https://www.michigan.gov/documents/deq/wrd-ot-ww-lab-manual_558729_7.pdf

New Mexico Lab Cert Study Guide

https://files.dep.state.pa.us/Water/BSDW/OperatorCertification/TrainingModules/ww12_laboratory_overview_wb_final.pdf

Online Videos/Tutorials

- YouTube Channes for Wastewater
- https://wateroperator.org/blog/the-best-youtube-channels-for-water-wastewater-operators
- American Water College
- https://www.youtube.com/watch?v=eJX1mkJl6JU
- Blacoh University Engineering
- https://www.youtube.com/watch?v=sb_heMM5vzs
- Nitrogen Removal Basics

Practice Exams and Questions

- https://www.indigowatergroup.com/wp-content/uploads/2021/04/Wastewater-10-17-07.pdf
- https://www.indigowatergroup.com/wp-content/uploads/2021/04/PEST-Update.pdf
- https://www.indigowatergroup.com/wp-content/uploads/2021/04/Collections.pdf
- https://quizlet.com/4346930/wastewater-laboratory-analyst-certification-exam-practice-questions-flash-cards/

Practice Exams and Questions

reatment and Collection practice exam questions:

http://www.abccert.org/testing_services/sample_exam_questions.asp

https://www.wef.org/skillsbuilder/

https://www.in.gov/idem/cleanwater/wastewater-compliance/wastewater-operator-certification-and-continuing-education/wastewater-certification-information/study-guides-for-the-wastewater-operator-certification-examinations/

http://www.cram.com/cards/wastewater-operator-certification-study-guide-level-i-1961692

http://www.montanawatercenter.org/wastewater-operator-resources

https://www.awwa.org/Publications/Books/Water-System-Operations/AWWA-Opcert-Exam-Prep-App

Sewer Geek http://www.sewergeek.com/Sewer_Geek/index.html

http://www.wef.org/OperationsResources/?ekmensel=c57dfa7b_129_0_7408_1

Royce CEU - https://royceu.com/public/default.aspx

https://royceu.com/public/PracticeQuizes.aspx

Ragsdale and associates

https://www.yumpu.com/en/document/view/11272248/introduction-to-wastewater-treatment-ragsdale-associates

Online College Materials

- Clackamas Community College WET Program https://www.clackamas.edu/academics/departments-programs/water-and-environmental-technology-Associate of Applied Sciences WET
- Mountain Empire Community College Certificate Warning:
- https://water.me.vccs.edu/courses/ENV149/env149_lessons.htm
- American Water College
- https://www.americanwatercollege.org/

Textbooks For Exam Study

- "WEF/ABC Wastewater Operator's Guide to Preparing for Certification Examination". Available in the WEF e-store.
- *"Activated Sludge-Evaluating and Controlling Your Process"* by Tim Hobson (1995). This is the reference for the Activated Sludge Certification Course.
- *"Aerobic Biological Wastewater Treatment Facilities: Process Control Manual"* Good Activated Sludge Reference. EPA 430/9-77-006.
- *"Utility Management"* from California State University is a good reference for Supervisory and Management at (916) 278-6142.
- *"Manage for Success"* from California State University is a good reference for Supervisory and Management at (916) 278-6142.
- *"Supervisory Management in the Water/Wastewater Field"* available from Michigan State University at 1-800-356-5705.
- For laboratory testing and analyses, "Water and Wastewater Laboratory Techniques (1995)", Available in the WEF e-store.

Other helpful references include:

- "Spellman's Standard Handbook for Wastewater Operators" is a three (3) volume set that has review questions and answers at the end of each chapter. These handbooks are available from CRC Press.
- The "Wastewater Treatment Plant Operation - Level C" is available from the University of Florida at Gainesville's website.
- A set of flash cards *"Flash Cards"* available from ACR Publications, 1-800-433-8150.

Textbooks For Exam Study

Spellman. 2004. Mathematics for Wastewater Treatment Plant Operators. ISBN#1-56670-675-0.

Parcher. 1998. Wastewater Collection System Maintenance, Technomic Publishing Company

AWWA. 2003. Basic Science Concepts and Applications 3rd edition. ISBN#1-58321-233-7.

Giorgi. 2003. Wastewater Operator Certification Study Guide 5th edition. (AWWA). ISBN-13: 9781583217283

Giorgi. Math For Wastewater Treatment Operators Grade 1-2 (AWWA). ISBN#978-1-58321-587-6

Giorgi. Math For Wastewater Treatment Operators Grade 3-4 (AWWA). ISBN#978-1-58321-586-9

Giorgi. Wastewater Operator Certification Study Guide ISBN-13: 9781583217283

Larsen. Math Handbook for Wastewater Treatment Plant Operators: Math Fundamentals and Problem Solving ISBN 1432742450

Price. 1991. Applied Math For Wastewater Plant Operators. ISBN 0877628092

Price. 1991. Applied Math For Wastewater Workbook ISBN: 9780877628095)

Price. 1991. Basic Math Concepts for water and wastewater Operators . ISBN 0877628084.

Wef/Abc Wastewater Operators' Guide To Preparing For The Certification Examination ISBN-13: 9781572782020 http://www.wef.org/StudyGuides/

WEF/ABC Collection Systems Operators' Guide to Preparing for the Certification Examination. WEF. Order No: E30132

WEF/ABC Wastewater Laboratory Analysts' Guide to Preparing for the Certification Examination. WEF. Order No: E00017

WEF/ABC Biosolids Land Appliers' Guide to Preparing for the Certification Examination. E110076

Reference Materials

Operation of Municipal Wastewater Treatment Plants Study Guide. ISBN 1572782412

http://www.owp.csus.edu/courses/wastewater.php

Operation of Wastewater Treatment Plants, Volume I, 8th Edition . Prepared by California State University under the supervision of Kenneth D. Kerri, EPA Grant Number T900690010. Manual ISBN 978-1-59371-039-2

Operation of Wastewater Treatment Plants, Volume II, 7th Edition. Prepared by California State University under the supervision of Kenneth D. Kerri, EPA Grant Number T900690010. Manual ISBN 978-1-59371-038-5.

Advanced Waste Treatment. 5th. Prepared by California State University under the supervision of Kenneth D. Kerri, EPA Grant Number T900690010. Manual ISBN#978-1-59371-035-4

Spellman's Standard Handbook for Wastewater Operators, Second Edition (3 Volume Set) . *ISBN: 1439818908 / ISBN-13: 9781439818909*

Collections:Kerri. Operation and Maintenance of *Wastewater* Collection Systems: A Field Guide

ISBN-10: 1884701434 ISBN-13: 9781884701436.

Operation and Maintenance of Wastewater Collection Systems: The wastewater collection system operator ISBN 1593710399

Math-Basic Science Concepts and Applications, 5th) By Nicholas Pizzi, Editor, American Water Works Association, ISBN#1-58321-233-7.

Applied Math for Wastewater Plant Operators, by Joanne Kirkpatrick Price, Technomic and CRC Publishing, Co., 1991 or later edition with accompanying workbook. ISBN: 9781566769891

CUMULATIVE MASTERY SUMMARY REPORT
Oregon Wastewater Treatment Grade I Exam

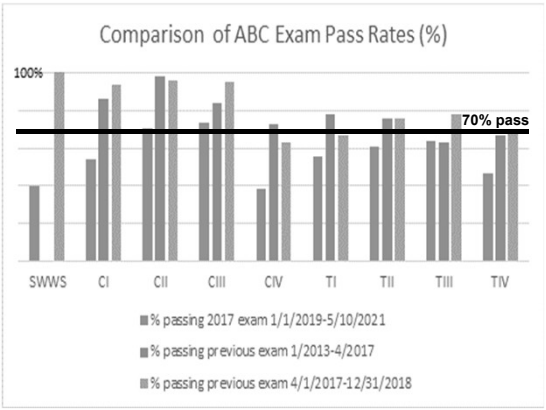
# M	Number Mastering	% M	% Mastering	PTS	Possible Points
# PM	Number Partial Mastering	% PM	% Partial Mastering	HIGH	Highest Points
# NM	Number Not Mastering	% NM	% Not Mastering	LOW	Lowest Points
				AVG	Average Points

Objective	# M	# PM	# NM	% M	% PM	% NM	PTS	HIGH	LOW	AVG
Area 1 - Lab										
Area 2 - Equipment E&M										
Area 3 - Equipment Operation										
Area 4 - Treatment MEA										
Area 5 - Safety, Admin, Etc.										
SUMMARY:										
All Objectives										
All Areas										

CUMULATIVE MASTERY SUMMARY REPORT
Oregon Wastewater Collection Grade I Exam

# M	Number Mastering	% M	% Mastering	PTS	Possible Points
# PM	Number Partial Mastering	% PM	% Partial Mastering	HIGH	Highest Points
# NM	Number Not Mastering	% NM	% Not Mastering	LOW	Lowest Points
				AVG	Average Points

Objective	# M	# PM	# NM	% M	% PM	% NM	PTS	HIGH	LOW	AVG
Area 1 - Equipment OEM										
Area 2 - System OMR										
Area 3 - Lift Station O&M										
Area 4 - System MEA										
Area 5 - SSA Procedures										
SUMMARY:										
All Objectives										
All Areas										



Collections or Treatment Exam Taking Tips

Know your strengths and weaknesses

PROCESS OF ELIMINATION!

Read question thoroughly (can you solve it in 3 minutes? =Go for it)—If not mark it and go back with about 30 minutes left

Exam doesn't go easy to hard!

Show all work (can get partial credit) (BOX answer!)

Periodically make sure your exam and answer key match up

Collections

Problem Types

- **Chemical Addition, Collection Systems, Flow Measurement, General Information, Maintenance, Management, Mathematics, Motors, Preliminary Treatment, Pumps and Pumping, Recordkeeping, Rules and Regulations, Safety**

Most Common Questions (varies)??

- **Equipment, Drinking Water Regulations, then Sampling**

Treatment

Problem Types

- Evaluate Incoming Wastestream/Sidestream Characteristics
- Monitor, Evaluate and Adjust Treatment Processes
- Evaluate and Maintain Equipment
- Operate Equipment
- Collect Samples and Interpret Laboratory Analyses
- Perform Laboratory Analyse
- Perform Security, Safety and Administrative Procedures

Most Common Questions (varies)??

- Equipment, Safety, then Sampling

Collections and Treatment Overlap

Most Common Questions (varies)??

- Mathematics, Equipment, Safety, Pumps, Rules and Regulations, Biological Lab Testing, Chemistry, Disinfection

Water Collections ABC Need To Know

Exam Level	I	II	III	IV
Operate Equipment	15%	15%	15%	15%
Evaluate Equipment	10%	15%	15%	15%
Monitor Collection System	15%	15%	15%	15%
Maintain lift station	10%	10%	10%	10%
Adjust Collection System	35%	30%	25%	25%
Safety and Admin. Duties	15%	15%	20%	20%

Water Treatment ABC Need To Know

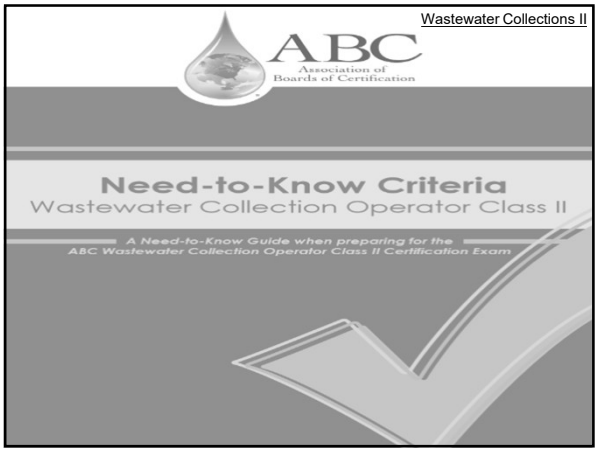
Exam Level	I	II	III	IV
Evaluate Wastewater	5%	5%	5%	5%
Monitor Treatment Process	34%	34%	34%	34%
Maintain Equipment	16%	15%	15%	15%
Operate Equipment	17%	16%	16%	16%
Sample Collection	8%	9%	10%	10%
Lab Analysis	5%	7%	9%	9%
Safety and Admin. Duties	15%	14%	11%	11%

ABC Need to Know and Formula Sheets

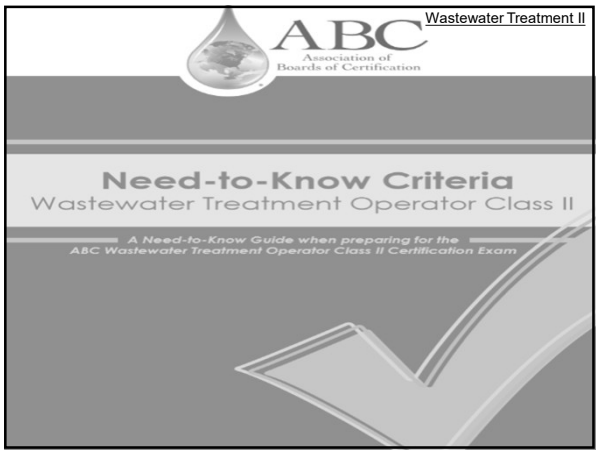
ABC Help Guides and Formula Sheets

Exam Resources
https://www.abccert.org/testing_services/certification_study_resources.asp

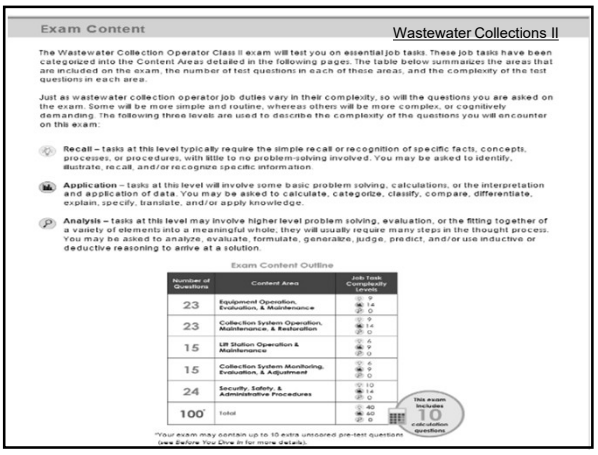
Formula Sheets
http://abccert.org/uploadedFiles/Public/documents/ABCWWTFCT_042017.pdf



Wastewater Treatment II



Wastewater Collections II



Exam Content

The Wastewater Collection Operator Class II exam will test you on essential job tasks. These job tasks have been categorized into the Content Areas detailed in the following pages. The table below summarizes the areas that are included on the exam, the number of test questions in each of these areas, and the complexity of the test questions in each area.

Just as wastewater collection operator job duties vary in their complexity, so will the questions you are asked on the exam. Some will be more simple and routine, whereas others will be more complex, or cognitively demanding. The following three levels are used to describe the complexity of the questions you will encounter on this exam:

Recall – tasks at this level typically require the simple recall or recognition of specific facts, concepts, processes, or procedures, with little to no problem-solving involved. You may be asked to identify, illustrate, recall, and/or recognize specific information.

Application – tasks at this level will involve some basic problem solving, calculations, or the interpretation and application of data. You may be asked to calculate, categorize, classify, compare, differentiate, explain, specify, translate, and/or apply knowledge.

Analysis – tasks at this level may involve higher level problem solving, evaluation, or the fitting together of a variety of elements into a meaningful whole; they will usually require many steps in the thought process. You may be asked to analyze, evaluate, formulate, generalize, judge, predict, and/or use inductive or deductive reasoning to arrive at a solution.

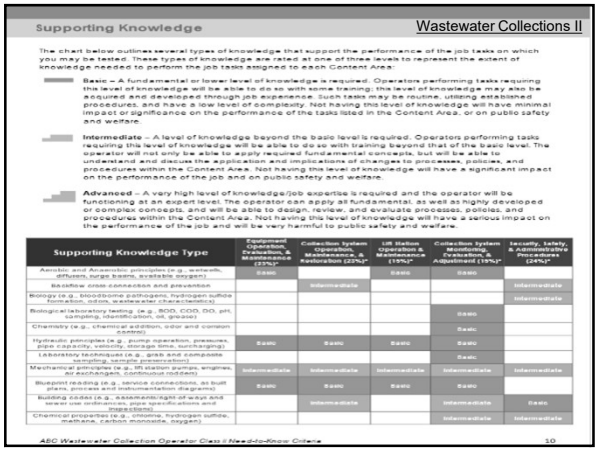
Exam Content Outline

Number of Questions	Content Area	Job Task Complexity Levels
23	Equipment Operation, Evaluation, & Maintenance	R 9, A 14, An 0
23	Collection System Operation, Maintenance, & Restoration	R 9, A 14, An 0
15	Lift Station Operation & Maintenance	R 6, A 9, An 0
15	Collection System Monitoring, Evaluation, & Adjustment	R 6, A 9, An 0
24	Security, Safety, & Administrative Procedures	R 10, A 14, An 0
100*	Total	R 40, A 60, An 0

This exam includes 10 calculation questions

*Your exam may contain up to 10 extra unscored pre-test questions (see Before You Dive in for more details).

Wastewater Collections II



Supporting Knowledge

The chart below outlines several types of knowledge that support the performance of the job tasks on which you may be tested. These types of knowledge are rated at one of three levels to represent the extent of knowledge needed to perform the job tasks assigned to each Content Area:

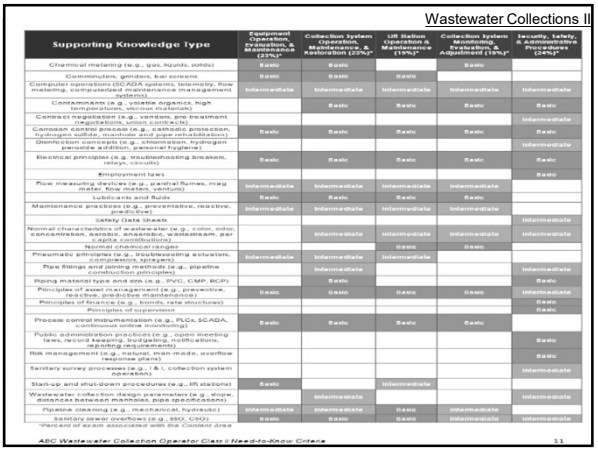
Basic – A fundamental or lower level of knowledge is required. Operators performing tasks requiring this level of knowledge will be able to do so with some training; this level of knowledge may also be acquired and developed through job experience. Such tasks may be routine, utilizing established procedures, and have a low level of complexity. Not having this level of knowledge will have minimal impact or significance on the performance of the tasks listed in the Content Area, or on public safety and welfare.

Intermediate – A level of knowledge beyond the basic level is required. Operators performing tasks requiring this level of knowledge will be able to do so with training beyond that of the basic level. The operator will not only be able to apply required fundamental concepts, but will be able to understand and discuss the application and implications of changes to processes, policies, and procedures within the Content Area. Not having this level of knowledge will have a significant impact on the performance of the job and on public safety and welfare.

Advanced – A very high level of knowledge/job expertise is required and the operator will be functioning at an expert level. The operator can apply all fundamental, as well as highly developed or complex concepts, and will be able to design, review, and evaluate processes, policies, and procedures within the Content Area. Not having this level of knowledge will have a serious impact on the performance of the job and will be very harmful to public safety and welfare.

Supporting Knowledge Type	Equipment Operation, Evaluation, & Maintenance (23%)*	Collection System Operation, Maintenance, & Restoration (23%)*	Lift Station Operation & Maintenance (15%)*	Collection System Monitoring, Evaluation, & Adjustment (15%)*	Security, Safety, & Administrative Procedures (24%)*
Aerobic and Anaerobic principles (e.g., wetwells, diffusers, surge basins, available oxygen)	Basic		Basic	Basic	
Backflow cross connection and prevention		Intermediate			Intermediate
Biology (e.g., bloodborne pathogens, hydrogen sulfide formation, odors, wastewater characteristics)					Intermediate
Biological laboratory testing, (e.g., BOD, COD, DO, pH, sampling, identification, oil, grease)				Basic	
Chemistry (e.g., chemical addition, odor and corrosion control)				Basic	
Hydraulic principles (e.g., pump operation, pressures, pipe capacity, velocity, storage time, surcharging)	Basic	Basic	Basic	Basic	
Laboratory techniques (e.g., grab and composite sampling, sample preservation)				Basic	
Mechanical principles (e.g., lift station pumps, engines, air exchangers, combustion gases)	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate
Blueprint reading (e.g., service connections, as built plans, process and instrumentation diagrams)	Basic	Basic	Basic	Basic	
Building codes (e.g., easements/right of ways and sewer use ordinances, pipe specifications and inspections)		Intermediate		Intermediate	Basic
Chemical properties (e.g., chlorine, hydrogen sulfide, methane, carbon monoxide, oxygen)				Intermediate	Intermediate

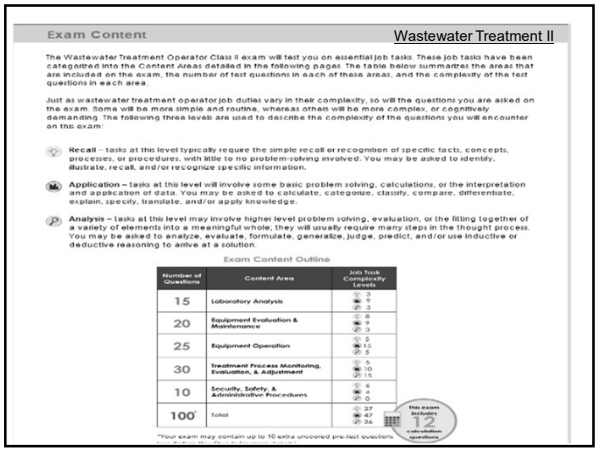
Wastewater Collections II



Supporting Knowledge Type	Equipment Operation, Evaluation, & Maintenance (23%)*	Collection System Operation, Maintenance, & Restoration (23%)*	Lift Station Operation & Maintenance (15%)*	Collection System Monitoring, Evaluation, & Adjustment (15%)*	Security, Safety, & Administrative Procedures (24%)*
Chemical metering (e.g., gas, liquid, solid)	Basic	Basic		Basic	
Comminuters, grinders, bar screens	Basic	Basic	Basic		
Computer operations (SCADA systems, telemetry, flow metering, computerized maintenance management systems)	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate
Contaminants (e.g., volatile organics, high temperatures, viscous materials)		Basic	Basic	Basic	Basic
Contract negotiation (e.g., vendors, pre-treatment negotiations, union contracts)					Intermediate
Corrosion control principles (e.g., cathodic protection, hydrogen sulfide, manhole and pipe rehabilitation)	Basic	Basic	Basic	Basic	Basic
Disinfection concepts (e.g., chlorination, hydrogen peroxide addition, personal hygiene)					Intermediate
Electrical principles (e.g. troubleshooting breaker, relays, circuits)	Basic	Basic	Basic	Basic	Basic
Employment laws					Basic
Flow measuring devices (e.g., parshall flumes, mag meter, flow meters, venturi)	Intermediate	Intermediate	Intermediate	Intermediate	
Lubricants and fluids	Basic	Basic	Basic	Basic	
Maintenance practices (e.g., preventative, reactive, predictive)	Intermediate	Intermediate	Intermediate	Intermediate	
Safety Data Sheets					Intermediate
Normal characteristics of wastewater (e.g., color, odor, concentration, aerobic, anaerobic, wastestream, per capita flow)		Intermediate	Intermediate	Intermediate	Intermediate
Normal chemical ranges			Basic	Basic	
Pneumatic principles (e.g., troubleshooting actuators, components, sprayers)	Intermediate	Intermediate	Intermediate		
Pipe fittings and joining methods (e.g., pipeline construction principles)		Intermediate			Intermediate
Piping material type and size (e.g., PVC, CMP, RCP)		Basic			Basic
Principles of asset management (e.g., preventive, reactive, predictive maintenance)	Basic	Basic	Basic	Basic	Intermediate
Principles of finance (e.g., bonds, rate structures)					Basic
Principles of supervision					Basic
Process control instrumentation (e.g., PLCs, SCADA, continuous online monitoring)	Basic	Basic	Basic	Basic	
Public administration practices (e.g., open meeting laws, record keeping, budgeting, notifications, reporting requirements)					Basic
Risk management (e.g., human made, overflow response plans)					Basic
Sanitary survey processes (e.g., I & I, collection system operation)					Intermediate
Start-up and shut-down procedures (e.g., lift stations)	Basic		Intermediate		
Wastewater collection design parameters (e.g., slope, distances between manholes, pipe specifications)		Intermediate			Intermediate
Pipeline cleaning (e.g., mechanical, hydraulic)	Intermediate	Intermediate	Basic	Intermediate	
Sanitary sewer overflows (e.g., SSO, CSO)	Basic	Basic	Basic	Intermediate	Intermediate

*Percent of exam associated with the Content Area

Wastewater Treatment II



Exam Content

The Wastewater Treatment Operator Class II exam will test you on essential job tasks. These job tasks have been categorized into the Content Areas detailed in the following pages. The table below summarizes the areas that are included on the exam, the number of test questions in each of these areas, and the complexity of the test questions in each area.

Just as wastewater treatment operator job duties vary in their complexity, so will the questions you are asked on the exam. Some will be more simple and routine, whereas others will be more complex, or cognitively demanding. The following three levels are used to describe the complexity of the questions you will encounter on this exam:

Recall – tasks at this level typically require the simple recall or recognition of specific facts, concepts, processes, or procedures, with little to no problem-solving involved. You may be asked to identify, illustrate, recall, and/or recognize specific information.

Application – tasks at this level will involve some basic problem solving, calculations, or the interpretation and application of data. You may be asked to calculate, categorize, classify, compare, differentiate, explain, specify, translate, and/or apply knowledge.

Analysis – tasks at this level may involve higher level problem solving, evaluation, or the fitting together of a variety of elements into a meaningful whole; they will usually require many steps in the thought process. You may be asked to analyze, evaluate, formulate, generalize, judge, predict, and/or use inductive or deductive reasoning to arrive at a solution.

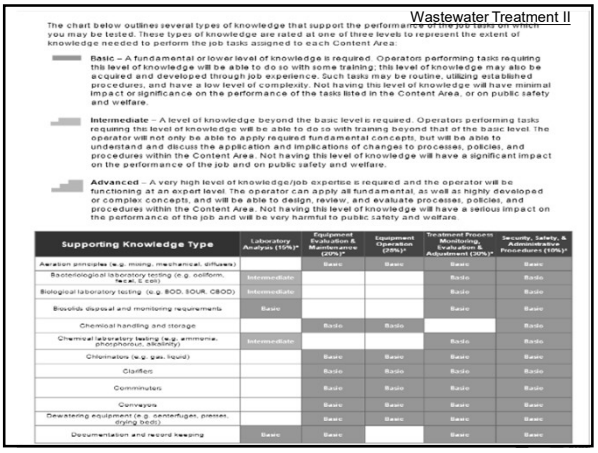
Exam Content Outline

Number of Questions	Content Area	Job Task Complexity Levels
15	Laboratory Analysis	R 9, A 3, An 3
20	Equipment Evaluation & Maintenance	R 8, A 9, An 3
25	Equipment Operation	R 5, A 13, An 5
30	Treatment Process Monitoring, Evaluation, & Adjustment	R 5, A 10, An 15
10	Security, Safety, & Administrative Procedures	R 6, A 4, An 0
100*	Total	R 27, A 47, An 26

This exam includes 12 calculation questions

*Your exam may contain up to 10 extra unscored pre-test questions

Wastewater Treatment II



The chart below outlines several types of knowledge that support the performance of the job tasks on which you may be tested. These types of knowledge are rated at one of three levels to represent the extent of knowledge needed to perform the job tasks assigned to each Content Area:

Basic – A fundamental or lower level of knowledge is required. Operators performing tasks requiring this level of knowledge will be able to do so with some training; this level of knowledge may also be acquired and developed through job experience. Such tasks may be routine, utilizing established procedures, and have a low level of complexity. Not having this level of knowledge will have minimal impact or significance on the performance of the tasks listed in the Content Area, or on public safety and welfare.

Intermediate – A level of knowledge beyond the basic level is required. Operators performing tasks requiring this level of knowledge will be able to do so with training beyond that of the basic level. The operator will not only be able to apply required fundamental concepts, but will be able to understand and discuss the application and implications of changes to processes, policies, and procedures within the Content Area. Not having this level of knowledge will have a significant impact on the performance of the job and on public safety and welfare.

Advanced – A very high level of knowledge/job expertise is required and the operator will be functioning at an expert level. The operator can apply all fundamental, as well as highly developed or complex concepts, and will be able to design, review, and evaluate processes, policies, and procedures within the Content Area. Not having this level of knowledge will have a serious impact on the performance of the job and will be very harmful to public safety and welfare.

Supporting Knowledge Type	Laboratory Analysis (15%)*	Equipment Evaluation & Maintenance (20%)*	Equipment Operation (25%)*	Treatment Process Monitoring, Evaluation & Adjustment (30%)*	Security, Safety, & Administrative Procedures (10%)*
Aeration principles (e.g. mixing, mechanical, diffusers)		Basic	Basic	Basic	Basic
Bacteriological laboratory testing (e.g. coliform, fecal, E coli)	Intermediate			Basic	Basic
Biological laboratory testing (e.g. BOD, SOUR, CBOD)	Intermediate			Basic	Basic
Biosolids disposal and monitoring requirements	Basic			Basic	Basic
Chemical handling and storage		Basic	Basic		Basic
Chemical laboratory testing (e.g. ammonia, phosphorous, alkalinity)	Intermediate			Basic	Basic
Chlorinators (e.g. gas, liquid)		Basic	Basic	Basic	Basic
Clarifiers		Basic	Basic	Basic	Basic
Comminuters		Basic	Basic	Basic	Basic
Conveyors		Basic	Basic	Basic	Basic
Dewatering equipment (e.g. centrifuges, presses, drying beds)		Basic	Basic	Basic	Basic
Documentation and record keeping	Basic	Basic		Basic	Basic

Wastewater Treatment II

Supporting Knowledge Type	Laboratory Analysis (15%)*	Equipment Evaluation & Maintenance (20%)*	Equipment Operation (25%)*	Monitoring, Evaluation, & Adjustment (30%)*	Security, Safety, & Administrative Procedures (10%)*
Effluent disposal and monitoring requirements	Intermediate			Intermediate	Basic
Electrical principles (e.g. troubleshooting breakers, relays, circuits)		Basic	Basic		Basic
Emergency preparedness		Basic	Basic		Basic
Flow measuring devices (e.g. parshal flumes, mag meter, venturis)		Basic	Basic	Basic	
Grit removal processes (e.g. grit chamber, aeration, cyclone)		Basic	Basic	Basic	Basic
Heavy equipment (e.g. operation, preventative maintenance)		Basic	Basic		Basic
Hydraulic principles (e.g. mass flow balance, detention time, loading, velocity, HRT)			Basic	Basic	
Industry safety practices (e.g. PPE, confined space, fall arrest, lockout/tag-out)	Basic	Basic	Basic		Basic
Influent monitoring and waste characteristics	Basic			Basic	Basic
Maintenance practices (e.g. preventive, reactive, predictive)		Basic	Basic		Basic
Ozone generation equipment		Basic	Basic	Basic	Basic
Physical laboratory testing (e.g. temperature, solids, DO)	Intermediate			Basic	Basic
Pneumatic principles (e.g. troubleshooting actuators, compression, sprayer)		Basic	Basic	Basic	Basic
Primary treatment processes (e.g. ponds, sedimentation basins)		Basic	Basic	Intermediate	Basic
Principles of asset management (e.g. preventive, reactive, predictive maintenance)		Basic	Basic	Basic	Basic
Process control instrumentation (e.g. PLCs, SCADA, continuous online monitoring)	Basic	Basic	Basic	Basic	
Quality control / quality assurance practices	Basic			Basic	Basic
Screening technology (e.g. bar screens, micro screens)		Basic	Basic	Basic	Basic
Secondary treatment processes (e.g. activated sludge, MBR, IBR)		Basic	Basic	Intermediate	Basic
Solids treatment concepts (e.g. dewatering, digestion, thickening)		Basic	Basic	Basic	
Tertiary treatment processes (e.g. media filtration, disinfection, post aeration, reclaimed recharge)		Basic	Basic	Basic	Basic
Treatment equipment (e.g. pumps, motors, generators)		Basic	Basic	Basic	Basic
Wastewater treatment practices (e.g. sludge age, SRT, MCRT, F/M ratio)	Intermediate			Basic	

*Percent of exam associated with the Content Area

Math Growth Mindset

Growth Mindset Maths is **an approach to teaching mathematics which believes that mindset is more important than initial ability in determining the progress made by pupils in their mathematical understanding**. Pupils with a growth mindset will make better progress than pupils with a fixed mindset.

Growth mind set people believe that they can learn anything and that their intelligence can grow

Students with a fixed mindset are those who are more likely to give up easily, whereas students with a growth mindset are those who keep going even when work is hard, and who are persistent.

Math Tips and Suggestions

1. **Already know your formula and Conversion sheet!**
2. **Practice conversions beforehand**
3. **Carry your units**
4. **Show all work (Baby Steps on the Calculator)**
5. **Box answer**
6. **WATCH UNITS!!!!!!!**
7. **Take a second and think if the units to your answer even makes sense**

DAY 1-am

- **How do you **attack** math word problems?**
- **How do you solve conversion problems?**

RULES TO SOLVING MATH WORD PROBLEMS

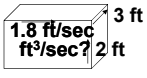
1. **READ THE PROBLEM FIRST (AND PUT IT INTO YOUR OWN WORDS)**
2. **LAY OUT THE PROBLEM=DRAW A DIAGRAM**
3. **DETERMINE WHAT YOU HAVE AND WHAT YOU NEED (YOU MAY HAVE EXTRA)**
4. **PERFORM CONVERSIONS**
5. **ARTICULATE THE REASON FOR USING AN EQUATION**
6. **DO DIMENSIONAL ANALYSIS FIRST**
7. **APPLY THE EQUATION---DO NOT PLUG AND CHUG**
8. **SOLVE THE PROBLEM**
9. **CHECK YOUR WORK— Take 5 Seconds and Think**

WORD PROBLEM

A channel is 3 ft wide with water flowing to a depth of 2 ft. The velocity in the channel is found to be 1.8 ft/sec. What is the flow rate in the channel in cubic feet per second?

Step 1: Use your own words. Got a channel with known dimensions and a flow rate, need to convert that value from one unit to another. This is a simple conversion problem

Step 2: Draw a diagram



Step 3: Conversions?

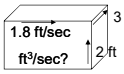
GIVEN: 1.8 ft/sec , 3ft, 2 ft **NEED: ft^3/sec**

CONVERSIONS:

None necessary

WORD PROBLEM

A channel is 3 ft wide with water flowing to a depth of 2 ft. The velocity in the channel is found to be 1.8 ft/sec. What is the flow rate in the channel in cubic feet per second?



Step 3: Conversions?
GIVEN: f=1.8 ft/sec, w=3ft, d=2 ft **NEED: ft³/sec**
CONVERSIONS: None necessary

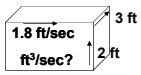
Step 4 Equation : flow in channel (FC) = f X w X d
Step 5: Solve Dimensional Analysis First!

$$(1.8\,\text{ft/sec})\times(3\,\text{ft})\times(2\,\text{ft})=\frac{\text{ft}}{\text{sec}}\times\frac{\text{ft}}{1}\times\frac{\text{ft}}{1}=\frac{\text{ft}^3}{\text{sec}}=\text{YES!}$$

WORD PROBLEM

A channel is 3 ft wide with water flowing to a depth of 2 ft. The velocity in the channel is found to be 1.8 ft/sec. What is the flow rate in the channel in cubic feet per second?

Step 6: Solve Problem



Equation : flow in channel (FC) = f X w X d
where f = flow
w = width of channel
d = depth of channel

$$(1.8\,\text{ft/sec})\times(3\,\text{ft})\times(2\,\text{ft})=10.8\,\frac{\text{ft}^3}{\text{sec}}$$

RULES TO SOLVING MATH Conversion PROBLEMS

1. **READ THE PROBLEM FIRST >>> Answer Units**
2. **Locate Formula on ABC formula sheet (hopefully you have already practiced using it)**
3. **DETERMINE WHAT IS GIVEN AND FORMULA YOU NEED**
4. **SOLVE FOR THE UNKNOWN**
5. *******LET UNITS GUIDE YOU!********
6. **APPLY THE EQUATION (COPY IT CORRECTLY)**
7. **SOLVE THE PROBLEM (BABY STEPS ON CALCULATOR)**
8. **CHECK YOUR WORK (TAKE 5 SECONDS AND THINK!**

ABC Formula Sheets

1. **Get our the ABC Formula sheets and a highlighter**
2. **Use your non programmable calculator that you will use on your exam**
3. **DO NOT USE YOUR IPHONE!**

Temperature Conversions

Celsius to Fahrenheit

1. **Locate Formula on ABC Formula sheet**
2. **Begin by multiplying the Celsius temp by 1.8.**
3. **Now add 32.**

$^{o}F = (^{o}C)\,(1.8) + 32$

$^{o}F = (17)(1.8)+32 = 62.6^{o}F = 63^{o}F$

Fahrenheit to Celsius

1. **Locate Formula on ABC Formula sheet**
2. **Begin by subtracting 32 from the Fahrenheit #.**
3. **Divide the answer by 1.8.**

$^{o}C = \dfrac{(^{o}F - 32)}{1.8}$

Convert 451°F to degrees Celsius

$^{o}C = \dfrac{(^{o}F - 32)}{1.8} = \dfrac{451-32}{1.8} = 233^{o}C$

Given the temperature of wastewater at 50 °F, what is the corresponding temperature in °C?

Locate Formula on ABC Sheet

A. 10°C
B. 12°C
C. 17°C
D. 20°C

Convert 75°F to degrees Celsius?

Locate Formula on ABC Sheet

$$^{o}C = \frac{(^{o}F - 32)}{1.8}$$

1. 24 °C
2. 107 °C
3. 75 °C
4. 102°C

Wastewater temperature is reported to be 12 °C. What is the temperature in °F?

Locate Formula on ABC Sheet---Beware the negative!

$$^{o}F = (^{o}C)(1.8) + 32$$

A. 48.9°F
B. 53.6°F
C. 58.1°F
D. 58.4°F

Convert -34°C to degrees F?

Locate Formula on ABC Sheet---Beware the negative!

1. -34 °F
2. 109 °F
3. -29 °F
4. 93°F

Convert 1.98 acres to square feet?

Locate conversion Factor on ABC Sheet

1. 3.96 ft^2
2. 4 acres
3. 86,300 ft^2
4. 1.98 ft^2

Convert 81 ft^3 to gallons?

Locate conversion Factor on ABC Sheet

1. 96 gal
2. 606 gal
3. 10 gal
4. 909 gal

Water Treatment ABC Need To Know

Exam Level	I	II	III	IV
Evaluate Wastewater	5%	5%	5%	5%
Monitor Treatment Process	34%	34%	34%	34%
Maintain Equipment	16%	15%	15%	15%
Operate Equipment	17%	16%	16%	16%
Sample Collection	8%	9%	10%	10%
Lab Analysis	5%	7%	9%	9%
Safety and Admin. Duties	15%	14%	11%	11%

Treatment Plant Operators

Treatment plant operators have many responsibilities ranging from:

- **Administration**
- **Planning and Design**
- **Operations and Maintenance**
- **Public relations**
- **Supervision**
- **Laboratory procedures**
- **Continuing Education**

Which one of the following is a treatment plant operator NOT responsible for:

a. **Plant tours**
b. **Process control decisions**
c. **Upgrading the electrical service panel**
d. **Collecting samples**

What is in Wastewater

- **Wastewater characteristics and lab testing done to determine its chemical makeup**

The secondary treatment standards for effluent limits for these parameters:

a. BOD_5, CBOD, TSS, and pH
b. FOG, BOD_5, and TSS
c. Nitrogen and phosphorous
d. Pathogenic organism

A Water Resource Recovery Facility has a 30 day monthly average BOD5 limit in their permit of 30 mg/L. Two samples were collected in May and the results were 28 and 36 mg/L. The operator should?

a. **report only the first result to remain below the permit level**
b. **average the results together and report a permit violation.**
c. **alter the second result to read 26 mg/l and then average the results together.**
d. **add more fictional numbers to lower the monthly average and not worry about any potential fines that may occur from this action**

Wastewater Characteristics

Table 2.2 Typical composition of untreated domestic wastewater.[2]

Contaminants	Unit	Concentration		
		Weak	Medium	Strong
Solids, total (TS)	mg/L	350	720	1200
Dissolved, total (TDS)	mg/L	250	500	850
Fixed	mg/L	145	300	525
Volatile	mg/L	105	200	325
Suspended solids (SS)	mg/L	100	220	350
Fixed	mg/L	20	55	75
Volatile	mg/L	80	165	275
Settleable solids	ml/L	5	10	20
Biochemical oxygen demand, mg/L, 5-day, 20°C (BOD_5, 20°C)	mg/L	110	220	400
Total organic carbon (TOC)	mg/L	80	160	290
Chemical oxygen demand (COD)	mg/L	250	500	1000
Nitrogen (total as N)	mg/L	20	40	85
Organic	mg/L	8	15	35
Free ammonia	mg/L	12	25	50
Nitrites	mg/L	0	0	0
Nitrates	mg/L	0	0	0
Phosphorus (total as P)	mg/L	4	8	15
Organic	mg/L	1	3	5
Inorganic	mg/L	3	5	10
Chlorides	mg/L	30	50	100
Sulfate	mg/L	20	30	50
Alkalinity (as $CaCO_3$)	mg/L	50	100	200
Grease	mg/L	50	100	150
Total coliform	no/100 mL	10^6-10^7	10^7-10^8	10^7-10^9
Volatile organic compounds (VOCs)	µg/L	<100	100-400	>400

Wastewater Characteristics

Organic contaminants are derived from animals and plants, or may be manufactured chemical compounds. All organics contain carbon

Typical domestic wastewater treatment plant, the BOD of the influent raw wastewater ranges around 200 to 250 mg/L

B.O.D.

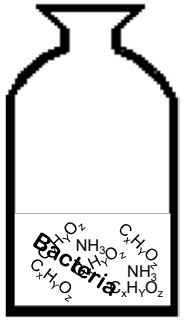
Biochemical Oxygen Demand

The Quantity of Oxygen Used in the Biochemical Oxidation of Organic Material.

Under:

Specified Time	5 Days
Specified Temperature	20^0 C
Specified Conditions	In the Dark In the Presence of Bacteria

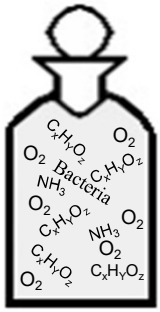
Measured Volume of Wastewater is Added to BOD Bottle.



Contains:

- Organics
- Ammonia
- Bacteria

300 ml Dilution Water Added

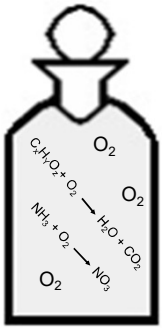


Dilution Water Contains:

- Nutrients
- Oxygen

Measure Initial D.O. Concentration

Incubate 5 Days

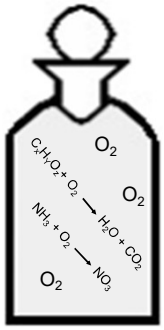


Some Oxygen Used:

- Respiration
- Nitrification

Measure D.O. Concentration

Measure Oxygen Loss (Demand)



D.O. Day 1 - D.O. Day 5

= Oxygen Demand

(Of What Is In The Bottle)

DILUTION WATER BLANK

CHECK ON QUALITY

MAXIMUM DEPLETION
0.2 mg/L

NOT USED IN CALCULATIONS

B.O.D. mg/L =

$$\frac{\text{D.0. DEPLETION (mg/L)}}{\text{SAMPLE VOLUME (mL)}} \times 300 \text{ mL}$$

D.O. DEPLETION = D.O. Initial - D.O. 5-Day

Minimum Depletion - 2.0 mg/L
Minimum Residual - 1.0 mg/L

B.O.D. Example Problem

Calculate the B.O.D.: BOD, mg/L = [(Initial DO - Final DO) x 300]/mL sample

Initial Sample D.O. = 8.1 mg/L
5-Day Sample D.O. = 2.1 mg/L
Vol. Of Sample in 300 mL Bottle = 60 mL

$$\text{B.O.D., mg/L} = \frac{\text{D.O. Depletion, mg/L}}{\text{Volume Sample, mL}} \times 300 \text{ mL}$$

$$= \frac{\text{Initial D.O. - Residual D.O.}}{\text{Volume Sample, mLs}} \times 300 \text{ mL}$$

$$= \frac{8.1 \text{ mg/L} - 2.1 \text{ mg/L}}{60 \text{ mL}} \times 300 \text{ mL}$$

$$= \frac{6.0 \text{ mg/L}}{60 \text{ mL}} \times 300 \text{ mL}$$

= 0.1 mg/L X 300 = 30 mg/L

BOD VIDEO

BOD

17. **The first stage of biochemical oxygen demand (BOD) can also be called _____ BOD**

A. Hydrolysis
B. Nitrification
C. Oxidation
D. Carbonaceous

How can the plant operator select the most effective operational procedures, determine the efficiency of treatment units processes, and identify developing treatment problems before they seriously affect effluent quality?

1. by relating laboratory results to operations
2. by relating weather conditions to discharge rates
3. by relating NPDES permit requirements to plant influent characteristics
4. by relating flow rates to the amount of disinfection chemicals used

What test indicates the rate of oxidation and provides an indirect estimate of the concentration of waste?

1. BOD
2. TSS
3. DO
4. DOC

The biochemical oxygen demand (BOD) test measures this:

a. non-biodegradable organic matter
b. percent of organic suspended solids
c. quantity of live bacteria
d. amount of oxygen to stabilize the biodegradable organic matter in the wastewater

What does the standard 5-day biochemical oxygen demand (BOD) test measure?

a. The amount of nitrogen produced by microorganisms as they consume and metabolize organic material in water
b. The amount of hydrogen used by microorganisms as they consume and metabolize organic material in water
c. The amount of oxygen used by microorganisms as they consume and metabolize organic material in water
d. the microorganism count as they consume and metabolize organic material in water.

The BOD test must create ideal growing conditions which will encourage microorganisms to effectively and efficiently utilize the digestible organic materials (waste). Running a BOD analysis on a sample consists of placing a portion of a sample (along with prepared dilution water) into an air-tight bottle (300 mls volume) and incubating the bottle at 20 +/- 1 deg C for (usually) ____ days. Measurements of oxygen consumed in a ____-day test period.

a. 1
b. 3
c. 5
d. 9

What is the typical sample **bottle** size for a BOD test?

a. 20 ml
b. 40 ml
c. 50 ml
d. 300 ml

What is the typical temp for a BOD test in degrees C (+/- 1 degrees C) ?

a. 20
b. 40
c. 50
d. 300

After 5 days of incubation, a BOD Blank should have a DO depletion of at least?

a. < 0.2 mg/L
b. 1 mg/L
c. 2 mg/L
d. 13.5 mg/L

After 5 days of incubation, a BOD sample should have a DO depletion of at least?

a. 0.2 mg/L
b. 1 mg/L
c. 2 mg/L
d. 13.5 mg/L

After 5 days of incubation, a inoculated sample bottle must lose at least _____ mg/L DO and have at least _____ mg/L DO remaining?

a. 0.2 mg/L, 1 mg/L
b. 1 mg/L, 5 mg/L
c. 2 mg/L, more than 1 mg/L
d. 2 mg/L, 0.2 mg/L

Wastewater Characteristics

Inorganic contaminants are not biodegradable, but may be nutrients necessary for microorganisms to live.

Typical domestic wastewater treatment plant, the BOD of the influent raw wastewater ranges around 200 to 250 mg/L

Wastewater Characteristics

Pathogens are disease-causing organisms including bacteria and viruses that can be deposited in the wastewater through human or animal wastes, or from improperly handled hospitals wastes. Diseases caused by pathogens that may be found in wastewater include:

- **Typhoid**
- **Cholera**
- **Dysentery**
- **Polio**
- **Hepatitis**

Day 1 pm
Math Conversions
Flow Rates

Agenda

Thurs Dec 14, 2023		Thurs Dec 14, 2023	
8:00-9:00 am	Overview of Wastewater and Collections systems, ABC exam taking tips and suggestions	2:45 -3:00 pm	Break
9:00-9:45am	Mathematical wastewater dimensional analysis	3:00-4: 00 pm	ABC Need To Know Criteria: Wastewater collection system/treatment operations PUMPS!!
9:45-10am	Break	4:00-5:30 pm	ABC Need To Know Criteria: Wastewater secondary treatment plant processes
10:00-11:00 am	ABC Need To Know Criteria: Wastewater Characteristics Needed for both collection system and the operations		
11:00-12:00 pm	ABC Need To Know Criteria: Wastewater collection system maintenance		
12:00-1:30 pm	Break		
1:30 – 2:45	Mathematical wastewater dimensional analysis/flow conversions		

Flow Conversions Short Cuts

1. 1 MGD X $(\frac{694.4\ gpm}{1MGD})$ = ___ gpm
2. 1cfs X $(\frac{448.8\ gpm}{1CFS})$ = ___ gpm
3. 1gpm X $(\frac{1mgd}{694.4\ gpm})$ = ___ mgd
4. 1gpm X $(\frac{1cfs}{448.8\ gpm})$ = ____ cfs

Time Conversions Short Cuts

1. 1 day $(\frac{24hr}{1day})$ $(\frac{60\ min}{1\ hr})$ = 1440 minutes
2. 1 day $(\frac{24hr}{1day})$ $(\frac{60\ min}{1\ hr})$ $(\frac{60\ sec}{1\ min})$ = = 86,400 seconds

Flowrate (Q) in cubic feet per second equals Cross–Sectional Area (A) of the conduit (pipe) in square feet times the Velocity (V) of the water in feet per second.
This statement is reduced to Q, ft^3/s = (A, ft^2)(V, ft/s)

Flowrate (Q) is always in ft^3/s, therefore:
- $(ft^3/s)(448.8)$ = Gallons/minute
- $(ft^3/s)(0.6463)$ = Million Gallons/day
- $(ft^3/s)(2,446.6)$ = Cubic Meters/day
- $(ft^3/s)(28.32)$ = Liters/second

Area (A) is always in ft^2, therefore:
- $(ft^2)(144)$ = square inches
- $(ft^2)(0.1111)$ = square yards
- $(ft^2)(0.0929)$ = square meters
- $(ft^2)(929.03)$ = square centimeters

Velocity (V) is always in ft/s, therefore:
- (ft/s)(12) = inches/second
- (ft/s)(0.3048) = meters/second
- (ft/s)(0.6818) = miles/hour
- (ft/s)(30.48) = centimeters/second
- (ft/s)(1.097) = kilometers/hour
- (ft/s)(0.5925) = knots

Convert 2 mgd to gpm?

Locate conversion Factor on ABC Sheet

1 MGD = 694 gpm

1. 0.002 gpm
2. 1388 gpm
3. 1256 gpm
4. 909 gpm

A pipeline has a carrying capacity of 3.5 cfs. What is the flow in gpm?

Locate conversion Factor on ABC Sheet

1 ft^3= 7.48 gal and 60 sec=1min

1 cfs = 448.8 gpm

1. 1265 gpm
2. 1298 gpm
3. 1570.8 gpm
4. 1807.2 gpm

A lift station pumps wastewater at a rate of 362 gpm. What is the flow in mgd?

Locate conversion Factor on ABC Sheet

1 MGD = 694 gpm

1. 0.52 MGD
2. 0.71 MGD
3. 0.82 MGD
4. 0.94 MGD

Convert 3.14 cfs to gpm?

Locate conversion Factor on ABC Sheet

1. 23.48 gpm
2. 25.18 gpm
3. 1409 gpm
4. 2365 gpm

Convert 5.3 ft^3/sec to million gallons per day?

Locate conversion Factor on ABC Sheet

1 ft^3= 7.48 gal, 86,400 sec=1d, 1MG=1,000,000 gal
1 cfs = 448.8 gpm, 1440 min/ 1 day

1. 5.3 mgd
2. 3.42 mgd
3. 2.1 mgd
4. I don't know

One cubic foot per second is equal to how many gph?

Locate conversion Factor on ABC Sheet

1 ft^3= 7.48 gal, 60 sec =1 min, 60 min = 1 hr
1 cfs = 448.8 gpm,

1. 2794 GPH
2. 26928 GPH
3. 6000 GPH
4. 448.8 GPH

A flow of 650 gpm would be approximately _____ MGD?

Locate conversion Factor on ABC Sheet

1 MGD = 694 gpm

1. 0.4772 MGD
2. 0.936 MGD
3. 1.714 MGD
4. 1.923 MGD
5. 650 MGD

Example 5. Velocity =rate (length/time)
A float is placed in a channel. It takes 2.5 min to travel 300 ft. What is the flow velocity in feet per minute in the channel?

According to ABC Formula Sheet for VELOCITY:

V= rate (length/time) = $\frac{300\ ft}{2.5\ min}$

V= 120 ft/min

V= 300 ft / 2.5min

Grit Channel velocity placing a stick of wood, marshmallow, or other identifiable object in the beginning section of the channel. Time the object's movement until it exits the channel.

A float takes 30 seconds to travel 37 feet in a sewer system at low flow periods. What is the velocity of flow in the sewer pipe (fps)?

- ABC Formula: Velocity=Distance/Time
- Given: 37 ft, 30 sec
- Solve:

1. 0.67 fps
2. 1.2 fps
3. 2.0 fps
4. 3.23 fps

A float travels 300 ft in a channel in 2 min and 14 sec. What is the estimated velocity in the channel (ft/sec)?

- **ABC Formula:** Velocity = Distance/ Time
- **Given:** 300 ft, 2 min and 14 sec = how many total seconds
- **Solve:**

1. **1.0 fps**
2. **1.25 fps**
3. **2.24 fps**
4. **3.35 fps**

Water Collections ABC Need To Know

Exam Level	I	II	III	IV
Operate Equipment	15%	15%	15%	15%
Evaluate Equipment	10%	15%	15%	15%
Monitor Collection System	15%	15%	15%	15%
Maintain lift station	10%	10%	10%	10%
Adjust Collection System	35%	30%	25%	25%
Safety and Admin. Duties	15%	15%	20%	20%

Wastewater Characteristics

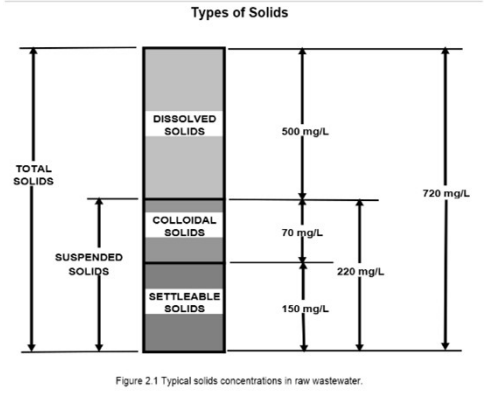


Figure 2.1 Typical solids concentrations in raw wastewater.

Wastewater is normally

A. 10% solids.
B. 25% settleable solids.
C. 12% volatile.
D. 99.9% water.

Wastewater Characteristics

Total Solids- Coors Dish at 103-105 degress C

• Total dissolved and suspended organic and inorganic residue left after evaporation, expressed in mg/L.

• Total solids include both dissolved and suspended materials.

• Suspended solids include both nonsettleable and settleable materials.

• Total solids concentration is ~ 720mg/L.

Wastewater Characteristics

Total Dissolved Solids-Passed a GFF, dried at 180 degrees C
• Solids which will pass through a standard glass fiber filter.
• Dissolved solids weight is the difference in weight between total solids and suspended solids.

• When a sample is filtered through fine mesh filter (example - 0.45 micron membrane filter), the suspended solids are captured on the filter pad and the dissolved solids will remain in the water passing through the filter.

• To determine the weight of dissolved solids, sample the water that passed through the filter. Evaporate the sample and weigh residue to determine weight of dissolved solids.

• Dissolved solids concentration is ~ 500mg/L

Wastewater Characteristics

Total Suspended Solids- Solids on a filter and AL dish dried at 103-105 degrees C

• Suspended solids are the solids that are captured on the filter pad, or the difference between the total and dissolved solids content of the sample.

• Includes solids which will settle or float in a clarifier and the lighter nonsettleable (colloidal) solids.

• The type of suspended solids is determined by size, shape, and weight.

• Suspended solids concentration is ~ 220 mg/L.

Wastewater Characteristics

Nonsettleable (Colloidal) Solids

• A portion of Suspended Solids

• The colloidal solids will not settle but will remain in suspension after the settleable solids have precipitated out.

The removal of colloidal solids usually requires the addition of a chemical flocculating agent or filtration.

• Calculated by subtracting the weight of settleable solids from the weight of suspended solids.

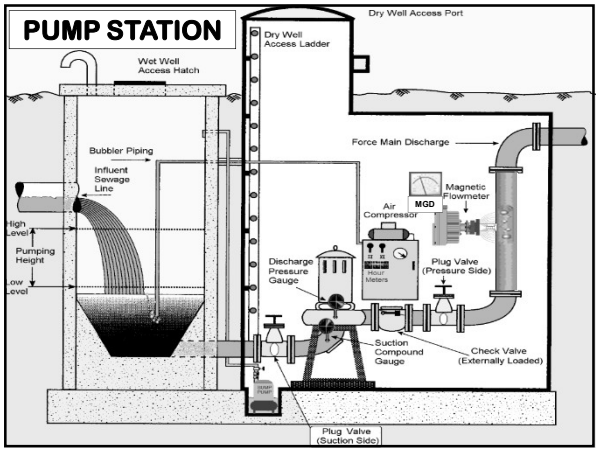
• Nonsettleable solids concentration is ~ 70 mg/L

Contaminants found in untreated wastewater may include—more than one answer:

a. Pathogens
b. Ozone
c. Organic contaminants
d. Inorganic contaminants

Collections and Treatment Overlap

- Pumps



STUFFING BOXES

Stuffing boxes have the primary function of protecting the pump against leakage at the point where the shaft passes out through the pump casing. If the pump handles a suction lift and the pressure at the interior stuffing box end is below atmospheric, the stuffing box function is to prevent air leakage into the pump. If, however, the pressure is above atmospheric (as is the case with flooded suction) the function of the stuffing box is to prevent liquid (like sewage) from leaking out of the pump.

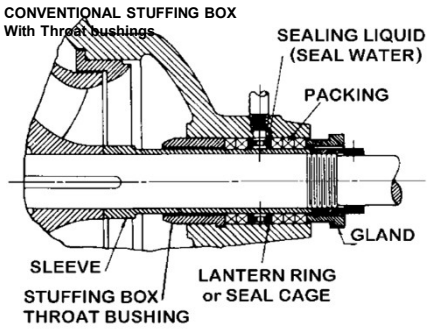
For general service pumps, a stuffing box usually takes the form of a cylindrical recess that accommodates a number of rings of packing around the shaft or shaft sleeve (see Figure 1 and Figure 2). If sealing the box is desired, a lantern ring or seal cage (see Figure 3) is used to separate the rings of packing into approximately equal sections. The packing is compressed to give the desired fit on the shaft or sleeve by a gland that can be adjusted in an axial direction. The bottom or inside end of the box may be formed by the pump casing (see Figure 4), a throat bushing (see Figure 1), or a bottoming ring (see Figure 2).

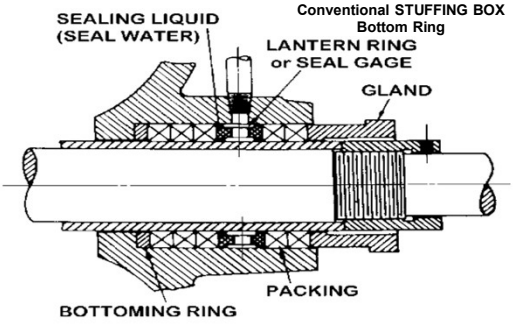
For manufacturing reasons, throat bushings are widely used on smaller pumps with axially split casings. Throat bushings are always solid rather than split. The bushing is usually held from rotation by a tongue-and-groove joint locked in the lower half of the casing.

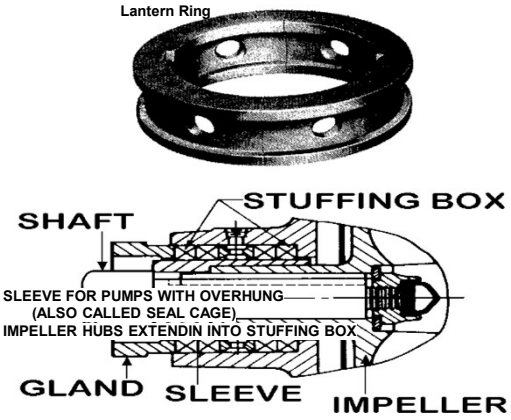
LANTERN RINGS (SEAL CAGES)

When a pump operates with negative suction head, the inner end of the stuffing box is under a vacuum and air tends to leak into the pump. For this type of service, packing is usually separated into two sections by a lantern ring, or seal cage (see Figure 1). Water (called seal water) is introduced under pressure into the space causing flow of this fresh water in both axial directions. This construction is useful for pumps handling liquids such as sewage, since it prevents outflow of the sewage material. Lantern rings are usually axially split for ease of assembly.

Some installations involve variable suction conditions, the pump operating part of the time with positive suction head, and some of the time with negative suction head (lift). When the operating pressure inside the pump exceeds the atmospheric pressure, the liquid lantern ring becomes inoperative (except for lubrication). However, it is maintained in service so that when the pump is primed at starting, all the air can be excluded







Which of the following are components of a typical, non clog, vertical, raw wastewater centrifugal pump?

a. mid bearing, grease flange, jack stop, and grinder sleeve
b. flexible coupling, shaft washer, pump base, and adjuster
c. Impeller, volute, wear rings, and package rings
d. Floor line, pump frame, suction base, and lateral ring

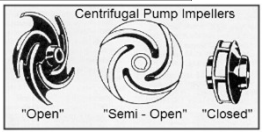
Centrifugal pump part(s) include _____.

a. Diaphragm
b. Impeller
c. Piston
d. Rotor
e. Both b & d

When you hear the terms "Open, Semi–Open & Closed" all in the same sentence, what is the subject being covered?

"Open" Impeller has no plate (or shroud) and is capable of handling liquids with solids concentrations up to 10%.
"Semi–Open" Impeller has a plate (or shroud) on one side and handles water with limited solids.
"Closed" Impeller pump is very efficient, but handles liquids with minimum particulate matter.

a. Impellers
b. Lantern Rings
c. Sleeves
d. Stuffing Boxes
e. Confined Entry Spaces



Which of the following do not apply to mechanical seals?

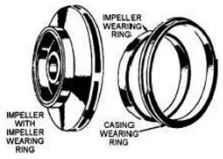
Mechanical seals are devices that are used to **provide a seal at the point of entry or exit of a rotating shaft**. Typically it is used to prevent the leakage of one high pressure fluid into a lower pressure fluid.

a. Leakage of raw sewerage from the top of the stuffing box is eliminated
b. Create more wear on the pump shaft or shaft sleeve
c. Lead to less power consumption
d. Will last for years when installed and operated properly

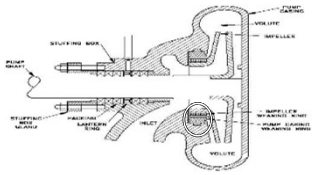
In a centrifugal pump, internal leakage is prevented by _____.

Impeller turns the liquid at a high rate of speed (the heart of the pump)
Sleeves protect the shaft from the liquid
Volutes are the housing on pumps that contain the impellers and liquid inside
Wear rings prevent internal leakage

a. Impellers
b. Sleeves
c. Volutes
☺ Wear rings



Wear rings are installed in a pump to ____.

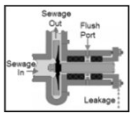


a. Hold the shaft in position
b. Keep the impeller in place
c. Concentrate wear on an economically replaceable part
d. Wear out rings instead of the sleeves

Leakage of "seal water" around the packing on a centrifugal pump is required. It is required because the "seal water" acts as a(n) _____.

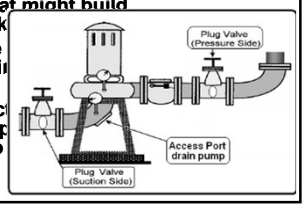
Visible leakage from a water seal is important because it demonstrates that the "seal water" pressure is greater (higher) than the pressure of the wastewater being pumped. The "seal water" cts as a lubricant, keeping the wastewater out of the seal packing.

a. Adhesive/Sealant
b. Conductor
c. Lubricant
d. Vapor Barrier



When shutting down a centrifugal pump for an extended period of time, an operator should:

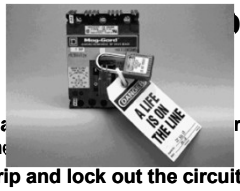
a. Close the discharge line and open the suction line so that seals are not allowed to dry out.
b. Close the suction line and open the discharge line so gases that might build up in the pump won't break
c. Close both the discharge lines, open the air vent li the pump.
d. Open the discharge, suc vent lines so that the pump of water and is vented to build up.



A properly operating electric motor that powers a pump will:

a. Be too hot to touch.
b. Vibrate and be noisy.
c. Feel cold when touched.
d. Feel warm when touched.

Of the following items, what is the first thing the operator should do before he/she places a hand inside a pump volute to [illegible]struction?



a. Ma[illegible]r tools to do th[illegible]
b. Trip and lock out the circuit breaker
c. Flush and drain the pump
d. Put on rubber gloves

Prior to repairing a pump's electrical circuit, which of the following actions should you take?

a. Disconnect the circuit breaker, and place a red tag stating, "do not activate", and lock out.
b. Notify your supervisor.
c. Tell all of the operators not to activate the circuit.
d. Turn the pump off.

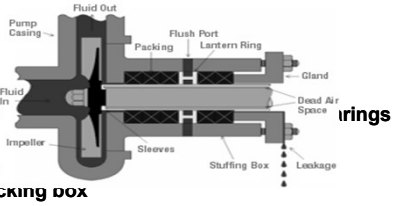
You have reinstalled a 3 phase, 220 V motor with new windings. Its starts to run in the wrong direction. The corrective action would be?

a. Check the motor starter
b. Reground the ground wire.
c. Reverse the connection of any two motors leads
d. Send it back to the repair shop to have the windings properly installed

The normal cause of electric motor failure is:

a. Dirt
b. Moisture
c. Friction
d. All of the above

A water seal on a pump serves a dual purpose. It acts as a lubricant and it also



a. Ac[illegible]rings fro[illegible]
b. Ke[illegible] packing box
c. Keeps the pump primed
d. Is a reserve water supply

The elevation of any pump above the source of the supply should not exceed __ feet.

The atmospheric pressure would be capable of sustaining a column of water 33.9 feet in height. If a pump could produce a perfect vacuum, the maximum height to which it could lift water at sea level would be 33.9 feet

Calculate Theoretical Maximum Vacuum (in feet).

$$\frac{(14.7 \text{ psi})(2.31 \text{ feet})}{1.0 \text{ psi}} = 33.96 \text{ feet}$$

The rise in elevation (referred to as "suction head") must be under 25 feet high, but ideally should be no more than 5 feet high. The suction head limitation will be listed as a spec on each pump, but should never exceed 25 feet at sea level.

a. 2.2
b. 22
c. 200
d. 224

Pump maintenance includes _____.

1. Packing glands must not be allowed to leak excessively and should be corrected. Packing around the shaft should be tightened just enough to allow about 20 drops per minute.
2. Bearings must have the proper amount of grease and fit clean to prevent premature failure.
3. Vibration must be addressed, or serious pump failure will result.
4. Maintenance operators must document all finds and express their concerns so the proper corrective or preventive maintenance action will occur.

a. Checking operating temperature of bearings
b. Checking packing gland
c. Operating two or more pumps of the same size alternately to equalize wear
d. All of the above

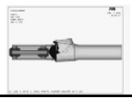
When carrying out a routine inspection on a centrifugal pump. It is noted by the operator that the bearings are excessively hot. This could be caused by _____.

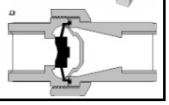
a. Over lubrication
b. Speed too slow
c. Worn impeller
d. Worn packing
e. Both c & d

A valve that allows water to flow in one direction only is a _____ valve.

Check valve allows one way flow of liquids
Gate valves are flat plates that are used usually to cut flow off completely
Globe valves are used to cut off or throttle flow and are round
A petcock is round or conical valve with a hole in the center of it. Often used in laboratory equipment on burettes

Check Valve & Pigging





a. Check
b. Gate
c. Globe
d. Petcock

A horizontal centrifugal pump has a rope packing. When the pump is operating, water slowly drips from the packing gland. This indicates that the _____.

a. Packing bolts or nuts on the packing gland should be tightened
b. Packing bolts or nuts on the packing gland should be loosened
c. Packing bolts or nuts on the packing gland should be are properly adjusted
d. Packing should be replaced

The electrical disconnect for a pump motor can "trip out" under which one of the following con

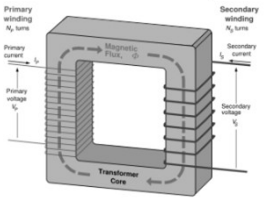
Electrical disconnects (like circuit breakers) are designed to protect equipment in the event of electrical irregularities on the "load side" of the pump. Motor shorts or motor overloads are examples of these factors that may trigger an electrical disconnect.

a. Clo
b. Lo
c. A s
d. A worn impeller

If a fuse continues to blow (fail), an operator should _____.

a. Replace it with a higher capacity fuse
b. Provide a "jumper" in the box
c. Inspect the affected equipment to determine the cause
d. Contact the power company to check for power surges

In electrical circuits a(n) _____is used to reduce the voltage where necessary.



ree-phase, pole mounted
step down" Transformer

The collection system pump station operator finds that a motor won't operate. The most likely thing that ...or should ...

Find and Reset the Overload Switch on Electric Motors

a. Check to make sure that all of the wiring is correct.
b. Check the overload.
c. Check to rotor by dismantling the motor.
d. Send the motor out for repair.
e. None of the above

On a routine pump station check the operator notices that a pump is drawing more amperage than usual. Which would most likely be the ...

When checking the packing gland, look for excessive leakage and repack if needed. When leakage is excessive, the maintenance operator should tighten the packing gland. Keep in mind the leakage should not be completely stopped because water serves as the coolant for the packing in the stuffing box.

a. Worn impeller
b. Thin sludge
c. Worn packing
d. Packing too tight

Closing a valve too quickly may cause ____.

Surges can cause Water Hammer
OPEN AND CLOSE VALVES SLOWLY

The AWWA operating formula for opening/closing a gate valve is 3 times the nominal valve size plus 2 or 3 turns of the operating nut. Example; 6" valve x 3 = 18 plus 2 or 3 = 20 to 21 turns to close a 6" valve. Take a 3 second delay after a slow turn

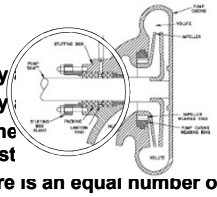
a. A surge in the line
b. No problems in the piping
c. The pipe fittings seat and become more secure
d. The wastewater to go septic

A collection system pump station operator just repacked a pump and placed it in operation. The leakage rate from the newly packed pump was determined to be excessive. The correct procedure for tightening down the pump packing is?

a. Tighten down both sides of the packing gland with ...down by ...
b. Tighten d... gland sli...
c. Tighten d... packing ...
d. None of the above.

1.Turn both sides 1 flat at a time with the pumps running, (you don't want to burn up the Teflon packing). Come back in 15 minutes to ensure your didn't overtighten the packing .
2.Packing glands must not be allowed to leak excessively and should be corrected. Packing around the shaft should be tightened just enough to allow about 20 drops per minute.

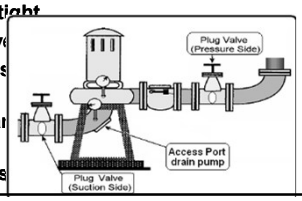
When repacking a centrifugal pump, the correct placement for the water seal ring would be.



a. Immediately ring.
b. Immediately ng ring.
c. So that it line al pipe hole in the st
d. So that there is an equal number of packing rings above and below the lantern ring.
e. Not important.

When removing a centrifugal pump from service for a long period of time, taking in to account that the head level is below the pump, what should the operator do?

a. Close the suction valve tight.
b. Close the discharge valve
c. Close the suction and dis tight.
d. Remove the drain plug a valve. ☺
e. Open the seal water lines

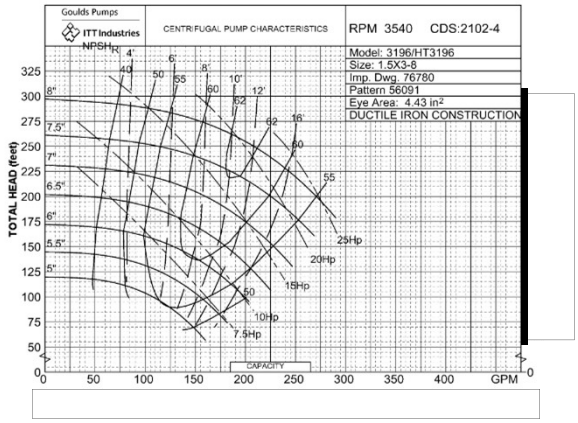


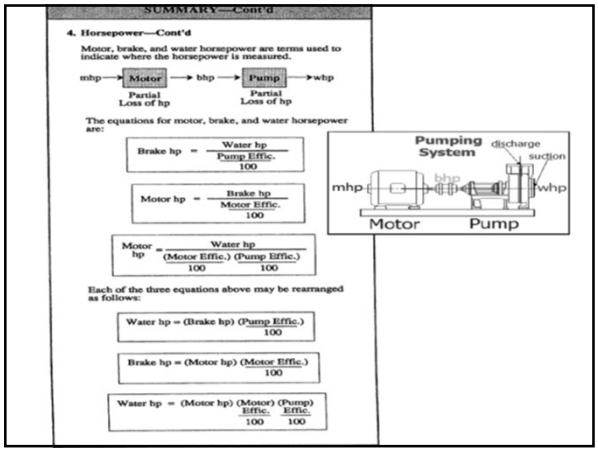
A centrifugal pump in your pump station is delivering less wastewater than its design flowrate. Which of the following could be the cause?

a. Actual Discharge Head is greater than the Design Head.

If the Head (or Pressure) on the Discharge side of the pump is greater (higher) than the Head (Pressure) that it was designed for, the pumping capacity will be less than expected. This condition may also affect the efficiency of the pump.

b. Actual Discharge Head is greater than the Design Head.
c. The check valve is in the open position.
d. The pump has been primed.





What is the first step a collection system pump station operator should take before starting work on a plugged pump?

a. Close the suction valve
b. Lock and tag out pump
c. Notify the Oregon State Department of Environmental Quality
d. Bleed out the air

What information *must be* on a warning tag attached to a [illegible] has been locked out?

a. [illegible]ving the tag
b. [illegible]e local electrical utility
c. Name [illegible] this pe[illegible] remov[illegible]
d. Date and Time to unlock the switch.

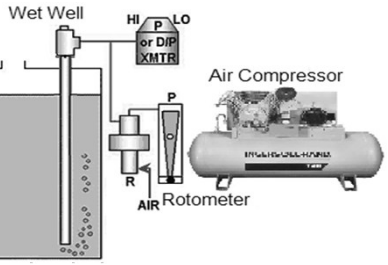
On the warning tag for a "locked – out" switch there needs to be information indicating who placed the lock on the switch as well as a description of the needed repairs.

You are the collection system pump station expert. While in the pump station, you notice that the discharge pressure suddenly increases and coincidentally the flowrate [illegible] the pump suddenly decre[illegible] Which of the following [illegible] to

a. C[illegible]
b. A
c. Th
d. The pump voltage was suddenly increased.

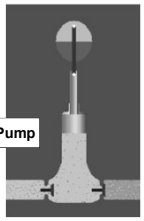
If there is any type of blockage in a pump's discharge line, the discharge pressure will increase (due to the line "backpressure") from the obstruction in the pipe. The flow through the pump will in turn decrease.

What is the function of the bubbler control on a pump wet well?



a. Mea[illegible] pum
b. Sen[illegible] regu
c. Aer[illegible] prev
d. Mea[illegible] regu

A positive displacement sludge pump should never be placed into operation _____.

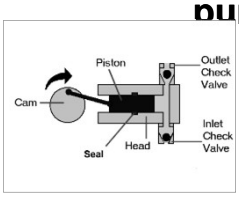


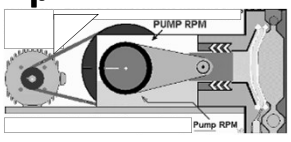
a. Without being primed
b. With the discharge valve closed
c. With the discharge valve open
d. None of the above

The slope of a sewer is measured by

A. The difference from the crown to the invert.
B. The difference in invert elevations over a length of pipe.
C. Using the diameter of the pipe.
D. Only entering the manhole.

A "ball check valve" will most likely be found in what type of pump?





a. Reciprocating Pump
b. Peristalic Pump
c. Centrifugal Pump
d. Progressive Cavity Pump
e. Archimedes Pump

Piston Pumps

a. Vary based on manufacturer
b. Cylinders do not vary with pressure and gallons per minute
c. Are commonly used in low velocity cleaners
d. Use a fluid cylinder, piston, intake and dicharge valves

A diaphragm pump is a type of

A. dynamic feed pump
B. positive displacement pump
C. rotary pump
D. centrifugal pump

Screw pumps lift wastewater to a higher elevation by

a. Being driven by a conical gear speed driver
b. The support of a single bearing
c. using pressurized discharge
d. operating at a constant speed within a housing or trough

An air gap can be used to

A. Clean sewer blockages caused by grease.
B. Let air into manholes.
C. Prevent backflow of wastewater into a drinking water supply.
D. Test for oxygen deficiency in manholes.

A cross-connection is a

A. Cast iron pipe connected to a concrete pipe.
B. Steel pipe connected to an asbestos pipe.
C. Potable water pipe connected to a supply of questionable origin.
D. Lateral line connected to an interceptor.

Wastewater carried in a collection system may come from

A. Digester supernatant.
B. Exfiltration.
C. Primary settling tank.
D. Inflow.

When using any hydraulic sewer cleaning method, care must be taken by the operator

A. To always plug the downstream manhole.
B. Not to cause flooding in homes and businesses.
C. To prevent any air gap from occurring.
D. To throttle flows from the hydrants by using the hydrant valve only.

Disease-producing bacteria are called

A. Saprophytic.
B. Facultative.
C. Pathogenic.
D. Parasitic.

A manhole with a center grating is normally used for

A. Venting.
B. Storm sewers.
C. Sanitary sewers.
D. None of the above.

A pig would be used as _____ in a force main.

A. A reamer.
B. A stopper.
C. A float.
D. A telltale.

A minimum scouring velocity of 2 ft/sec (0.6 m/s) in sewers is necessary so that

A. Flow velocities can be estimated between manholes.
B. Roots won't grow in sewers.
C. Sewer pipes won't become eroded on the bottom.
D. Solids won't build up in a sewer and reduce flow capacity.

A cross-connection is best defined as

A. Ground water entering a gravity sewer through cracks in the piping.
B. A lateral line connected to the main illegally.
C. Storm drainage piped into a domestic collection system.
D. A potable water supply connected to a potential source of pollution.

When dealing with collection systems, I& I refers to: _____.

A. Inflow and inspection.
B. Inspection and information.
C. Infiltration and inflow.
D. None of the above.

Corrosion of sewer pipes may be caused by

A. Laminar flow through them.
B. Oils in wastewater.
C. Fungi.
D. Acids in wastewater.

In a collection system, wastewater that contains no "free" or dissolved oxygen is

A. Aerobic.
B. Anaerobic.
C. Ambient.
D. Debris.

The primary reason why it is important not to have cross-connections of sewers with water supply systems is

A. Possible overloading of water systems.
B. Possible loss of drinking water pressure.
C. Possible drinking water contamination.
D. Loss of wastewater from the sewerage system.

A pig would most likely be used in the cleaning of a

A. Gravity sewer.
B. Storm sewer.
C. Force main.
D. House or building sewer.

Flow rates can be expressed in which of the following units of measurement

A. $in.^3$ (mm^3)
B. gal/lb (mL/kg)
C. mgd (L/s)
D. lb/mil. gal (mg/L)

A sewer manhole is

A. The lowest point in the channel.
B. A gate that opens or closes swinging around a set of hinges.
C. An opening in a sewer provided for the purpose of access.
D. A small hole in a sewer where a wastewater service line connects.

The crown of a sewer pipe is the

A. Bottom.
B. Top.
C. Flow line.
D. Outside at the grade line.

The primary purpose of wastewater disinfection is

A. Reduction of suspended solids.
B. Destruction of algae.
C. Prevention of receiving water contamination.
D. Oxidation of effluent.

A flow of 1,000,000 gpd or (3785 m^3/d) is approximately

A. 500 gpm (approximately 32 L/s)
B. 700 gpm (approximately 44 L/s)
C. 1000 gpm (approximately 63 L/s)
D. 60 000 gph (approximately 63 000 mL/s)

What should be considered as the scouring velocity of sanitary sewers?

A. 1 ft/sec (0.3 m/s)
B. 2 ft/sec (0.6 m/s)
C. 4 ft/sec (1.2 m/s)
D. 4.5 ft/sec (1.4 m/s)

A manhole barrel is referred to as

A. An object with flashing lights placed next to a manhole for safety.
B. The entrance to the manhole.
C. The cylindrical section between the cone and the shelf.
D. The cover support around the rim.

Of the following, which does not lead to roots entering a collection system?

A. Improper pipe bedding.
B. Misaligned pipe joints.
C. Differential settling.
D. Manhole walls properly sealed.

Of the following abbreviations listed, which is not used in computing or expressing flow rates?

A. ft/sec (m/s)
B. gpm (L/s)
C. mgd (m^3/d)
D. psi (kgf/cm^2)

Sewer lines can move after years in place due to

A. Settlement.
B. Frost action.
C. Nearby activities.
D. All of the above.

The end of a sewer pipe that is formed to fit into the bell of the next pipe is called

A. Clamp.
B. Spigot.
C. Invert.
D. Housing.

Which of the following is a component of a manhole?

A. Cone.
B. Barrel.
C. Shelf.
D. All of the above.

When the velocity of flow in a collection system is 2 ft/sec (0.6 m/s) or greater

A. A hydraulic jump will occur.
B. A scouring action will develop.
C. Dissolved solids will separate causing a drop in pH.
D. Solids will settle out and cause blockage in the sewer line.

Inflow can best be defined as

A. Flow into a treatment facility.
B. Direct discharge of stormwater to a sewer.
C. Storm flow plus wastewater flow.
D. None of the above.

Solids that may settle to the bottom of a wet well are called

A. Colloidal solids.
B. Scum.
C. Suspended solids.
D. Settleable solids.

Odors encountered in manholes at the end of force-mains are usually caused by

A. Scavengers.
B. Chemicals in the wastewater.
C. Aerobic bacteria.
D. Anaerobic conditions.

The gas most typically associated with septic wastewater is

A. Carbon monoxide.
B. Carbon dioxide.
C. Hydrogen sulfide.
D. Methane.

The recommended maximum allowable velocity in sewers is

A. 1 ft/sec (0.3 m/s)
B. 5 ft/sec (1.5 m/s)
C. 8 ft/sec (2.4 m/s)
D. 10 ft/sec (3.1 m/s)

In addition to being poisonous, hydrogen sulfide can also cause?

A. Vapor locks in manholes.
B. Stoppages in sewer lines.
C. Crown corrosion.
D. All of the above.

_____ is a disease which can be caused by the ingestion of wastewater.

A. Influenza.
B. Tetanus.
C. Typhoid.
D. Legionnaire's disease

Infiltration can best be defined as

A. The flow of groundwater into a sewer through faulty joints.
B. Industrial waste discharge into a sanitary sewer.
C. Stormwater discharged into a sanitary sewer.
D. All of the above.

A lift station O& M manual should include

A. Names and emergency telephone numbers of collection system operators, vendors and contractors.
B. An agency budget.
C. Instructions for preserving BOD samples.
D. None of the above.

The purpose of an air-gap device is to

A. Eliminate the need for check valves in lift stations.
B. Prevent any water of questionable quality from contaminating potable water sources.
C. Allow storm flows to bypass the collection system and allow storm water to flow over outfalls.
D. Reduce corrosion of manhole covers and rungs.

In a collection system that serves mainly residential customers, at what time of day would lowest flows generally occur?

A. Midmorning.
B. Afternoon.
C. Evening.
D. Very late at night.

A combined sewer would be best defined as

A. A sewer intended to receive both wastewater and storm and/or surface water.
B. A sewer combined with other sewers.
C. A sewer line used to collect storm water solely.
D. A sewer line used to collect infiltration and inflow solely.

An invert is best defined as

A. Water level.
B. Sea level.
C. Lowest point in the channel.
D. Highest point in the channel.

Infiltration can be caused by

A. Poor joints.
B. Cracked pipes.
C. Root intrusion.
D. All of the above.

The abbreviation mgd means

A. Metric gallons per day.
B. Maximum gallons per day.
C. Mean gallons per day.
D. Million gallons per day.

The pH of a solution is based upon

A. The temperature.
B. The dissolved material.
C. The hydrogen ion concentration.
D. The concentration of a Na+ solution.

When there is a collection system failure, what is likely to happen?

A. Wastewater gets treated.
B. The workers fail to get paid.
C. Public safety may be compromised.
D. The public won't notice anything.

During a rainstorm, which of the following may increase the most?

A. Exfiltration.
B. Inflow.
C. Exflow.
D. They will all increase at the same rate.

One million gallons per day (3,785 m^3/day) is approximately equal to

A. 1.0 ft^3/sec (28.3 L/s)
B. 1.5 ft^3/sec (43.8 L/s)
C. 10 ft^3/sec (283.1 L/s)
D. 15 ft^3/sec (424.7 L/s)

BOD is defined as

A. Bacteria oxygen demand.
B. Bacteria optical density.
C. Biochemical oxygen demand.
D. None of the above.

Heavier material and settleable solids are removed from wastewater in ?

A. Vacuum filtration.
B. Primary treatment.
C. Preliminary treatment.
D. None of the above.

Which of the following best describes how the largest quantity of water infiltrates into sanitary sewers?

A. Leaks through manhole covers.
B. Porous pipes.
C. Defective pipe joints.
D. Drainage through catch basins.

Of the following choices only one is not used to convey wastewater from homes or businesses. That one exception is

A. Building sewer.
B. Lateral sewer.
C. Storm sewer.
D. None of the above

High concentrations of heavy metals should be precluded by industrial pretreatment requirements from entering the sanitary sewer system because

A. They will damage pumps and motors.
B. They tend to cause sewer stoppages.
C. They will eventually improve the receiving waters.
D. They may affect the treatment process.

A medium strength wastewater contains approximately

A. 50 - 75 mg/L BOD5 and TSS.
B. 75-100 mg/L BOD5 and TSS.
C. 150-300 mg/L BOD5 and TSS.
D. 400-800 mg/L BOD5 and TSS.

Which is best used to determine when a sewer line needs to be cleaned?

A. The amount of free time the crew has.
B. Odors coming from manholes.
C. Blockages and complaints.
D. Experience and records.

One cubic yard (yd^3) (0.765 m^3) of concrete contains

A. 3 ft^3 (85 L).
B. 9 ft^3 (255 L).
C. 27 ft^3 (765 L).
D. 33 ft^3 (934 L).

The principal purpose of a standard manhole is to

A. Monitor flow.
B. Trap rodents.
C. Connect roof drains to.
D. Provide access for cleaning and inspection.

Storm drains are intended to carry

A. Sanitary wastewater only.
B. Surface and storm water.
C. Both storm and wastewater.
D. All of the above.

"Peak flow" refers to

A. Highest BOD level.
B. The most corrosive period of flow.
C. Highest flow during a certain period.
D. The design flow of the sewer.

You would expect to find a drop manhole at the

A. Summit of a sewer.
B. Intersection of two streets.
C. Junction of two sewers of different levels.
D. Junction of two sewers of different diameters.

The invert of a sewer pipe is the

A. Top.
B. Outside diameter.
C. Outside at the grade line.
D. Bottom where wastewater flows.

The elevation of a sewer refers to the elevation of the

A. Center line of the sewer.
B. Center of the top on the inside.
C. Center of the top on the outside.
D. Center of the bottom on the inside.

If the inside diameter of a sewer pipe is 20 in. (500 mm) and the pipe wall is 1.5 in. (40 mm) thick, what is the outside diameter of the pipe?

A. 21.5 in. (540 mm)
B. 22.5 in. (570 mm)
C. 23.0 in. (580 mm)
D. 24.0 in. (610 mm)

Odors from wastewater collection systems usually result from

A. High alkaline wastewater.
B. Fresh domestic wastewater.
C. Infiltration of alkaline ground water.
D. Anaerobic conditions developing in solids accumulated in the pipe.

Which two of the following factors most generally determine the capacity of a sewer?
(1) Depth. (2) Size. (3) Slope. (4) Pipe material.

A. 1 and 2 above.
B. 1 and 3 above.
C. 2 and 3 above.
D. 2 and 4 above.

Day 2 AM
Math Problems

Agenda

Thurs, Dec 15, 2023			Friday, Dec 15, 2023	
8:00-9:00 am	Mathematical wastewater conversions		2:45 -3:00 pm	Break
9:00-9:45am	ABC Need To Know Criteria: Wastewater collection system operations and cleaning		3:00-4: 00 pm	ABC Need To Know Criteria: Wastewater collection system operations and cleaning
9:45-10am	Break		4:00-5:00 pm	ABC Need To Know Criteria: Wastewater treatment plant analytical procedures.. Award Certificates
10:00-11:00 am	ABC Need To Know Criteria: Wastewater collection system maintenance			
11:00-12:00 pm	ABC Need To Know Criteria: Wastewater treatment plant maintenance			
12:00-1:00 pm	Lunch Break			
1:00 – 2:45	ABC Need To Know Criteria: Wastewater treatment plant operations and solids handling			

One milligram per liter (1 mg/L) can also be expressed as

A. 0.01%
B. 0.001%
C. 0.0001%
D. 0.00001%

One cubic foot (ft) (0.028 m) of water weighs approximately

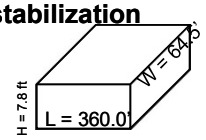
A. 8.34 lb (3.8 kg)
B. 14.7 lb (6.7 kg)
C. 62.4 lb (28 kg)
D. None of the above.

A stick travels 60 ft (18.3 m) in 40 sec in a 10 in. (250 mm) sewer. What is the flow velocity in the sewer?

A. 0.5 ft/sec (0.15 m/s)
B. 0.67 ft/sec (0.20 m/s)
C. 1.0 ft/sec (0.30 m/s)
D. 1.5 ft/sec (0.46 m/s)

If a stabilization pond is 360 ft long, 64.5 ft wide, and 7.8 ft deep, what is the number of gallons in the stabilization pond?

Given:
- ABC Formula:
- Solve:

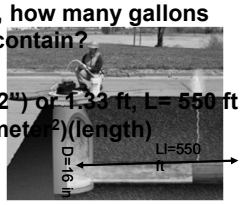


1. **181,116 gal**
2. **24,213 gal**
3. **3,233 gal**
4. **1,354,747 gal**

Water is flowing through a rectangular shaped grit channel exactly 6 feet deep. This grit channel measures 4.25 feet wide with a velocity of 1.3 feet per second (fps). Find the flowrate (Q) in CFS

1. 33.15 CFS
2. 12 CFS
3. 11.81 CFS
4. 223 CFS

A pipe is 16 inch in diameter sewer pipe is 550 ft long. Assuming it is full with sewer water after a precipitation event, how many gallons does the pipe contain?

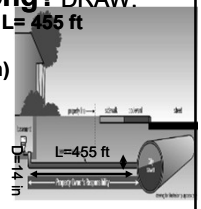


- Given: D= 16 in (1'/12") or 1.33 ft, L= 550 ft
- ABC Formula: V= 0.785(diameter^2)(length)
- Solve:

A. 4,295 gallons
B. 5,716 gallons
C. 51,670 gallons
D. 7,282 gallons

Determine the volume in gallons for a pipeline that is 14 inches in diameter and 455 ft long? DRAW:

- Given: D= 14 in (1'/12") or 1.16 ft, L= 455 ft
- Formula: V= 0.785(diameter^2)(length)
- Solve:

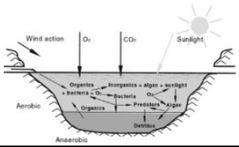


1. 64.97 gallons
2. 3,638 gallons
3. 828 gallons
4. 6,198 gallons

A waste treatment pond serves a population of 7,460 people. If the covers 28.5 acres, what is the population loading (people/acre) on the pond?

- Given:
- Formula: Pop Loading = $\frac{\text{(people)}}{\text{Acre}}$
- Solve:

1. 198 people/acre
2. 488 people/acre
3. 262 people/acre
4. 238 people/acre



The influent BOD into a primary clarifier which holds 860,000 gpd is 205 mg/L. What the lb/day BOD entering the primary clarifier?

[ ]= 225 mg/L, Volume= 860,000 gal = 0.86 MG, lbs=?

Given: Conversion =(860,000 gal)(1MG/1,000,000 gal) = 0.86 MG

ABC Formula:

Solve: Lbs/day= (dosage mg/L)(flow rate MG)(8.34 lb/ 1 gal)

1. 1136 lb/d
2. 1256 lb/d
3. 1470 lb/d
4. 1522 lb/d

Calculate the pounds of BOD per day entering the trickling filter.

Data: Raw wastewater flow = 1.5 MGD
Raw wastewater BOD= 150 mg/1
There is a 30% reduction through primary treatment

A. 560 lb/d
B. 870 lb/d
C. 1313lb/d
D. 1880 lb/d

A settling basin 60ft. by 20ft. and 12ft deep is used to treat a flow of 2.4 mgd. What is the detention time?

DT= $\frac{(60\ ')(20\ ft)(12\ ft)(7.48\ gal/\ cu\ ft)}{2{,}400{,}000\ gpd}$ =

A. 15 minutes
B. 30 minutes
C. 1.1 hours
D. 2.3 hours

A wastewater treatment pond is operated at a depth of 5 ft. The average width of the pond is 440 ft and the average length is 780 ft. If the flow to the pond is 0.2 MGD, what is the detention time in days?

- Given: 5', 440', 780' ,7.48 gal/1 cft, 1MG/1,000,000 g, (0.2 MGD);
- Formula: $DT = \frac{(volume)}{(flow\ rate)}$
- Solve:

1. 31 days
2. 64.2 days
3. 12835680 days
4. 12 days

The settleability test indicates that after 30 minutes, 215 mL of sludge settled in the 1-liter graduated cylinder. If the mixed liquor suspended solids (MLSS) concentration in the aeration tank is 2180 mg/L, what is the sludge volume index?

- Given: 215 ml, 30 min, 2180 mg/L
- Formula: $SVI = \frac{(SSV_{30})(1{,}000\ mg/g)}{MLSS\ (mg/L)}$
- Solve:

1. 0.096%
2. 9.6 %
3. 89.4%
4. 98.6%

Food to Microorganism Ratio

(F/M) ratio

- Measure the ratio of food to microorganisms by weight in the aeration tanks
- The "food" in the ratio is the CBOD entering the process.
- The "microorganisms" are the activated sludge solids in the aeration tanks, which are measured as ppm or mg/L of MLTSS.

A complete-mix activated sludge treatment plant has a seasonal low-flow period with an average daily low into aeration of 1.2 MGD, a CBOD into aeration of 230 mg/L, and aeration volume of 0.25 million gallons, and an MLVSS of 2500 mg/L. What is the current F/M ratio?

F/M = $\frac{lbs/d\ \ BOD}{Lbs\ of\ MLTVSS}$

F/M= $\frac{(1.2\ MGD)(230\ mg/L)(8.34)}{(0.25\ MG)(2500\ mg/L)(8.34)}$

F/M= 2301 ppd/5212 ppd

F/M= 0.44

1. 0.22
2. 0.32
3. 0.44
4. 0.52

A plant ran blowers for 24 hours at 5000 cfm. How many cubic ft of air were required to remove a pound of BOD per day if the system removed 6000 lb of BOD?

Air needed= (5000 ft3/min (1440 Min/ day = 7,200,000 cfd
Air needed= 7,200,000 cfd /6000 lbs in a day= 1200 cf

A. 110
B. 595
C. 660
D. 1200

Three types of sewers are

A. Sanitary, storm, pipes.
B. Sanitary, storm, combined.
C. Sanitary, storm, conventional.
D. Conventional, surface, combined.

The human detection threshold of hydrogen sulfide gas is _____.

☺A. 0.0005 ppm
B. 0.00047 ppm
C. 0.5 ppm
D. 10ppm

Wastewater Treatment ABC Need To Know

Exam Level	I	II	III	IV
Evaluate Wastewater	5%	5%	5%	5%
Monitor Treatment Process	34%	34%	34%	34%
Maintain Equipment	16%	15%	15%	15%
Operate Equipment	17%	16%	16%	16%
Sample Collection	8%	9%	10%	10%
Lab Analysis	5%	7%	9%	9%
Safety and Admin. Duties	15%	14%	11%	11%

7. **It is important to regularly measure and record influent wastewater temperatures because_____**

A. Chemical dosages must be recalculated depending on the temperature
B. Biological processes will slow as the temperature decreases; this may require process adjustments
C. Flow measurement devices are very sensitive to temperature and must be recalibrated for different temperatures
D. Disinfection is no longer needed at temperatures below 10°C (50°F)

NPDES permits for secondary treatment plants typically have average monthly effluent limits for five-day biochemical oxygen demand (BOD5) and total suspended solids (TSS) of:

0 1. 10 and 30 mg/L, respectively
1 b.20 and 30 mg/L, respectively
2 c.30 and 30 mg/L, respectively
3 d.30 and 20 mg/L, respectively

The Federal Clean WaterAct (FCWA, 1972, and later modifications, 1977, 1981, and 1987) established water quality goals for the navigable (surface) waters of the United States. One of the mechanisms for achieving the goals of the Clean Water Act is the National Pollutant Discharge Elimination System(NPDES) of permits, which is administered by the Environmental Protection Agency (EPA).

7.

The Clean Water Act was significantly reorganized and expanded (it was also promulgated=which means put into law) in what year?

A. 1986
B. 1974
C. 1972
D. 1969

Day 2 AM

Breakpoint Chlorination

Breakpoint chlorination: The point at which near complete oxidation of nitrogen compounds are reached . Any point beyond breakpoint is mostly free chlorine (HOCL and OCL^-)

A. Amount of chlorine required

Theory: 7.6 to 15 times the ammonia nitrogen content of the water

Practice: up to 25 times the ammonia nitrogen content

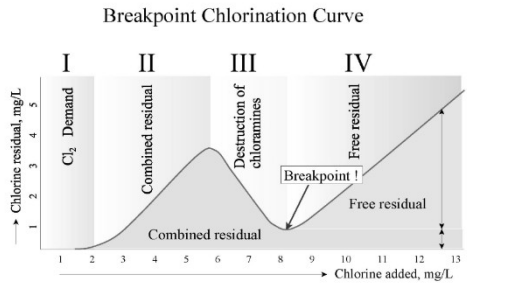
B. Beyond breakpoint

90% free residual chlorine (HOCL and OCL^-)

10% combined chlorine

C. Why must breakpoint chlorination be reached?

- Necessary for the production of free residual chlorine (HOCL and OCL^-)
- Reduces taste and odors
- Reduces chloramines



Breakpoint Chlorination

Zone I: Chlorine is destroyed by reducing agents such as iron, manganese, clay and silt. Chlorine reduced to chloride

Zone II: Chlorine comes into contact with organics and ammonia. Chloroorganics and chloramines are formed.

Zone III: Chloroorganics and chloramines are partially destroyed. Chloramines are broken down and converted to nitrogen gas which leaves the system

Zone IV: Breakpoint. Beyond this point, free available residual is formed. Some chloroorganics still remain as combined residual.

Chlorine demand is difference between applied chlorine and the free chlorine residual at any two points on the breakpoint curve.

The chlorine curve has three locations where a measurable residual can be detected. The strongest, most aggressive form of chlorine is found on the _____ portion of the curve.

1. disinfection-by-product (DBP)
2. chloramine destruction
3. free-chlorine
4. monochloramine buildup

In water disinfection, hypochlorination refers to the use of _____ hypochlorite

1. Sodium
2. Calcium
3. Magnesium
4. Potassium

Chlorine residual may be determined using the reagent:

1. Diethyl-p-phenylene diamine
2. Ethylene diamine tetraacetic acid
3. Polychlorinated biphenyls
4. Sodium thiosulfate

A chlorine demand test will show the:

1. Safe amount of chlorine that may be fed without killing people
2. Number of lbs required to kill 100% of coliforms
3. Amount of chlorine required to give a desired residual after a given time
4. Amount of chlorine required to satisfy the biochemical oxygen demand

Chlorine Disinfection

- pH 7 is ideal
- Warm temp better disinfection 75-80 ^{o}F ideal (cold water longer contact time)
- High turbidity = poor disinfection
- High OM = THM
- High ammonia= loss of disinfection power
- Inorganic (Mn, Fe, H_2S, NH_3, NO_3) reduce chlorines disinfection power

Chlorine Gas Disinfection

- Greenish-yellow 2.5 times heavier then air
- Expansive 2^{o}C to 30^{o}C (84% larger volume)
- Keep chlorinator room between 60-120^{o}F, scrubber system
- A full container is only 85% full
- 150 lb cylinder = 285 lbs full (hand truck)=max rate 40 lbs/day
- 1 Ton cylinder = 3700 lbs= max rate 400 lbs/day
- Ton = 2 valves (top gas, bottom liquid)
- 1 Ton = horizontal on trunnions (All others= vertical)
- Self contained breathing apparatus (SCBA), use ammonia rag (creates white vapor) to detect leak
- Frosting occurs on tank when feed rates are

Chlorine Gas Disinfection

- Gas is extremely corrosive
- Reacts violently with organic substances
- Keep it away from organic chemicals (grease)!
- Protect it from sunlight, moisture and high temps
- Corrosion resistant piping, valves, and metering systems
- Need safety training: Know what you are

Which of the following is not true about chlorine gas?

a. it is 2.5 times heavier than air
b. it is corrosive
c. it is extremely toxic
d. it is flammable

An employee is caught in a room where chlorine gas is leaking. He has no SCBA, he should

a. lay down on the floor and quickly crawl out of the room
b. walk out of the room quickly
c. pull shirt over mouth and face and quickly walk out of the room
d. keep mouth closed, head as high as possible, and quickly walk out of the room holding breath.

Where is the best place to store a self contained breathing apparatus (SCBA)?

a. inside a cabinet in the chlorinator room
b. in an unlocked cabinet outside the chlorinator room
c. locked in a cabinet in the office
d. locked in a cabinet just outside the chlorinator room

What is the maximum amount of chlorine gas that can be removed from a 150-lb. cylinder in 24 hrs?

a. 26 lbs.
b. 40 lbs.
c. 75 lbs.
d. there is no maximum

Feeding Chlorine Gas


- Weigh scale to asses use
- Fusible plug valve (prevents rupture) melts at 157°F (slow leak of chlorine). 1 plug in 150lb, 3plug in 1 ton


- Chlorinator feeds the gas or liquid Cl to the water (pressure relief valve, feed rate indicator, flow regulator, injector/ejector)

The fusible plug on a chlorine cylinder melts at about _____ degrees.

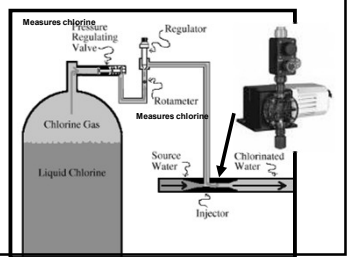
1. 135 - 158
2. 158 - 165
3. 165 - 172

The fusible metal plug on a chlorine cylinder is designed to open at what temperature range:

1. 105 to 112 F
2. 136 to 145 F
3. 157 to 162 F
4. 200 to 212 F

Feeding Chlorine Gas

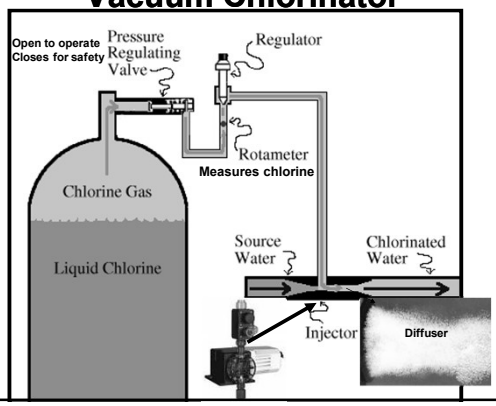
- Injector/ejector uses venturi effect to pump gas into stream
- Diffuser is a pipe that disperses the chlorine



Vacuum Chlorinator

- A vacuum (created by injector/ejector) pulls gas into water
- <u>Pressure Relief Valve (safety and use)-</u> forced open by negative head created with injector
- Rotameter- measures chlorine
- Feed rate indicator is a ball floating in a glass tube (lbs/day). Needle valve or V notch plug controls flow
- Very safe a break in the line closes PRV

Vacuum Chlorinator



A vacuum is formed in the chlorinator by the:

a. chlorine cylinder pressure
b. pressure differential through the ejector
c. chlorine feed pump
d. rotameter

A chlorine injector works by:

1. Creating a vacuum that draws the chlorine out of the cylinder.
2. Pumping liquid chlorine from the bottom of the cylinder into the wastewater
3. Pumping gaseous chlorine from the top of the cylinder into the wastewater
4. Literally squirting chlorine into the wastewater with a little pump

The purpose of a rotameter is to:

a. create a vacuum
b. maintain a smooth fluid flow
c. meter the flow of fluid
d. reduce pressure

Which of the following procedures is done when preparing to disconnect a chlorine cylinder?

a. close the cylinder valve first to allow time for the chlorine to be drawn off
b. loosen the line to the tank and then shut off the valve to the chlorine cylinder
c. shut off the water supply and allow sufficient time for the chlorine to be drawn off
d. turn the chlorinator feed rate valve off then turn the valve on the chlorinator cylinder

A malfunctioning gas chlorination system has normal gas pressure, no feed rate indicated on the rotometer, and no injector vacuum. What is the most likely cause of the problem?

1. Air leak upstream of the rotometer
2. Gas line plugged
3. Injector clogged
4. Pressure reducing valve diaphragm ruptured

When connecting a chlorine cylinder, you should always replace the:?

a. lead or fiber washer
b. pressure regulator
c. fusible metal plug
d. valve seats

Chlorine leaks in metal containers tend to:

a. become larger
b. become smaller
c. remain the same size
d. become encrusted

A chlorine feed room should be:

a. closed with no ventilation
b. open at the top
c. ventilated near the floor
d. ventilated near the ceiling

In detecting chlorine gas leaks from the disinfection assembly, an ammonia soaked rag will produce:

a. a dense white vapor
b. toxic fumes
c. bubbles to form
d. an explosive environment

Which of the following would be the safest action to take in the event of a major chlorine container leak?

1. Call the fire department
2. Notify local police or sheriff
3. Roll the container so that liquid escapes rather than gas.
4. Submerge the container in a basin or stream

What test/parameter is used as an indication of the organic strength of wastewater?

A. BOD (Biochemical Oxygen Demand)
B. B SVI (Sludge Volume Index)
C. pH
D. TSS (Total Suspended Solids)

Which of the following tests is not run on wastewater influent?

A. pH
B. BOD
C. coliform
D. suspended solids

Which of the following <u>treatment process</u> are in the correct order for proper <u>wastewater treatment</u> plant operation?

1. a.influent, screening, grit removal, pre-aeration, aeration basin, secondary clarifier, chlorination, dechlorination, effluent discharge
2. b.aeration, flowmeter, screening, grit removal, secondary clarifier, aeration basin, dechlorination, chlorination
3. c.sedimentation, flowmeter, screening, aeration basin, secondary clarifier, dechlorination, effluent discharge, chlorination
4. d.screening, solids handling, disinfection, chlorination, secondary clarifier, flow measurement

Which of the following <u>secondary treatment process</u> are in the correct order for proper <u>wastewater treatment</u> plant operation?

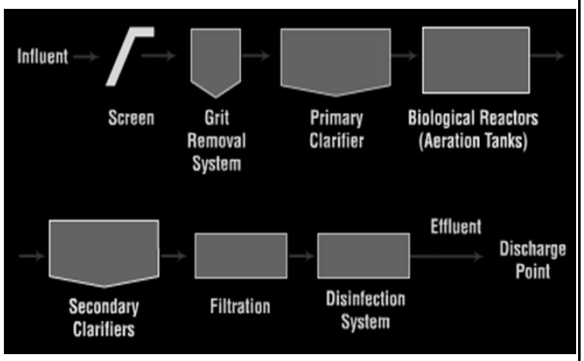
1. grit removal, solids handling, flowmeter, aeration, effluent
2. sedimentation and floatation, biological, chemical, and physical processes, disinfection, effluent
3. disinfection, aeration, solids removal, effluent
4. influent, effleunt, solids handling, disinfection

Wastewater is treated in order to

A. Prevent pollution.
B. Protect public health.
C. Remove harmful wastes from wastewater.
D. All of the above.

POTW is the short version for _____ ?

1. Publicly Owned Treatment Works
2. Private Owned Treatment Works
3. Privatized Owned Treatment Works
4. None of the above



When wastewater being treated is split and a portion flows to one treatment unit while the remainder flows to another similar treatment unit.

A. parallel
B. series
C. unified
D. none of the above

When wastewater being treated flows through one treatment unit and then flows through another similar treatment unit.

A. parallel
B. series
C. unified
D. none of the above

Preliminary Treatment

- **Headworks and Grit**

What functions are performed at the headworks of a WWTP?

1. **sampling**
2. **flow measurement**
3. **chemical addition**
4. **screening**
5. **grit removal**
6. **All of the above**

In a treatment plant, the term "headworks" usually relates to an area that:

1. is a place where the bathrooms are located
2. is where the plant supervisors have their offices
3. is a location where wastewater effluent enters the plant
4. is a location where influent enters the treatment plant
5. is an area located in the shop building where commodes are rebuilt for resale to the general public

Preliminary treatment may include (but not limited to) which of the following unit operations:

1. flow equalization, flow metering, and primary clarification
2. comminution, bar screens, digestion
3. grit chambers, comminution, flowmeter, and sedimentation
4. bar screens, barminutor, grit chamber
5. flow metering, sedimentation, comminution, flow equalization

The primary treatment process in a wastewater treatment plant is normally found:

1. before the preliminary treatment and after secondary
2. after secondary treatment and after preliminary
3. after preliminary treatment and after secondary
4. after preliminary treatment but before secondary
5. parallel to the preliminary/secondary processes

Odors in the preliminary treatment area come from all of the following EXCEPT

A. grit
B. influent wastewater
C. screenings
D. anaerobic digestion gases

The purpose of racks or screens is to remove which of the following?

A. dissolved solids
B. grit particles
C. large solids
D. settleable solids

Place the following screen types in order from smallest to largest

A. trash rack, fine screen, coarse bar screen, fine bar screen, micro-screen
B. micro-screen, fine screen, fine bar screen, coarse bar screen, trash rack
C. micro-screen, coarse bar screen, fine bar screen, drum-screen, fine screen, trash rack
D. micro-screen, drum-screen, bar rack, coarse screen, fine screen

Bar screens are being replaced with rotary drum screens in the head works. What change in activities should be adjusted with the new installation?

A. increase preventative maintenance schedule

B. increase chemical budget for caustic to headworks scrubbers

C. install prechlorination facility to oxidize organics before screening

D. schedule screenings transfer to the landfill more frequently

In addition to the size of the treatment plant, the amount of debris in the wastewater, the quantity of wastewater, what else does routine operation of screens and racks depend on?

A. the head loss across the units

B. the size of the pumps

C. the sensor readings throughout the plant

D. the types of meters throughout the plant

Manually cleaned bar screens should be cleaned frequently to?

A. minimize head loss across the screens and prevent the formation of hydrogen sulfide

B. prevent septic conditions from developing upstream of the screens

C. prevent a shock load from occurring if septic wastes enter the plant after bar screen cleaning

What is the function of a bar screen versus a comminutor?

A. The bar screens trap larger solids for removal, whereas the comminutor shreds large particles into much smaller particles

B. The bar screen removes fine particles equivalent to that of a communitor.

C. A comminutor requires more maintenance than a bar screen

D. There is no difference

Comminution can be described as:

A. shredding

B. sieving

C. screening

D. settling

Large debris (sticks, rocks, 2 by 4s), large floating solids, and fibrous materials (rags, strings, cloth, etc.) are categorized as

A. scum

B. Sludge

C. Grit

D. dissolved solids

E. screenings

A device used to screen wastewater and cut up large solids is a

A. bar cutter
B. comminutor
C. Imhoff emulsifier
D. screen-dicer

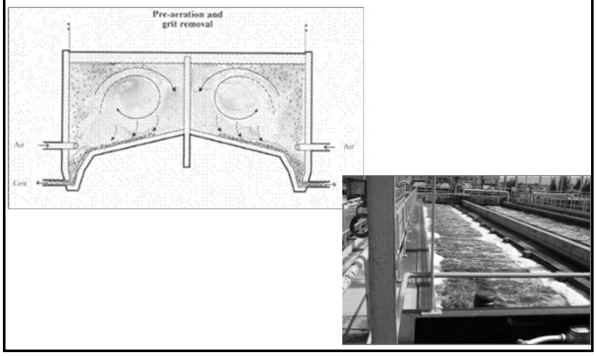
One disadvantage of communitors and grinders is/are?

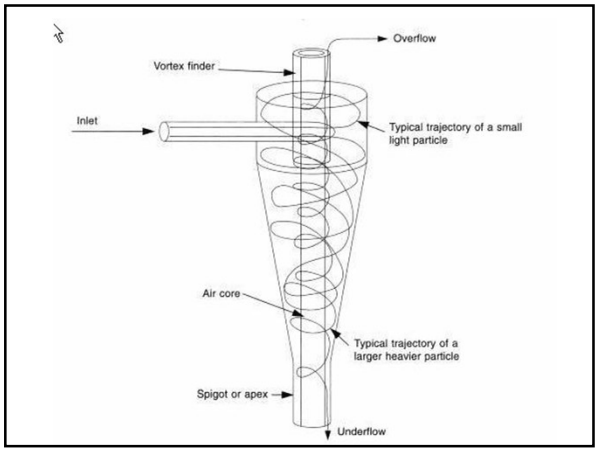
A. Shredded materials reduces treatment capacity downstream
B. Reduced potential for clogged pipes and damaged equipment
C. Increased screenings disposal costs
D. More frequent overflows of the influent channel

Which of the following <u>preliminary treatment</u> process are in the correct order for proper <u>wastewater treatment</u> plant operation?

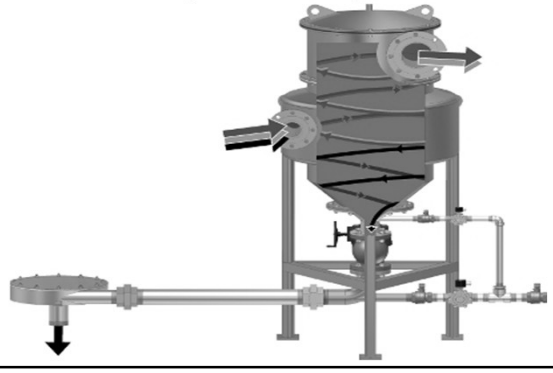
A. influent, screening, grit removal, pre-aeration, sedimentation,
B. aeration, flowmeter, screeingin, grit removal
C. sedimentation, flowmeter, screening, aeration
D. screening, solids handling, disinfection

Aerated Grit Chamber





Grit Cyclone Separator



Grit Basins typically remove sand, gravel, eggshells, and coffee grounds by

A. decreasing water velocity and allowing them to settle
B. placing wire mesh in the flow path as a strainer
C. scooping the surface of the water
D. Introducing microorganisms to consume them

Which of the following is most closely associated with grit?

A. Wood
B. Sand
C. Paper
D. Grease

Various factors must be taken into consideration when selecting a grit removal process?

0 **quantity and characteristics of grit, potential adverse**
1 **effects on downstream processes, head loss**
2 **requirements, space requirements, removal**
3 **efficiency, organic content, and cost.**
4 **All of the above** ☺

Why is adequate ventilation required in a grit-removal chamber?

A. To prevent creating a vacuum.
B. To prevent forming a corrosive atmosphere.
C. To promote aeration for biological activity.
D. To promote heavier grits to settle faster.

Preliminary treatment of wastewater does not include

A. odor control
B. flow measurements
C. grit removal
D. sludge sedimentation

The flow velocity of most grit removal systems is

A. 0.50 ft/sec
B. 1.0 ft/sec
C. 2.5 ft/sec
D. 5.0 ft/sec

The basic components of wastewater grit material consists of such materials as sand, cinders, rocks, coffee grounds, cigarette filter tips, and other relatively nonputrescible organic and inorganic substances

1. True
2. False

1.0 fps is considered ideal for grit removal because it allows organic solids to move downstream for treatment.

1. True
2. False

Hand-cleaned grit chambers are typically used in what size plants?

A. Large plants with flows greater than 11 mgd.
B. Medium-sized plants with flows between 6 and 10 mgd.
C. Small plants with flows generally between 3 and 5 mgd.
D. The smallest plants with flows generally less than 1 mgd.

In an aerated grit chamber, diffused air

A. is used to control odors
B. allows heavier grit particles to settle while keeping the light organic particles is suspension
C. reduces the amount of air needed for activated sludge treatment
D. starts the decomposition of microorganisms

Aerated grit chambers provide a period of wastewater detention to trap grit through air-induced rotation of the wastewater at approximately what speed?

A. 1 ft/s (0.3 m/s).
B. 3 ft/s (0.9 m/s).
C. 5 ft/s (1.5 m/s).
D. 7 ft/s (2.1 m/s).

One of the major purposes of grit removal is

A. odor control
B. solids thickening
C. equipment protection
D. none of the above

10. **Aerated grit chambers are found most often at wastewater plants having**

1. An activated sludge process
2. Rotating biological contactors
3. Anaerobic digestion
4. Trickling filters

9. **During normal flows, grit should be removed from the grit channel**

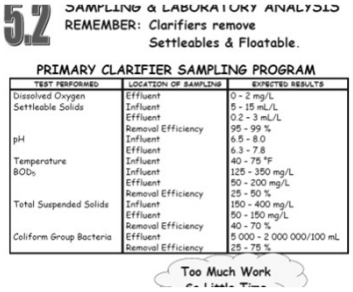
A. Every 6 hours
B. Every 8 hours
C. Every 12 hours
D. On a daily basis

11. **In a cyclone grit separator the water and lighter particles are carried out in the**

A. Apex channel
B. Orifice hole
C. Primary vortex
D. Secondary vortex

Primary Treatment

- Clarification



Which treatment unit is not dependent on bacteria for efficiency?

A. aeration basins
B. oxidation ditches
C. polishing ponds
D. primary clarifiers

Primary treatment units remove settleable solids from the wastewater stream through

A. biological treatment
B. chemical addition
C. biofiltration
D. gravity sedimentation

The efficient operation of a primary clarifier depends on the:

A. proper design of the clarifier
B. condition of the wastewater that is fed
C. characteristics of the wastewater
D. operating care given by the operator
E. All of these answers are correct

In most municipal treatment plants the treatment that immediately follows the grit channel is called _____?

A. settling tank
B. sedimentation tank
C. sedimentation and floatation unit
D. clarifier
E. All of the above

Primary sedimentation does not include

A. separation of readily settleable solids
B. separation of floatable solids.
C. equalization of sidestream flows
D. removal of soluble biochemical oxygen demand

If a short-circuiting event occurs in a clarifier, the operator should do which of the following first:

A. check the wiring to the scraper drive
B. identify the probable cause and recommend corrections
C. change clarifier fuses at the Hands-On-Automatic (HOA) controller
D. increase the rate of sludge removal from the clarifier sludge sump area
E. restart the pump under manual control and start the motor to the chain and flight mechanisms

The effluent weirs within clarifiers should be level in order to reduce the possibility of:

A. clogging of the V-notch effluent weirs
B. corrosion of the metal weir materials of construction
C. creating a breeding area for vectors like flies and mosquitoes
D. uneven overflow from the tanks and the possibility of short-circuiting

Saw-toothed (V-Notch) weirs are used on uncovered circular clarifiers to:

A. catch floating material
B. save overall costs by cutting down on the amount of metal or fiberglass used
C. break up the surface scum such that it can be drawn off the tanks efficiently
D. provide for better flow distribution out of the clarifier
E. maintain the cleansing action of the saw-tooth shape by creating a weir scour velocity of 2 feet per second

Which of the following are correct about settleable solids removal effeciences of a primary clarifier?

A. 10-15% of the settleable solids
B. 20-25% of the settleable solids
C. 50-55% of the settleable solids
D. 90-99% of the settleable solids

Typically, primary treatment removes __percent of influent suspended solids.

A. 10% to 15%
B. 20% to 50%
C. 40% to 60%
D. 50% to75%

Typically, primary treatment has a BOD removal efficiency in the range of _____.

A. 10% to 15%
B. 20% to 50%
C. 40% to 60%
D. 50% to75%

What is the purpose of primary treatment?

A. to remove screening materials and measure flow
B. to removal all solid organic material before aeration
C. to capture floatable materials (scum) and reduce some of the biodegradable load (and remove settable solids) before they reach the aeration chamber/basin. This lowers the biological load entering the secondary system
D. to remove colloidal, suspended, and setteable solids
E. to remove screening materials and grit

Sludge from a clarifier should be drawn off:

A. once a week, approximately
B. typically in the morning during heavy flows, otherwise not important
C. during the weekdays only, when the operators are at work
D. on a regular and frequent basis
E. when the rising sludge becomes noticeable inside the clarifier

In drawing sludge from a primary clarifier, the best practice is to draw:

A. small quantities of sludge, many times daily
B. a large quantity of sludge at least once each day
C. only as often as is necessary to reduce flotation, usually twice weekly
D. sludge removal is done frequently during the night so as not to interfere with the daily waste-water treatment
E. the sludge when the blanket surface approaches the surface of the water in the clarifier.

Scum collecting on the surface of a primary clarifier:

A. will not cause trouble and need not be looked after or attended to

B. must be removed by skimming or it could present trouble in the secondary treatment process

C. may be disposed of by stirring with a surfactant chemical

D. is caused only by certain commercial establishments or industries that create inorganic wastes volumes that tend to surface in the primary clarifier

The principal reason for frequent or continuous removal of sludge from the primary clarifier would be to:

A. keep sludge wasting to the digester such that the digesters will remain constantly fed and full at all times

B. avoid possible anaerobic decomposition in the clarifier

C. maintain a constantly thin concentration of solids inside the sludge lines

D. avoid sludge withdraw with low solids concentration

Assume that the raw wastewater entering the primary clarifier contains 0.8 mg/L DO. As the wastewater passes through the primary clarifier, the DO will typically:

A. stay the same

B. increase

C. decrease

D. be removed by the sludge pump

E. pass on through to secondary treatment for removal

Each Clarifier/tank will be sized, as a maximum, for _____ percent of the plant design flow (facility designs will normally include two tanks)?

1. 27 %
2. 37 %
3. 67 %
4. 77 %

Which of the following is NOT a typical component of a circular clarifier?

A. chains and flights
B. skimmer arm
C. influent center well
D. scum trough

Advantages of rectangular clarifiers over circular clarifiers

1. **Occupy less space when multiple units used**
2. **Provide longer travel distance for settling to occur**
3. **Less short circuiting**
4. **All of the above**

Disadvantages of rectangular clarifiers over circular clarifiers

1. Possible dead corners
2. Sensitive to flow surges
3. Restricted in width by collecting equipment
4. Higher maintenance costs of sprocket, chains & flights
5. All of the above

The "clarified" liquid then flows from the primary clarifier to further treatment called secondary or biological treatment. Approximately _____% of the solids contained in the raw wastewater are removed in the primary clarifiers.

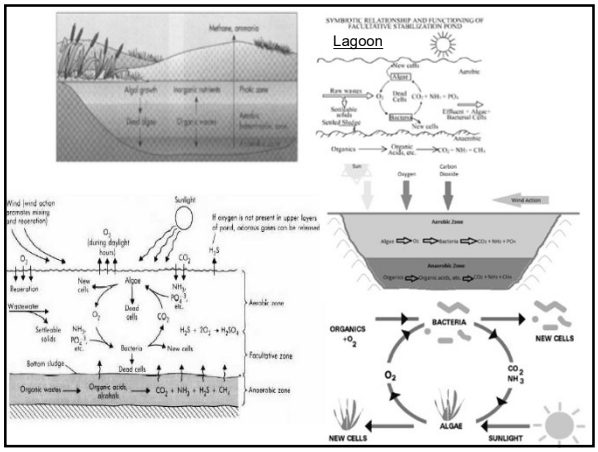
1. 10 - 20 %
2. 30 - 40 %
3. 50 - 60 %
4. 90 - 100 %

Secondary Treatment

- Activated Sludge,
- Rotating Biological Contactors
- Trickling Filters
- Lagoons

For every pound of organic matter oxidized by bacteria in a secondary treatment process, approximately how many pounds of bacterial (secondary) solids are produced?

A. 0.1 to 0.6 pounds
B. 0.3 to 0.7 pounds
C. 0.4 to 0.8 pounds
D. 0.1 to 0.4 pounds



Most dissolved oxygen in a facultative stabilization lagoon comes from _____.

A. algae photosynthesis
B. addition of sodium nitrate
C. nitrification
D. breakdown of organic matter

Floating solids in the primary cell of a facultative lagoon system may mean:

A. Septic conditions from overloading
B. The lagoon is operating normally
C. It is hydraulically under loaded
D. Poor dike maintenance

For waste stabilization ponds, the minimum water depth should not be lowered to less than?

A. 1 foot
B. 3 feet
C. 4 feet
D. 5 feet

The color of a good, active primary pond is?

A. black
B. clear
C. green
D. gray

Operating a pond with a detention time of 3 days would provide treatment comparable to

A. primary sedimentation
B. trickling filtration
C. activated sludge
D. sand filtration

The activated sludge process removes soluble biochemical oxygen demand (BOD) from wastewater by

A. coagulation
B. absorption
C. adsorption

The ratio of organic loading to the mass of microorganisms in an aeration basin is the _____.

A. MLSS
B. F:M
C. C:N:P
D. SVI

The operational food-to-microorganism ratio for conventional activated sludge is

A. 0.2 to 0.4
B. 0.2 to 0.6
C. 0.1 to 0.25
D. 0.5 to 0.15

Rotifers are single celled protozoa.

A. True
B. False

Wastewater microbiology

Which of the following is not a member of the total coliform bacteria group?

A. Escherichia
B. Enterobacterc.
C. Streptococcus
D. Klebsiella
E. Citrobacter

Which of these protozoan species is most often associated with a stable activated process and high-quality effluent?

A. flagellates
B. stalked ciliates
C. amoebae

What magnification power setting is recommended for viewing the microscopic properties of an activated sludge sample?

A. 50X
B. 100X
C. 150X
D. 200X
E. 250X

An operator examines mixed liquor through a microscope and sees red worms.
These worms mean that the mixed liquor

A. contains young sludge
B. is just right
C. contains old sludge

An operator examines mixed liquor through a microscope and sees dispersed floc with very little to no filamentous microorganisms. The operator can conclude that

A. The activated sludge is operating properly
B. The sludge volume index (SVI) is probably low and settling characteristics are good
C. The aeration tanks may be organically overloaded and corrective action is required
D. A decrease in the return activated sludge rate is needed.

In a conventional activated sludge plant, oxygen demand is highest:

A. at the head end of the tank
B. in the middle of the tank
C. at the outlet of the tank
D. nowhere - oxygen demand is uniform throughout the tank

As the size of the activated sludge floc particles increases, what relative levels of oxygen are needed to prevent filamentous organisms?

A. higher than current level of dissolved oxygen (DO)
B. oxygen levels do not need adjusting
C. oxygen levels do not apply to floc particle increases

The organic strength of wastewater is best determined by the concentration of

A. biochemical oxygen demand
B. chemical oxygen demand
C. dissolved solids
D. turbidity

During plant rounds, an operator notices that the secondary effluent is cloudy. The operator should

A. take no action because everything is fine
B. reduce the chlorine feed rate
C. remove some primary tanks from service
D. check the dissolved oxygen level in the aeration tank

In addition to high energy costs, excess DO levels can cause

A. damage to floc particles due to turbulence
B. in the effluent excess ammonia nitrogen
C. filamentous growth in activated sludge
D. solids to float in the aeration tank

Under which of the following conditions should you consider increasing the wasting rate?

A. white, billowing foam on the aeration tank
B. sludge volume index (SVI) of 175 and no filaments
C. the sludge is dark brown with settled volume of 650 mL
D. none of the above

In an anoxic activated sludge process, oxygen for facultative bacteria is provided by nitrate nitrogen.

a. True
b. False

The two bacteria primarily associated with nitrification are Nitrosomonas and ____?

A. Nitrofer
B. Nitrothiothrix
C. Nocardia
D. Nitrobacter

Which two compounds are formed during nitrification?

A. oxygen and hydrogen
B. nitrate and nitrite
C. nitrogen gas and nitrite
D. nitrogen and phosphorus itrite

Nitrogen and _____ are common nutrients essential for microbial growth.

A. chlorine
B. phosphorus
C. sulfur
D. boron

Denitrification with rising solids or filamentous bacterial bulking can adversely affect the performance of a gravity thickener

A. True
B. False

Which of the following is NOT a nutrient found in wastewater?

A. nitrate
B. orthophosphate
C. hydrogen sulfide
D. Nitrite
E. ammonia

The lower regions of a trickling filter are normally anaerobic because of reduced air circulation

A. True
B. False

A condition occurring on trickling filters when the hollow spaces (voids) become plugged to the extent that water passage down through the filter is inadequate. _____ may be the result of excessive slime growths, surface trash build-up, or media breakdown.

A. plugging
B. ponding
C. clogging
D. capping

A sample for volatile solids analysis is ignited in a muffle furnace at a temperature of _ ___degrees C.

A. 650
B. 550
C. 750
D. 350

A properly designed and operated gravity thickener should have an overflow total suspended solids (TSS) concentration of less than 500 mg/L.

A. True
B. False

The ideal temperature range for a mesophilic anaerobic digester is _____ .

A. 34 degrees to 36 degrees C
B. 24 degrees to 26 degrees C
C. 44 degrees to 56 degrees C

The ratio in a well-operated digester ranges between 0.1 and 0.35. If the ratio exceeds 0.35, it indicates such issues as increased organic loading, hydraulic overloading, etc. Mesophilic digestion Mesophilic organisms grow optimally in a temperature range of approximately 30°C to 38°C (85°F to 100°F).

In a properly functioning anaerobic digester, the off-gas ratio should be approximately 30% methane and 70% carbon dioxide

A. True
B. False

Digester gas contains approximately 65% methane and 35% carbon dioxide.

Which of the following types of solids is most easily thickened in a dissolved air flotation thickener?

A. primary solids
B. secondary waste activated sludge
C. lime solids
D. solids cake

Class B biosolids are considered lime stabilized when the pH is raised to _____ for at least _____ hours.

A. 15, one
B. 12, two
C. 13, three

Solids conditioning methods to improve dewaterability include which of the following?

A. chemical treatment
B. thermal treatment
C. wet oxidation
D. elutriation
E. all of them

Wastewater solids which have been decomposed to relatively inert solids are called ____.

A. organic
B. septic
C. stable
D. fresh

Secondary sludge is more suitable for gravity thickening than primary sludge primarily because of its

A. temperature
B. age
C. bound water

The term FOG in wastewater B flow overflow guard means

A. fats, oils, and grease
B. flow overflow guard
C. free oxygen generation
D. federal operator guidelines

What is the most important factor when conditioning solids for dewatering?

A. particle size
B. sludge temperature
C. filamentous bacteria
D. nitrification

Older sludges generally require _____ polymer for coagulation and flocculation.

A. less
B. the same amount of
C. no
D. m o r e

What parameters are needed to determine organic loading?

A. Flow, MLSS
B. Flow, BOD
C. BOD, COD
D. Flow, COD

Wastewater originating from households is described as ____.

A. institutional
B. sanitary
C. domestic
D. commercial

Mechanical aeration provide aeration and _____.

A. toxics removal
B. increased storage capacity
C. sludge removal
D. mixing

The activated sludge process consists of aeration tanks and _____.

A. secondary clarifiers
B. screens
C. digesters
D. primary clarifiers

Sludge digestion is used to ___.

A. remove excess solids
B. reduce volatile solids and pathogens
C. remove excess BOD
D. disinfect sludge solids

If you noticed that raw wastewater had developed a blackish color with an unpleasant sour odor and by testing you found the pH was down from a normal 7.2 to a pH value of 6.1, this would indicate

1. High infiltration.
2. High oxygen content.
3. Anaerobic decomposition (septic wastewater).
4. Possible discharge of acid waste into the sewer system.

Two examples of fixed-film reactors are _____.

Trickling filters

A. aeration basins and clarifiers
B. screens and grit removal systems
C. aerobic and anaerobic digesters
D. trickling filters and RBCs

Trickling filters and rotating biological contractors (RBCs) are fixed film process. What is a fixed film?

A. A thin sheet of plastic covering the biological treatment system to protect it from algal growth.
B. A viscous jellylike slime with living organisms such as bacteria, protozoa, algae, and fungi
C. A viscous film made up of algae only.
D. A jellylike film made up of glucose, organic polymers, and worms.
E. All of the above

The primary difference between a RBC and a trickling filter is that the RBC

A. is a biological process
B. is covered with biomass
C. is a fixed film reactor
D. rotates through the wastewater

What is another name of a filter fly?

A. Psychoda

B. Flycopod

C. Bugocytis

D. Flycopodis

Collections and Treatment Overlap

Most Common Questions (varies)??

- **Mathematics, Equipment, Safety, Pumps, Rules and Regulations, Biological Lab Testing, Chemistry, Disinfection**

Day 2-pm Math

Agenda

Fri 15, 2023		Friday, Dec 15, 2023	
8:00-9:00 am	Mathematical wastewater conversions	2:45 -3:00 pm	Break
9:00-9:45am	ABC Need To Know Criteria: Wastewater collection system operations and cleaning	3:00-4: 00 pm	ABC Need To Know Criteria: Wastewater collection system operations and cleaning
9:45-10am	Break	4:00-5:00 pm	ABC Need To Know Criteria: Wastewater treatment plant analytical procedures.. Award Certificates
10:00-11:00 am	ABC Need To Know Criteria: Wastewater collection system maintenance		
11:00-12:00 pm	ABC Need To Know Criteria: Wastewater treatment plant maintenance		
12:00-1:00 pm	Lunch Break		
1:00 – 2:45	Mathematical Applications for Wastewater and Collections. ABC Need To Know Criteria: Wastewater treatment plant operations and solids handling		

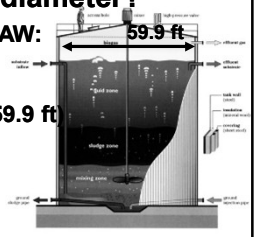
A solution was found to be 2.3% alum. How many milligrams per liter of alum are in the solution?

1. **23,000 mg/L**
2. **2.3 mg/L**
3. **230,000 mg/L**
4. **I don't know**

ABC Level I

What is the area (ft^2) of an digester that is 59.9 ft in diameter?

DRAW:



- **Given:** D= 59.9 ft, A= ?
- **Formula:** A= 0.785 (D)(D)
- **Solve:** A=(0.785)(59.9 ft)(59.9 ft)
  A= 0.785 (D)(D)

1. **92.63 ft^2**
2. **121 ft^2**
3. **1,987 ft^2**
4. **2,820 ft^2**

Anaerobic Digester

Thermophilic Aerobic Digester

Digester Operation

If a pump will fill a aeration tank in 23 hours at 6 gpm, how long will it take a 15 gpm pump to fill the same tank?

1. 9.2 hrs
2. 2.16 hrs
3. 2.5 hrs
4. 32.5 hrs

.....hrs....	=	.....gpm....
smaller value / larger value	=	smaller value / larger value
X hrs / 23 Hrs	=	6 gpm / 15 gpm

If a pump discharges 20,350 g, in 3 hr and 45 minutes, how many gallons per minute is the pump discharging?

Locate Formula on ABC Sheet

#gal=?,Convert 3 hr=180 min+45 min=225 min

Rate=20,350 gallons

GPM(rate)= (gallons) / (minutes)

1. 46 gpm
2. 90.4 gpm
3. 3000 gpm
4. 155 gpm

A total of 52 gallons of screenings are removed from the wastewater flow during a 24-hr period. What is the screenings removal reported as cu ft./day?

Screening Removal= (volume) / Time of removal

1. 389 cubic feet/day
2. 6.95 cubic feet/day
3. 2.16 cubic feet/day
4. 52 cubic feet/day

An average of 2.25 cu ft of screenings is added to a screening pit each day. If the pit is 6.0 ft by 10 ft and 4.2 ft deep, how many days will it take to fill the pit?

Number of days = pit volume cu ft / Screenings removed cu ft/day

Number of days = pit volume cu ft / Screenings removed cu ft/day

•Number of days = pit volume cu ft / Screenings removed cu ft/day

1. 34 days
2. 79 days
3. 112 day
4. 68 days

The BOD entering a waste treatment pond is 200 mg/L. If the BOD in the pond effluent is 5 mg/L. What is the BOD removal efficiency?

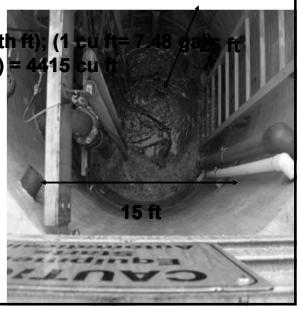
- Given: BOD= 200 mg/L= In ; BOD= 5 mg/L Out
- ABC Formula: Efficiency = Removal, % = (In – Out) / (In) X 100%
- Solve:

1. 92%
2. 88%
3. 2.5 %
4. 97.5 %

A circular wet well has a diameter of 15 ft, and a depth of 25 ft. What is the million gallon capacity of the wet well?

V gal = 0.785 (D)(D)(depth ft); (1 cu ft= 7.48 gal); 25 ft

V= 0.785 (15 ft)(15 ft)(25 ft) = 4415 cu ft



1. 4415 MG
2. 33,028 MG
3. 0.029 MG
4. 0.033 MG

What is the flowrate in cfs in a full 1 foot diameter pipe line with a 4 ft/s velocity?

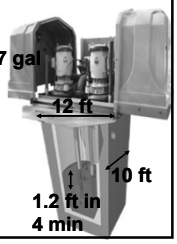
Given: V= 4 ft/s; Q= ___ CFS, D= 1 ft
Formula: $A = 0.785 (Diameter)^2$; $Q = VA$
Solve:

1. 4.0 cfs
2. 2.5 cfs
3. 452 cfs
4. 3.14 cfs

A rectangular wet well is 12 ft long, 10 ft wide. With no influent to the well, a pump lowers the water level 1.2 ft during a four minute pumping test. What is the gpm flow rate? Handy Dandy #52

Pumping Rate = $\frac{\text{(length ft) (width ft) (Well level ft) (7.48 gal)}}{\text{Duration of test}}$

PR= (12 ft)(10 ft)(1.2 ft) = 144 cu ft
144 cu ft (7.48 gal / 1 cu ft) = 1077 gal



1. 240 gpm
2. 269 gpm
3. 144 gpm
4. 1077 gpm

You are asked to determine the Food-to-Micro-organism (F/M) ratio for an activated sludge facility with an average plant flowrate of 2 MGD, primary effluent BOD concentration of 120 mg/L, primary effluent TSS concentration of 100 mg/L, a MLTSS concentration from the aeration basin of 2 400 mg/L of which 80% is volatile. There are four aeration basins on-line arranged in parallel. Each basin measures 80 feet long, 20 feet wide, and 10 feet 5 inches deep.

- Given:
- Formula: $F/M = \frac{\text{lbs/d BOD}}{\text{Lbs of MLTVSS}}$
- Solve:

1. 0.10
2. 0.25
3. 0.55
4. 0.75

Actual velocities in sewers may be measured by

A. Time of travel using dye.
B. Time of travel using a float.
C. Time of travel using a tracer.
D. All of the above.

When measuring flow velocities between manholes using a floating object in a sewer flowing half full, the velocity of that float will be

1. The average velocity of the wastewater.
2. 10-15% slower than the average velocity of the wastewater.
3. 10-15% faster than the average velocity of the wastewater.
4. 50% of the average velocity of the wastewater.

The main reason for conducting a dye test instead of a smoke test is because

1. It is less expensive than smoke.
2. The service connection could have a dip in it or the trap may be full of water.
3. It takes less time to do the test.
4. None of the above.

A fluorescent dye is used to estimate the velocity in a sewer. The dye is injected into the water at one manhole and the travel distance to the next manhole is 500 ft. The dye appears at the downstream manhole in 195 seconds. The dye continues to be visible until the total elapsed time is 221 seconds. What is the ft/sec velocity of flow in the sewer pipe?

- Given:
- Formula: V=Distance/Time,
- Solve: Page 39 Chapter 3, Time=(T1+T2) / 2 Where (

1. 0.83 fps
2. 1.6 fps
3. 2.4 fps
4. 2.98 fps

If 121 mg/L suspended solids are removed by a trickling filter, how many lbs/day suspended solids are removed when the flow is 3,178,000 gpd, ABC #35?

- Given:
- Formula: ppd = (conc)(8.34)(MGD)
- Solve:

1. 2175 ppd
2. 2876 ppd
3. 3207 ppd
4. 3477 ppd

The total influent flow (including recirculation) to a SR trickling filter is 1.4 MGD. If the trickling filter is 90 ft in diameter, what is the hydraulic loading rate in gpd/sq ft on the trickling filter (ABC #33)? Under/Overloaded?

- Given: D= 90 ft, Flow rate; 1,400,000 gpd
- Formula: HLR= gpd/ sq ft
- Solve:

1. 220 gpd/ sq ft
2. 256 gpd/ sq ft
3. 270 gpd/ sq ft
4. 298 gpd/ sq ft

A trickling filter is 70 ft in diameter, with a media depth of 6 ft, it receives a flow of 800,000 gpd. If the BOD concentration of the primary effluent is 185 mg/L, what is the organic loading rate on the trickling filter in lbs BOD/1000 cu ft (ABC #42)?

- Given: D= 70 ft; 6 ft, Flow rate; 800,000 gpd or 0.8 MG
- Formula: OLR= BOD/day / 1000 cu ft
- Solve:

1. 53 ppd/ 1000 cu ft
2. 60 ppd/ 1000 cu ft
3. 64 ppd/ 1000 cu ft
4. 68 ppd/ 1000 cu ft

An activated sludge system has a total of 26,000 lbs of mixed liquor suspended solids. The suspended solids leaving the final clarifier in the effluent is calculated to be 390 lbs/day. The pounds suspended solids wasted from the final clarifier is 2860 lbs/day. What is the solids retention time (Mean cell residence time) in days?

- Given:
- Formula: MCRT = lbs MLSS / Lbs/d SS + clarifier solids removed ppd
- Solve:

1. 6.8 days
2. 7.8 days
3. 8.0 days
4. 9.8 days

The suspended solids concentration entering a trickling filter is 146 mg/L. If the suspended solids concentration in the trickling filter effluent is 46 mg/l, what is the suspended solids removal efficiency of the trickling filter ABC #51?

- Given:
- Formula: Removal Eff = (In-OUT) / IN X 100
- Solve:

1. 52%
2. 58%
3. 62 %
4. 68.5%

Collections and Treatment Overlap

Most Common Questions (varies)??

- **Mathematics, Equipment, Safety, Pumps, Rules and Regulations, Biological Lab Testing, Chemistry, Disinfection**

To control hydrogen sulfide and odors in a 12 in. (300 mm) diameter sewer, the chlorine dosage must be 10 mg/L. When the flow is 0.37 mgd (1400 M^3 /d), the feed rate is

1. **15.4 lb/day (7.0 kg/d)**
2. **30.8 lb/day (14 kg/d)**
3. **154 lb/day (70 kg/d)**
4. **308 lb/day (140 kg/d)**

Closed circuit television units with video tape can help to evaluate the condition of a wastewater collection system by

1. **Providing live inspection during use.**
2. **Giving the exact location of a problem.**
3. **Studying the effectiveness of a cleaning technique.**
4. **All of the above.**

Some of the causes of physical injuries in manholes include

1. **Slips and falls.**
2. **Failure to use proper lock out/tag out procedures.**
3. **Infection and disease.**
4. **All of the above.**

Some ways to determine if a certain house is connected to a sanitary sewer include using

1. **Dye testing.**
2. **Smoke tests.**
3. **Closed circuit television inspection.**
4. **Both a. and b.**

What is the main intent of the OSHA regulations?

A. **Create a safe work environment**
B. **Identify hazards in the workplace**
C. **Protect the public from hazardous chemicals**
D. **Train operators in safe procedures**

426

The most hazardous condition associated with storage areas, slurry tanks , or other confined spaces where wet activated carbon is present is?

A. Combustion
B. Depletion of oxygen
C. Fire
D. Oxidation

427

Operators working in confined spaces should wear?

A. Bright orange jackets, rubber boots , and gloves
B. Safety harnesses and hard hats
C. Tool belts with flash lights attached
D. Utility belts with full complement of tools and accessories

428

After testing all toxic gasses, explosive, and oxygen levels how long are you supposed to run the ventilation system (with the hose at the bottom) before entering?

A. 2 minutes
B. 8 minutes
C. 10-15 minutes
D. 30 minutes

429

What is the typical cubic feet per minute (CFM) for a fan blower used before confined space entry?

A. 450
B. 500
C. 750-850
D. 1000

430

When used to ventilate a manhole, a portable blower should be at least ____ feet away.

A. 1.0
B. 3.0
C. 4.0
D. 7.0

The most effective means of reducing atmospheric hazards in a confined space is through the use of?

A. Vents
B. Explosive meters
C. Portable blowers
D. Mice

432

When a confined space must be entered, the minimum number of workers on the job should be?

A. One
B. Four
C. Three
D. Three and a supervisor

433

Which of the following is not considered a confined space?

A. Manhole
B. Anaerobic digester
C. Lift station wet well
D. Operator control room

434

What are the two most important safety concerns when entering a confined space? ?

A. Corrosive chemicals and falls
B. Bad odors and claustrophobia
C. Extreme air temperatures and slippery surfaces
D. Oxygen deficiency and hazardous gases

435

What piece of safety equipment must an operator wear when entering a confined space?

A. Boots
B. Harness
C. Gloves
D. Goggles

436

Which respiratory protection devices are not acceptable for use in a confined space (2 answers)?

A. canister gas mask
B. supplied-air hose mask
C. self-contained breathing apparatus
D. five-minute air escape pack
E. paper filter mask

Operators should get out of the manhole as soon as:

A. the flow increases
B. H_2S exceeds 5 ppm
C. The lower explosive limit activates
D. None of the above

Which of the following does not define a confined space?

A. It is large enough and so configured that a person can bodily enter it.
B. It is not designed for continuous occupancy.
C. It does not provide sufficient natural light.
D. It has limited or restricted means for entry.

439

In confined space entry, LFL stands for

A. Lower flammability limit
B. Low floor level
C. Lighting factor limitations
D. Lifeline/flotation locations

440

Oxygen deficiency becomes a concern when the oxygen level in a confined space is less than

A. 19.5%
B. 22.5%
C. 25.5%
D. 28.5%

441

Which of the following is a major hazard of entering a manhole?

A. Toxic exposure.
B. Physical injuries.
C. Psychological trauma.
D. Infection and disease.
E. All of the above.

442

What factors should be considered when providing trench shoring?

A. Length of trench
B. Depth of trench
C. Structures or sources of vibration near trenches
D. Type of soil
E. All of the above

443

OSHA requires that a protective system be used in trenches _____ feet or deeper.

A. 1
B. 2
C. 3
D. 4
E. 5

444

An engineer must approve any trench shoring design above

A proper protective system is required to ensure that the walls of the excavation do not cave in. Shoring is a complete framework designed to support the trench walls. Shielding is the placement of a 2-sided, braced steel box in the trench. Operators using a shielding must always work within the walls of the shield. Sloping/benching is the practice of removing the trench wall at a designated slope. Soil removed from a trench should be placed a minimum of 2 feet from the trench and should only be placed on one side of the trench

A. 2 deep
B. A water line
C. 20 feet in length
D. 50 feet in length
E. 20 feet deep

Shoring must protude _____ above the top of the excavation.

A. 3 feet
B. 24 inches
C. 1 ft
D. 18 inches

446

In a trench deep enough to require a ladder(s), the worker must not be required to travel more than _____ to get to the ladder

A. 3 steps
B. 10 feet
C. 25 feet
D. 15 feet

A means of egress, such as a ramp or ladder, must be placed so that no more than 25 feet of travel is required in trenches that are more than 4 feet deep.

447

An occupied trench excavation that is 4 feet or deeper must have exits (ladders) at intervals of _ feet.

A. 5
B. 18
C. 25
D. 50

What is the best "tool" for ensuring safe working conditions in a confined space?

A. Hammer
B. Screw Driver
C. A confined space entry permit

One of the reasons that air should be excluded from anaerobic digesters is because

A. Gas storage capacity is reduced
B. The entrance of air mixed with gas produced in the digester could create an explosive mixture
C. It interferes with action of the aerobic bacteria
D. Harmful bacteria may be brought in with the air
E. It lowers the temperature of the digester

Hydrogen sulfide has a specific gravity of _____.

A. 0.5
B. 1.0
C. 1.2
D. 2.5

Carbon dioxide is one of the gases given off by the decomposition of sludge. It is not poisonous, but it may cause ?

A. Combustion.
B. Corrosion.
C. Burns.
D. Asphyxiation.
E. None of the above.

452

What is the usual alarm set point for methane?

A. 1percent of the lower explosive limit
B. 10 percent of the lower explosive limit
C. 25 percent of the Upper explosive limit
D. 50 percent of the lower explosive limit

453

What concentration of hydrogen sulfide deadens the sense of smell in 3 to 15 minutes?

A. 1 ppm.
B. 5 ppm.
C. 10 ppm.
D. 20 ppm.

454

Where is the most sulfide in a sewer produced?

A. In flowing wastewater with dissolved oxygen less than 1.0 mg/L.
B. In the biological slime layer on the sewer wall submerged in wastewater with dissolved oxygen less than 0.1 mg/L.
C. On the moist pipe wall above the wastewater.
D. Inside lateral connections.

455

Anyone of the following may be present in a manhole or similar structure. Which is the most toxic to man when inhaled?

A. Carbon dioxide.
B. Nitrogen.
C. Hydrogen sulfide.
D. Methane.

456

Which of the following is true about gas test kit calibrations/set points?

A. More than 10 mg/L hydrogen sulfide
B. More than 10% of the Lower Explosive Limit (LEL)
C. Less than 19.5 % or more than 23.5% Oxygen content
D. All of the above

457

What is the most toxic gas encountered in manholes?

A. Carbon monoxide
B. Hydrogen sulfide
C. Methane
D. Natural gas

458

The part(s) of a pipe that is most vulnerable to corrosion from septic wastewater in a gravity collection system is/are the

1. Bell.
2. Crown.
3. Flange and bolts.
4. Invert.

Hydrogen sulfide may cause the following conditions

1. Rotten egg odor.
2. Excessive pH values.
3. Corrosion of sewers, structures, and equipment.
4. Both a. and c.

What is the usual alarm set point for Hydrogen Sulfide (mg/L)?

A. 1
B. 10
C. 25
D. 50

461

The dangerous gases most likely encountered in the wastewater industry are ?

A. Oxygen, hydrogen, and ozone.
B. Carbon monoxide, methane, and hydrogen sulfide.
C. Flourine, bromine, and iodine.
D. Freon, nitrogen, and cyanide.

462

The presence of hydrogen sulfide in a collection system is usually caused by the

1. Bacterial oxidation of sulfur in the presence dissolved oxygen
2. Bacterial reduction of methane in the absen of dissolved oxygen
3. Bacterial reduction of methane in the presence of dissolved oxygen
4. Bacterial reduction of sulfate compounds in the absence of dissolved oxygen

463

Which of the following is not part of a traffic control zone?

A. Termination area.
B. An advance warning area.
C. An emergency pull-off.
D. A transition area.

464

Biological activity in long, sluggish-flow, flat-grade sewer lines will likely

A. Decrease line sediment
B. Create oxygen deficiency in the air in manholes, sewers, or wet wells
C. Stop toxic gas production
D. Increase the "carrying capacity" of the line

465

Preparing for a public open house, what following in-plant arrangements must be made?

A. A printed handout is available and up-to-date
B. Adequate coffee cups and ash trays are available
C. All pump casings are repainted
D. Visitor safety is ensured

466

Hearing protection must be made available to all employees exposed to noise levels above:

A. 85db; average over 8 working hrs
B. 850db; average over 8 working hrs
C. 85db; continously for 8 working hrs
D. 85db at any point in the 8hr work day

467

Which type of fire extinguisher should be used on a burning electric motor?

Type C fire extinguishers uses carbon dioxide to smother a fire. Types A and B use water and foam, respectively, which could conduct electricity.

A. Type A.
B. Type B.
C. Type C.
D. Any of the above.

468

Class "C" extinguishers are used for ____.

A. wood fires
B. gas fires
C. electrical fires
D. metal fires

Which of the following abbreviations stands for a document that provides a profile of hazardous substances or mixtures?

A. CERCLA
B. OSHA
C. CFR
D. MSDS

Which of the following causes the greatest increase in chlorine demand?

A. increase in organic matter
B. alkalinity increase
C. pH increase
D. phosphate concentration increase

Chlorine gas is _____.

A. nontoxic
B. odorless
C. heavier than air
D. colorless

Chlorine is primarily used to

A. disinfect
B. prevent corrosion
C. raise pH
D. stabilize organics

In the application of chlorine for disinfection, which of the following is not an operational consideration?

A. mixing
B. contact time
C. D.O.
D. pH

Chlorine residual may be determined by using the reagent.

A. diethyl-p-phenylene diamine (DPD)
B. ethylenediamine tetraacetic acid (EDTA)
C. polychlorinated biphenys (PCB)
D. sodium thiosulfate ($Na_2S_2O_3$)

The addition of chlorine, carbon dioxide, or sulfuric acid will __ ___the pH of wastewater.

A. neutralize
B. lower
C. increase
D. have no effect on

Chloramines are _____.

A. free chlorine
B. enzymes
C. combine chlorine
D. found in polluted water

Which of the following conditions increases chlorine demand?

A. increase in alkalinity
B. increase in organic matter
C. increase in phosphate concentration
D. decrease in pH

If ammonia vapor is passed over a chlorine cylinder, it indicates the presence of a leak by turning

A. yellow
B. white
C. gray
D. brown

The reaction of chlorine and ammonia in wastewater produces a compound called _____.

A. ammonium chloride
B. chloral hydrate
C. chloramine
D. hydrazine

Combustible gas detectors measure gases and vapors in percent

A. upper explosive limit
B. lower explosive limit
C. hydrogen sulfide
D. carbon dioxide

A proper steel-toe safety shoe should be capable of resisting the impact of at least ft. -lb.

A. 10
B. 50
C. 100
D. 300

An atmosphere should be considered dangerous when oxygen content falls below _%.

A. 25.5
B. 21.5
C. 20.5
D. 19.5

If water is added to concentrated acid instead of acid into water;

A. Water will sink to the bottom immediately
B. Dilution is faster
C. Temperature decreases and the mixture tends to form ice.
D. Heat is generated and the mixture tends to splash acid
E. There is no difference

Collections and Treatment Overlap

<u>Most Common Questions (varies)??</u>

- Mathematics, Equipment, <u>Safety,</u> Pumps, Rules and Regulations, Biological Lab Testing, Chemistry, Disinfection
- RANDOM CERT QUESTIONS!

Which of the following devices continuously measures and calculates a variable in cumulative fashion?

A. Totalizers
B. Mechanical meters
C. Transmitters
D. Recorders

Unit processes used for sludge dewatering include the following EXCEPT

A. centrifugation
B. sand drying beds
C. pressure filtration
D. anaerobic digestion

What types of wastes generally are prohibited from discharge to wastewater treatment plants?

A. anaerobic
B. organic
C. corrosives with a pH lower than 5.0
D. all of the above

Wastewater that contains no measurable DO and nitrate is referred to as

A. aerobic
B. anaerobic
C. toxic
D. autotrophic

The primary function of secondary clarifiers is to

A. provide dechlorination detention time
B. remove phosphorus and BOD
C. remove solids produced during treatment
D. remove grit carryover

Which polymer has an ionic charge that may vary with the pH of the solids being conditioned?

A. polyelectrolyte
B. nonionic
C. cationic
D. anionic

A sample composed of a series of samples taken based upon time or flow is a

A. grab sample
B. periodic sample
C. sequential sample
D. composite

Fine particle solids that will not settle from wastewater are known as _____.

A. volatile solids
B. suspended solids
C. dissolved solids
D. colloidal solids

The term A.C. in the phrase "A.C. induction motor" stands for

A. Automatic Control
B. Alarm Contact
C. Average Capacity
D. Alternating Current

Which of the following is NOT a form of polymer used in wastewater treatment?

A. gel
B. condensed vapor
C. dry powder
D. emulsion

A semi closed impeller is a component of a _____ pump.

A. plunger
B. centrifugal
C. progressing cavity
D. rotary lobe

ORP stands for .

A. Oxygen Recirculation Pump
B. Oxygen Residual Probe
C. Oxidation-Reduction Potential
D. Oxygen Reclamation Process

The main gases or compounds of concern for operators regarding odor generation are ____?

A. H_2S and NH_3
B. NH_3 and CH_4
C. O_2 and N_2
D. H_20 and H_2S

Which of these is used for open- channel flow measurement?

A. propeller meter
B. Parshall flume
C. Venturi meter
D. magnetic flow meter

In a floating-cover digestion tank, the bacterial activity taking place is ___.

A. autotrophic
B. aerobic
C. anaerobic
D. facultative

The natural global process of water recycling is known as ___.

A. the nitrogen cycle
B. recarbonation
C. nitrification
D. the hydrologic cycle

Muriatic acid is also known as _____.

A. hydrochloric acid
B. sodium hydroxide
C. ferric chloride
D. sulfuric acid

The process used to maintain constant flow in a system is referred to as flow _____.

A. batching
B. streaming
C. equalization
D. comminution

Which of the following chemicals is NOT typically used to precipitate phosphorus?

A. calcium hypochlorite
B. ferrous sulfate
C. lime
D. aluminum sulfate

The two design configurations typically available for solid-bowl centrifuges are _____.

A. horizontally and vertically opposed
B. gravity and high-pressure
C. recessed plate and diaphragm
D. concurrent and countercurrent

One of the following should be used when checking for a small chlorine leak. (Hint: It forms a small, white cloud)

A. soap
B. ammonia fumes
C. a match
D. oil

Which of the following is not used in measuring flow?

A. Weir.
B. Ball and weight.
C. Venturi meter.
D. Parshall flume.

The average person contributes _____ of total suspended solids (TSS) to the sewer daily.

A. 0.11 lb (0.06 kg)
B. 0.20 lb (0.09 kg)
C. 0.38 lb (0.17 kg)
D. 0.50 lb (0.23 kg)

Excessive flows encountered during a storm are an indication of

A. High ratio of exfiltration.
B. High rates of inflow.
C. Abnormally high water usage.
D. All of the above.

The angle of repose is defined as

A. The top of the soil minus the distance to the trench.
B. Minimum natural slope.
C. Maximum natural slope.
D. The depth from the top of the soil to the bottom of the trench.

A trunk sewer is

A. A main sewer line that receives many laterals.
B. A main sewer line that receives many branches.
C. A main sewer line that serves a large territory.
D. All of the above

A drop manhole is

A. A manhole where the outgoing pipe invert is higher than the influent line.
B. A manhole where the outgoing pipe invert is significantly lower than the influent pipe invert.
C. A manhole that has more than one influent pipe.
D. A manhole with a sump.

The gauge pressure that is equivalent to the static head from a 75 ft (22.9 m) column of water is approximately

A. 9.1 psig (62.7 kPa)
B. 20.0 psig (137.9 kPa)
C. 32.5 psig (224.1 kPa)
D. 48.8 psig (336.5 kPa)

When crossing under a stream, which type of pipe is most commonly used?

A. Ductile Iron
B. Concrete
C. Class 52 fiberglass
D. Blue brute class 52

The minimum velocity (aka ideal velocity) to prevent solids deposition in sewers is about

A. 1 ft/sec (0.3 m/s)
B. 2 ft/sec (0.6 m/s)
C. 5 ft/sec (1.5 m/s)
D. 10 ft/sec (3.1 m/s)

The ingestion of wastewater can cause which of the following diseases?

A. Sinusitis.
B. Tetanus.
C. Bronchial pneumonia.
D. None of the above.

An equation which describes the gravity flow of wastewater in sewer pipes is

1. Chick's Law.
2. The Chezy equation.
3. The Manning equation.
4. The Hazen-Williams equation.

The hydraulic radius of a sewer refers to

A. The diameter.
B. The perimeter.
C. One-half the diameter.
D. The wetted perimeter divided by the diameter.

If you are informed that a large quantity of acid waste was accidentally discharged into a sanitary sewer in your city, you could determine when it reached the wastewater treatment plant because

1. The pH of the raw wastewater would rise.
2. The pH of the raw wastewater would fall.
3. The volatile portion of the suspended solids would be greatly increased.
4. The dissolved oxygen in the raw wastewater would exceed the saturation value.

A hydraulic jump is likely to occur where

1. Flow drops from a sewer into a basin.
2. The velocity of flow is suddenly increased.
3. The flow depth is greater than the critical depth.
4. Wastewater moving at a high velocity at shallow depth strikes wastewater having a substantial depth.

Inverted siphons are used to

1. Prime pumps in a pumping station.
2. Prevent flooding of pumping stations.
3. Cross depressions or small water courses.
4. Connect an individual house when elevations are low on the property owners side.

The hydraulic head losses associated with transitions are

1. Static losses.
2. Hydrostatic losses.
3. Velocity reductions.
4. Friction and conversion losses.

Crown corrosion normally results from

1. Two or more gases when they mix together.
2. Hydrogen sulfide in the presence of moisture forms an acid that deteriorates the top of the sewer pipes.
3. The excessive amount of nitrates in the wastewater.
4. None of the above.

Odors in the collection systems may be caused by

1. Aerobic bacteria.
2. Anaerobic bacteria.
3. Psychrophilic organisms.
4. Inorganic chemicals reacting with inert solids.

The difference between static head and dynamic head is:

(1) Static head is the difference between the water surface elevation on the suction side of a pump and water surface on the discharge side of a pump.

(2) Static head is the difference between the elevation at the bottom of the wet well and the elevation from where wastewater is discharged.

(3) Dynamic head is the static head plus one-half the pipe coefficient.

(4) Dynamic head is the static head plus the friction or energy losses that result from liquid flowing through the pipes, valves and fittings in the lift station.

1. 1 and 2 above
2. 1 and 3 above
3. 1 and 4 above
4. 4 and 3 above

A manhole shelf is

1. A portable workbench that can fit down a manhole.
2. The working areas on either side of the invert.
3. The lip that retains the manhole cover.
4. None of the above.

All sewers should be designed and constructed with hydraulic slopes sufficient to give mean velocities when flowing full or half full of not less than

1. 1.0 mph (1.6 km/h).
2. 2.0 ft/min (10.2 mm/s).
3. 2.0 ft/sec (0.61 m/s).
4. 3.1 ft/sec (0.96 m/s).

A check valve is best defined as

1. A sluice valve.
2. A valve to prevent backflow
3. A globe valve.
4. A unidirectional valve.

A drop manhole

1. Accommodates lines at various grades.
2. Dissipates velocity.
3. Reduces splashing.
4. All of the above.

The decomposition and decay of organic material in a sewer system containing no "free" or dissolved oxygen is called

1. Aerobic
2. Anaerobic
3. Ambient
4. Auxillary

When cleaning stoppages between property lines and the main line sewer, the access is called a (an)

1. Manhole.
2. Invert.
3. Cleanout.
4. Channel.

Which of the following would not cause stoppages in sewers?

1. Adverse hydraulic conditions.
2. Grease.
3. High velocities.
4. Roots.

Metal detectors may be used to locate

1. Asbestos – cement pipe
2. Vitrified clay pipe
3. Buried manhole covers
4. All the above

Efforts to eliminate infiltration and inflow in a collection system are made primarily

1. To reduce hydraulic loads.
2. To reduce dilution of wastewater.
3. To prevent debris from entering into pipes.
4. To provide for a higher ground water table.

Normal hydraulic cleaning of a sewer line removes

1. Gases.
2. Grit.
3. Heavy debris.
4. All of the above.

A bell of a pipe that is chipped during installation should not be left in place because it may cause

1. Infiltration.
2. Exfiltration.
3. Root intrusion.
4. All of the above.

The atmosphere in a sewer system may be

1. Tested with the proper equipment.
2. Corrosive to metal.
3. Perfectly O.K. to breathe.
4. All of the above.

When nearby residents complain of objectionable odors emanating from a pump station, you should

1. Tell the residents that you have no control over odors.
2. Use large amounts of lime to raise the pH of the septic wastewater.
3. Determine the cause of the odors and take corrective action.
4. Use commercial masking agents.

When working in a manhole and a rumbling sound is heard, what is most likely happening?

1. Light traffic in the distance.
2. Increase in flow from nearby lift station.
3. Rodents in the system have been disturbed.
4. None of the above.

Of the following chemicals listed, which are of benefit for odor control at pump stations or in the collection system?

1. Chlorine.
2. Hydrochloric acid.
3. Hydrogen peroxide.
4. Both a. and c.

The location of the clearing tool must be known at all times when using a power-rodding machine

1. So there is enough rod left over if it breaks.
2. So you know where to place the debris trap.
3. So you will know where to place the leader tool if the rod becomes coiled.
4. So you will know where to dig to recover the tool if it becomes stuck.

In which direction would you place the nozzle in the sewer when using high velocity cleaning machines?

1. Upstream in the sewer against the flow.
2. Downstream in the sewer with the flow.
3. Does not matter.
4. Depends on the velocity.

Which of the following sewer rodding tools can be used when roots are a problem?

1. Square stock corkscrew.
2. Auger.
3. Root saw.
4. All of the above.

Which of the listed methods cleans sewer lines hydraulically?

1. Chemical addition.
2. High velocity jetting machine.
3. Power bucket machine.
4. Power rodding machine.

What does the term "porcupine" refer to in the context of a collection system?

1. A bucket machine with spikes.
2. A chemical used to dissolve grease.
3. A cleaning tool used to scour pipes.
4. None of the above.

After using rodding equipment to clear a blocked sewer, you should then

1. Allow it to rest.
2. Clear it with a bucket machine.
3. Check it for proper infiltration.
4. Clean it hydraulically to restore full capacity.

In wastewater collection systems television inspection is used to

1. Determine what joints have to be sealed.
2. Regulate flow.
3. Determine where sources of infiltration originate.
4. Both a. and c.

What is the main purpose of a manhole?

1. A sampling point for wastewater.
2. For water storage in case of a blockage.
3. For access to inspect or clean lines.
4. To trap rodents.

Which one of the following tools is not used in rodding a sewer line?

1. Porcupine.
2. Lag screw pull.
3. Root saw.
4. Sand corkscrew.

One reason for knowing the exact location of a cleaning tool as you clean a line is so

1. The proper charges can be made to homeowners.
2. The slope of the sewer can be computed and recorded.
3. The valves inside the sewer can be reopened after the line is cleaned.
4. You can record where line stoppages have occurred.

To be most effective in reducing or eliminating odors, chlorine must be added

1. At the source of the odor problem.
2. Upstream of the problem area.
3. Downstream of the problem area.
4. None of the above.

The major reasons for equipment maintenance are

1. Reliability.
2. Cost effectiveness.
3. Safety.
4. All of the above.

Solids that settle in a sewer line will most likely result in the generation of

1. Carbon monoxide.
2. Hydrogen sulfide.
3. Oxygen.
4. Methanol.

Odors will normally be detected in sewers that are

1. Experiencing large amounts of infiltration.
2. Hydraulically under-loaded.
3. Relatively short in total mileage piped.
4. None of the above.

Of the following, which is the most important to a good preventive maintenance program (2 answers)?

1. Adequate budget.
2. Sufficient number of personnel.
3. Good records.
4. Good equipment.

The application of 10 mg/L of chlorine to wastewater at a pump station

1. Will cause problems in the operation of the treatment plant.
2. Is not permitted.
3. Should only be done during rainstorms.
4. Is used for odor control.

A good collection system maintenance program includes which of the following?

1. A regular inspection schedule.
2. A thorough knowledge of collection systems.
3. An adequate record keeping system with sewer line location maps.
4. All of the above.

The purpose of a maintenance schedule is

1. To train new personnel.
2. For equipment replacement.
3. To spend the monies that were appropriated.
4. To help prevent problems from developing.

Roots may be temporarily removed from sewers by the use of

1. Power rodders.
2. Addition of a diluted chlorine solution.
3. Pumping.
4. Flushing.

Hydrogen sulfide can be found under which of the following conditions?

1. At most house services.
2. A fast flowing trunk line.
3. Sluggish lines that are coated on the inside with slimes.
4. Lines that service an industrial waste complex with a high pH.

When we talk about good housekeeping around a pump station, we mean

1. Reading magazines.
2. Keeping coffee fresh and warm.
3. Not hosing down all spills immediately.
4. Providing a proper place for tools and equipment.

Suppose an 8 in. (200 mm) diameter sewer line is backing up, the problem being caused by an excessive grease buildup. Which of the following pieces of equipment could not be used to alleviate the problem?

1. Bucket machine.
2. Chemicals or bacteria.
3. Ball and line.
4. Power rodder.

What is the solids recovery rate of a belt filter press with the following operational data?

Hours of operation = 10
Solids filtered = 80,000 gal
Solids content = *5%*
Volatile solids content = 70%
Cake solids = 22%
Cake produced = 68 wet tons

A. 20%
B. 63%
C. 82%
D. 90%

When placing a manhole hook under a sewer manhole cover the operator should pull

1. Upwards.
2. With his/her back to the traffic.
3. Does not matter.
4. With his/her back in line with the center of the road.

In the event that a forced draft ventilation fan in a pump station fails, it must be fixed immediately because

1. The pumps will overheat.
2. Bacterial contamination could occur.
3. Explosive gases could accumulate.
4. All of the above.

When operating a power-rodding machine, it is extremely important that the operator

1. Extends the rod to the next manhole before starting to rotate the tool.
2. Has a district or maintenance supervisor present at all times.
3. Has the rod moving in or out of the sewer whenever it is rotating.
4. Avoids rodding in a sewer unless there is a full flow in the sewer line.

One practical method of removing roots in a collection system would be to

1. Excavate the pipe.
2. Use an axe or chainsaw.
3. Use a flexible rod and cutter.
4. Apply heavy doses of chemicals.

When using a hydraulic sewer-cleaning method, care must be taken

1. To prevent any air gap from occurring.
2. To always plug the downstream manhole.
3. Not to cause flooding in homes and basements.
4. To throttle flows from fire hydrants by using the hydrant valves.

Of the following items, which would be of least importance when filling out the daily report for a high velocity sewer-cleaning crew

1. Total distance of sewers cleaned that day.
2. Sizes of sewers cleaned that day.
3. The number of sewer rods broken each day.
4. Specific identification of the sewers cleaned.

The main objective for the operation and maintenance of a wastewater collection system is

1. Keeping an eye out for vandals.
2. Keeping organic solids out of the effluent.
3. Keeping all industrial discharges from entering the collection system.
4. None of the above.

Blockages can be positively identified and the location pinpointed by

1. Dye tests.
2. Smoke tests.
3. Trees growing over the sewer.
4. Closed circuit television inspection.

Flushing of a sewer line would best remove

1. Grit.
2. Roots.
3. Heavy debris.
4. None of the above.

The proper care of hand tools requires that they

1. Be cleaned after use.
2. Be kept in good condition.
3. Be used only for their intended use.
4. All of the above.

A manhole should be ventilated

1. During hot weather.
2. During low flow periods.
3. When methane gas is present.
4. When more than 20% oxygen is present.

When a sewer is being rodded or jetted to clear a blockage, the work is usually started from the

1. Wet manhole.
2. Dry manhole.
3. Chimney between manholes.
4. Flooded manhole if the wastewater is not too deep.

When a mechanical blower is used to ventilate a manhole

1. The blower should discharge into the manhole.
2. The suction of the blower should exhaust air from the manhole.
3. Both suction and discharge lines should be in the manhole.
4. None of the above.

Drawdown is a hydraulic term which refers to the following condition in a typical sewer

1. Siphoning.
2. Draining the line.
3. An area where the flow slows.
4. The surface curve at a free flowing outlet of a pipe.

Hydraulic pipe cutters are normally used to cut

1. Vitrified clay pipe.
2. Asbestos cement pipe.
3. Reinforced concrete pipe.
4. Cast iron pipe.

Smoke testing of sewers

1. Is a process for determining if sewer gas is present in a manhole.
2. Can be used to detect downspout connections to a sewer.
3. May be used to measure the quantity of infiltration when the ground water table is low.
4. Both b. and c.

Which of the following pipe materials is most commonly corroded by sewer gases?

1. Vitrified clay pipe (VCP).
2. Polyvinyl chloride pipe (PVCP).
3. Reinforced concrete pipe (RCP).
4. Ductile iron pipe (DIP).

When filling a hydraulic cleaner with water from a fire hydrant

1. You should only fill the tank 3/4 full.
2. Make sure the fire hydrant is open halfway.
3. Be certain the fill hose extends well into the tank.
4. Be sure there is an air gap between the fill hose end and the water level.

A rodding machine sits 30 ft (9.1 m) away from a manhole and 145 ft (44.2 m) of rod is taken off the reel. Assuming that the manhole is 10 ft (3.1 m) deep, how far into the sewer line is the end of the rod?

1. 105 ft (32.0 m)
2. 115 ft (35.1 m)
3. 125 ft (38.1 m)
4. 155 ft (47.2 m)

The rate of travel of a sewer ball through the line must be controlled in order to

1. Move debris.
2. Remove slime.
3. Maintain a constant speed.
4. Prevent the wastewater from surcharging upstream.

A bucket machine may be used to clean a sewer that is

1. Loaded with grease.
2. Plugged with roots.
3. Composed of vitrified clay and that is full of large rocks.
4. On a flat grade.

The most effective method used to check for illegal connections to a wastewater collection system is

1. Dye testing.
2. Smoke testing.
3. Flow measurement.
4. A telephone survey.

Infiltration, or the entry of storm and groundwater into the collection system, causes collection systems and treatment plants to increase in size. Which of the problems listed below causes the greatest volume of infiltration into the system?

1. Residential sump pump discharges tied into the sanitary sewer
2. Faulty house sewers.
3. Faulty joints in trunk sewers.
4. Crushed sections of sewer lines.

When performing repairs to a sewer line under a public road, which of the following is/are essential step(s)?

1. Inform the public in advance if the work is to be of a major scope.
2. Clearly and properly install all barricades and safety devices at the construction site.
3. Contact the fire and police departments to inform them of where and when construction will occur.
4. All of the above.

When using a sewer ball to clean a sewer, in which direction would the ball be moving?

1. Upstream.
2. Downstream.
3. It doesn't matter.
4. Always towards the nearest lift station.

Roots in sewers causing stoppages can be positively identified as the source of the problem by

1. Dye tests.
2. Smoke tests.
3. Closed circuit television inspection.
4. Observing roots in flow downstream, after clearing a stoppage with a power rodder.

If a sewer line is known to have root problems, you could use a _____ to improve the condition.

1. Shield.
2. Scooter.
3. Power rodder.
4. Sewer ball.

The difference between a masking agent and a chemical such as potassium permanganate is

1. The masking agent is a permanent solution and potassium permanganate is not.
2. Potassium permanganate is very costly and masking agents can easily be made.
3. Masking agents cover up and potassium permanganate chemically oxidizes the odor causing material.
4. None of the above.

The flow velocity in a sewer may be measured by a

1. Weir.
2. Parshall flume.
3. Venturi meter.
4. None of the above.

Catch basin inlets to stormwater sewers have been used primarily to

1. Settle out sand and grit from the stormwater flow.
2. Prevent the dissemination of odors from the sewer.
3. Act as an equalizer of the flow to avoid overtaxing the capacity of the sewer.
4. Prevent floating objects from entering the storm sewer obstructing the flow in the sewer.

The purpose of smoke testing is to

1. Eliminate insects and rodents from the collection system.
2. Measure the volume of air in a sewer line from manhole to manhole.
3. Determine which way the water will flow.
4. Locate inflow sources.

High velocity cleaners use _____ to remove debris from the sewers.

1. Centrifugal force.
2. Cutting and scraping action.
3. High water pressure.
4. All of the above.

Problems that may arise when a check valve leaks include

1. The check valve seat may wear prematurely.
2. The pump can spin backwards.
3. Electrical costs will be higher due to re-pumping of previously pumped wastewater.
4. All of the above.

Which of the following equipment is not necessary when conducting a closed circuit television examination of a sewer?

1. Picture monitor.
2. AM-FM radio.
3. Cable pulling winch.
4. Communication system.

Odors in manholes at the end of force mains are usually caused by

1. Turbulence.
2. Aerobic bacteria.
3. Anaerobic conditions.
4. Both a. and c.

Sources of infiltration can best be located by

1. Smoke tests.
2. Visual tests.
3. Flow metering.
4. TV inspection.
5. All of the above

When placing a weir in an open channel, the measurement of the head should be made upstream from the weir. To avoid surface drawdown that occurs from the crest, the measurement location should be at least how far away from the weir?

1. At the weir crest.
2. Twice the head.
3. Four times the head.
4. Just behind the crest.

The best method to initially use to retrieve a broken section of sewer rod that has snapped inside an 8 in. (200 mm) diameter line, assuming that the broken rod comes from a power rodder and that it can not be retrieved by hand, is

1. Look at your footage meter on the rodder, mark out the distance on the street and excavate.
2. Try and push the rod down to the next manhole.
3. Use a rod retriever.
4. None of the above.

Exfiltration should be controlled to prevent

1. Possible groundwater contamination.
2. A depletion of wastewater that is needed to operate a treatment facility properly.
3. Backfill from washing away.
4. Both a. and c.

Which of the following <u>would not</u> be a reason for prechlorination either at the treatment plant inlet or somewhere in the collection system?

1. To improve grit removal.
2. To help control corrosion in long force mains.
3. To control odors at the headworks.
4. To accomplish at least partial disinfection during overflow emergencies.

Obstructions in sewers can best be cleared by

1. Very small blasting charges.
2. A power rodder with an auger head.
3. Lamping between manholes.
4. Using a hose from the nearest fire hydrant.

You have a new gasoline powered diaphragm-type pump for dewatering at sewer repair sites. You are using heavy duty spiral-wire reinforced suction hose. Which of the following is a practical limit of height to set the pump above the water level in the ditch?

1. 3 to 8 ft (0.9 to 2.4 m). If you try to pump with more than 8 ft (2.4 m) of suction lift, the plies of the pump diaphragm will rupture.
2. 20 to 25 ft (6.1 to 7.6 m). This is approaching the suction lift limits due to barometric pressure.
3. 40 ft (12.2 m). Safety regulations limit net suction lift to 40 ft (12.2 m) or less for gasoline powered field pumps.
4. 65 ft (19.8 m). The suction hose would collapse with more than 65 ft of negative water column.

It is recognized that the soundest mechanical equipment maintenance program, in addition to proper lubrication, includes

1. No other key features.
2. Continuous use of machinery until it breaks down, after which it is replaced.
3. Periodic inspection of each part of all mechanical equipment and repair or replacement of their parts when needed before failure.
4. Replacement of machine parts at regular intervals.

In preparing an effective schedule for maintaining a wastewater collection system, which of the following factors should be considered?

1. Checking system records.
2. "Bench marking" against high-performing systems.
3. Past experience of system performance.
4. All of the above.

A person may gain knowledge or become familiar with a collection system by

1. Schooling and seminars.
2. By being patient - in time you will learn.
3. Learning from experienced fellow workers.
4. Both a. and c.

Which of the following is the correct procedure for opening and closing valves on high pressure lines?

1. They should be opened and closed very slowly.
2. They should be opened and closed as quickly as possible.
3. No special procedures are required.
4. All valves should be closed by turning in a clockwise direction and opened by turning counter clockwise.

Corrosion control may be accomplished by which of the following methods?

1. Increasing the oxygen content.
2. Increasing the carbon dioxide content.
3. Increasing the hydrogen ion concentration.
4. Decreasing the volume of flow from the pump stations.

Normally, hydrogen sulfide will be found under what conditions?

1. Fast flowing trunk line.
2. A line that services an industrial waste complex with a high pH.
3. A sluggish line that is coated on the inside with algal slime.
4. At most house service connections.

A pig would most likely be used in a

1. Gravity sewer.
2. Storm sewer.
3. Force main.
4. House or building sewer.

How can members of a balling crew most effectively communicate with each other?

1. Writing.
2. Telegraph.
3. Hand signals.
4. By shouting down the sewer.

An example of "single use" plan is a(n)

A. regulating principle or directive
B. indication of exactly how each step is to be carried out
C. budget
D. chronological sequence of performance acts

Which of the following flow measuring devices is the most accurate?

A. venturi tube
B. Parshall flume
C. magnetic meter
D. weir

Weirs are most often used to measure flows in

A. treatment plant headworks
B. open channels
C. pipelines

Calcium hypochlorite may also be referred to as

A. HTH
B. Quicklime
C. HGL
D. $Ca(OH)_2$

In a lift station, oxygen deficiency in the atmosphere may be overcome by

A. lowering the temperature in the lift station
B. providing adequate ventilation
C. sealing the vents
D. not overloading the pumps
E. increasing motor speed

The pressurized piping that conveys wastewater from a lift station is called a

A. Bubbler
B. Syphon
C. Force main

Which of the following discharges would, in general, require the lowest 15 chlorine dosage for adequate disinfection?

A. primary plant effluent
B. activated sludge plant effluent
C. trickling filter effluent
D. sand filter effluent

A level-sensing device that pumps low-volume, low-pressure air through a vertical tube, such as one found in a wet well or metering flume, is called a

A. Bubbler
B. Force main
C. megger

An electrical instrument used for checking the insulation resistance on motors, feeders, bus bar systems, grounds, and branch circuit wiring is called a

A. Megger
B. Force main
C. Bubbler
D. Syphon

In lieu of shoring a trench for sewer construction, the side walls must be sloped at a ratio of at least % horizontal to 1 vertical.

A. True
B. False

Federal Clean Air Act initiatives require facilities that generate more than 25 ton/yr of volatile organic compounds (VOCs) to conduct an analysis to evaluate the technical and economic feasibility of controlling VOCs

A. True
B. False

EPA estimates that more than 2,4 billion pounds of toxic air pollutants are emitted annually. The largest single source, at 886 million pounds, is?

A. cows
B. wastewater collection and treatment facilities
C. chemical industry
D. trees

A fitting mounted on a pipe for attaching a new connection, typically a building service line connection to a sewer main, is called a _____.

A. Brace
B. Easement
C. Bracket

A/An _____ is a sewer line installed lower than the normal gradient to pass under rivers or depressed roadways.

A. Force main
B. Bubbler
C. Megger
D. Inverted syphon

A treatment plant uses sulfur dioxide to dechlorinate effluent. An operator needs to adjust the sulfonator so that the dosing concentration is 1.5 mg/L more than the chlorine residual. Based on the following information, what should be the sulfonator feed rate?

Design flow: 5 mgd
Chlorine dosage rate: 4 mg/L
Chlorine residual: 0.9 mg/L

A. 25lb/d
B. 100 lb/d
C. 167lb/d
D. 267lb/d

A British thermal unit is defined as the amount of heat required to raise the temperature of one of the following:

A. 1 cubic foot of water 1 degree F
B. 1 pound of water 1 degree F
C. 1 kilogram of water 1 degree C
D. 1 liter of water 1 degree C

Wastewater Collections and Treatment
2-Day ABC Licensure Exam
Preparatory Course
Sept 7-8, 2026

"Levels 1-4"

OESAC # 9429

1.6 CEUs

Dr. Matthew J. La Force
Engineering Science Department
Clackamas Community College
503-594-3148
laforce@clackamas.edu

Water & Environmental Technology CLACKAMAS COMMUNITY COLLEGE

Agenda

Mon Sept 7, 2026	
8:00-9:00 am	Overview of Wastewater and Collections systems, ABC exam taking tips and suggestions
9:00-9:45am	Mathematical wastewater dimensional analysis
9:45-10am	Break
10:00-11:00 am	ABC Need To Know Criteria: Wastewater Characteristics Needed for both collection system and the operations
11:00-12:00 pm	ABC Need To Know Criteria: Wastewater collection system maintenance
12:00-1:30 pm	Break
1:30 – 2:45	Mathematical wastewater dimensional analysis/flow conversions

Mon Sept 7, 2026	
2:45 -3:00 pm	Break
3:00-4: 00 pm	ABC Need To Know Criteria: Wastewater collection system/treatment operations PUMPS!!
4:00-5:30 pm	ABC Need To Know Criteria: Wastewater secondary treatment plant processes

Agenda

Tues Sept 8, 2026	
8:00-9:00 am	Mathematical wastewater conversions
9:00-9:45am	ABC Need To Know Criteria: Wastewater collection system operations and cleaning
9:45-10am	Break
10:00-11:00 am	ABC Need To Know Criteria: Wastewater collection system maintenance
11:00-12:00 pm	ABC Need To Know Criteria: Wastewater treatment plant maintenance
12:00-1:00 pm	Lunch Break
1:00 – 2:45	ABC Need To Know Criteria: Wastewater treatment plant operations and solids handling

Tues Sept 8, 2026	
2:45 -3:00 pm	Break
3:00-4: 00 pm	ABC Need To Know Criteria: Wastewater collection system operations and cleaning
4:00-5:00 pm	ABC Need To Know Criteria: Wastewater treatment plant analytical procedures.. Award Certificates

Course Title:	Wastewater Collections and Treatment 16 hours, 4-day ABC Licensure Exam Preparatory Course ***"Levels 1-4"*** **1.6 CEUs**
CEU's Requested:	1.6 WW
Dates	Various, 2026
Location:	Clackamas Community College, Oregon City, Oregon
Sponsor:	Clackamas Community College, Oregon City, Oregon
Sponsor Contact:	Matt LaForce
Contact Phone Number	503-594-3148
Contact Email:	laforce@clackamas.edu
OESAC Course Number:	
Course Summary:	Our ABC Licensure Wastewater Collections and Treatment preparatory exam review. Upon successful completion of this workshop, students, levels 1 through 4, will understand the ABC need-to-know criteria as applied to the certification exam questions.

The class will be taught by Matthew J. LaForce, Ph.D.

Dr. LaForce received his Masters of Science degree in geology and his doctoral degree in soil science working in inorganic environmental chemistry from the University of Idaho.

After completing his Ph.D., Doctor LaForce was a research associate at Sanford University in environmental chemistry and an assistant professor of hydrogeology at San Francisco State University.

Dr. LaForce is currently the departmental head of Engineering Sciences at Clackamas Community College. He has been instructing water and wastewater courses for over 20 years.

Dr. MATTHEW J. LA FORCE
Department Chair Engineering Sciences
Clackamas Community College
Email: laforce@clackamas.edu
Phone: 503-594-3148

EDUCATION

Post Doctoral Fellow ***Stanford University*** Jan. 2000 – Sept 2000
Research Topic: Temporal Bioaccessibility of Arsenic, Chromium, and Lead.
Mentor: Scott Fendorf

Ph.D. Soil Science/Soil Chemistry ***University of Idaho*** Jan. 2000
Dissertation Title: Seasonal Cycling of Redox-Active Metal(loid)s within Mining-Impacted Wetlands.
Major Professor: Scott Fendorf

M.S. Geology ***University of Idaho*** Dec. 1996
Thesis Title: The Effects of Simulated Dredging and Flooding on Trace-Element Rich Sediments in Lake Coeur D'Alene and the Coeur D'Alene River, Idaho.
Major Professor: Kenneth Sprenke

B.S. Geology/Environmental Sciences ***Cortland College*** Aug. 1994
Minor in Biological Sciences
Senior Thesis Title: A Geophysical Investigation of the Port Leyden Nelsonite.
Major Professor: Robert Darling

PROFESSIONAL EXPERIENCE

Department Chair Engineering	***Clackamas Community College***	2008, 2011-Present
Director Oregon Backflow Training	***Clackamas Community College***	2008-Present
Professor	***Clackamas Community College***	Sep. 2006-Present
Assistant Professor	***San Francisco State (SFSU)***	Aug. 2001 - 2006
Post Doctoral Scientist/Instructor	***Stanford University***	Jan. 2000 - Sept. 2000
Visiting Researcher	***Stanford University***	Mar. 1999 -Dec. 2000
Teaching and Research Assistant	***University of Idaho***	Aug. 1995 - Jan. 1999

COURSES INSTRUCTED

Fifty courses instructed over 25 years at University of Idaho, Stanford, San Francisco State University and Clackamas Community College.

-All teaching evaluations have been excellent and are available upon request.

Water Distribution I, Water Treatment I-II, Mathematics For Water and Wastewater Operation, Water and Wastewater Operations I-III, Environmental Chemistry I and II, Elementary and Aquatic Microbiology, Wastewater Collections, Hydraulics, Geostatistics, Contaminant Hydrogeology, Hydrogeology, Environmental Geology, Planetary Climate Change, Introductory Geology, Soil Science

Matthew La Force's Curriculum Vitae

HONORS AND AWARDS

Western Soil Science Society of America
- 1st place oral presentation — June 2000

Pacific Division of AAAS
- 1st place oral presentation — June 2000

American Association for Advancement of Science (AAAS)
- 1st place oral presentation — June 1996

Pacific Division of AAAS
- Sunshine Mining Award for Excellence in Geosciences — June 1996

Pacific Division of AAAS
- Robert I. Larus Travel Award — June 1996

Sigma Xi Excellence in Research and Writing, SUNY Cortland — May 1994

PROFESSIONAL ORGANIZATIONS AND EDITORIAL AFFILIATIONS

Board of Directors/Educational Representative
Oregon Environmental Services Advisory Council
Member of Oregon DEQ Operator Certification Program Advisory Committee
Member of Oregon Water and Education Foundation
Member of Waterworks Short School Clackamas Community College
Member of the Oregon Cross Connection Specialist Regional Subcommittee
Member of USC Foundation For Cross Connection Control
Director Oregon Backflow Training Program
President West Linn Youth Lacrosse
Vice President West Linn Youth Lacrosse
Past President of Western Soil Science Society of America
Past Secretary/Treasurer of Western Soil Science Society of America
Past Executive Committee Member - American Association of Advancement of Sciences
-Pacific Division
Ad hoc reviewer for *Applied Geochemistry, Environmental Science and Technology, Journal of Environmental Quality,* and *Soil Science Society of America Journal.*

PUBLICATIONS

Book Chapters

Hansel, C.M., M.J. LaForce, S.E. Sutton, and S. Fendorf. 2002. Ecosystem Dynamics of Zinc and Manganese within a Mine-Waste Impacted Wetland. In S. Wood and R. Hellmann (Eds.) "Water-Rock Interactions, Ore Deposits, and Environmental Geochemistry, A Tribute to David A Crerar", Geochemical Society Special Publication, Geochemical Society of America. 411-454.

Matthew La Force's Curriculum Vitae

Research Articles

Fendorf, SE, M. La Force, and G.C. Li. 2004. Temporal Changes in Soil Partitioning and Bioaccessibility of Arsenic, Chromium, and Lead. *J Environ Qual* 33: 2049-2055.

C.M. Hansel, M.J., La Force, S.E. Fendorf and S. Sutton. 2002. Spatial and temporal association of As and Fe species on aquatic plant roots. *Environ. Sci Technol.* 36:1988-1994.

La Force, M.J., C.M. Hansel, and S.E. Fendorf. 2002. Seasonal transformation of manganese in a Palustrine Emergent Wetland. *Soil Sci. Soc. Am. J.* 66:1377-1389.

Bostick, B.C., C.M. Hansel, La Force, M.J., and S.E. Fendorf. 2001. Seasonal fluctuations in Zn speciation within a contaminated wetland. *Environ. Sci. Technol.* 35:3823-3829.

La Force, M.J., G.C. Li, and S.E. Fendorf. 2000. Arsenic speciation, seasonal transformations, and co-distribution with iron in a mine waste palustrine emergent wetland. *Environ. Sci. Technol.* 34:3937-3943.

La Force, M.J. and S.E. Fendorf. 2000. Solid phase iron characterizations during common selective sequential extractions. *Soil Sci. Soc. Am. J.* 64:1608-1614.

La Force, M.J., C.M. Hansel, and S.E. Fendorf. 2000. Constructing simple wetland sampling devices. *Soil Sci. Soc. Am. J.* 64:809-811.

La Force, M.J, S.E. Fendorf, G.C., Li, and R.F. Rosenzweig. 1999. Redistribution of trace elements from contaminated sediments of Lake Coeur d'Alene during oxygenation. *J. Environ. Qual.* 28:1195-1201.

Harrington, J.M., M.J. La Force, W.C. Rember, S.E. Fendorf, and R.F. Rosenzweig. 1998. Phase associations and mobilization of iron and trace elements in Coeur d'Alene Lake, Idaho. *Environ. Sci. Technol.* 32:650-656.

La Force, M.J., S. Fendorf, G.C. Li, G.M. Schneider, and R.F. Rosenzweig. 1998. A laboratory evaluation of trace element mobility from flooding and nutrient loading of Coeur d'Alene river sediments. *J. Environ. Qual*. 27:318-328.

Matthew La Force's Curriculum Vitae

Professional Papers

C. Oze, M.J. La Force, C. Wentworth, D.K. Bird and R. Coleman. 2002. Assessing mineral weathering and chromium geochemistry in the Willow Core, Santa Clara County, Ca. United States Geologic Survey Open File Report 2002

M.J. La Force, J. Neiss. 2002. Assessing serpentine soil geochemistry and distribution. Inspiration Point, Presidio, San Francisco, Ca. Open File Report 2002

INVITED PRESENTIONS AND LECTURES

La Force, M.J., and S.E. Fendorf. 1996. Trace element mobility in the Coeur d'Alene Basin. Northwest Science Association. Spokane, WA.

Fendorf, S.E., M.J. La Force, and C.M. Hansel. 2000. Trace element cycling within wetland ecosystems. Peninsula Geologic Society Meeting, Stanford, CA.

La Force, M.J., and S.E. Fendorf. 2000. Arsenic speciation and co-distribution with Fe in a palustrine emergent wetland. Western Soil Science Society of America, Ashland Or.

La Force, M.J. 2002. 4th Biennial San Francisco Ecological Restoration Conference. San Francisco Recreation and Parks Department. Hosted workshop on native soils and bioremediation. Randall Museum.

La Force, M.J. 2002. Sustainable Park Workshop Series. San Francisco Recreation and Parks Department. Hosted workshop on diagnostic soil properties and the 12 soil orders. Randall Museum.

La Force, M.J. 2003. The geochemistry of serpentine soils at inspiration point. San Jose State Geology Department.

Invited Guest Lecture, Stanford University. 2001. Science of Soils. Created and implemented pedology and Keys to Soil Taxonomy lectures.

Invited Guest Lecture, Stanford University. 2001. Science of Soils. Created and implemented pedology and Keys to Soil Taxonomy lectures.

Invited Guest Lecture, Taylor Middle School. Implemented a guest lecture on rock and mineral identification. I encouraged students to appreciate the importance of the geosciences.

Invited Guest Lecture, Sequoia High School. I implemented a guest lecture on soil formation and agriculture.

Matthew La Force's Curriculum Vitae

Papers presented at professional meetings

La Force, M.J., R. Hay, and B. Darling. 1994. A geophysical investigation of the Port Lyeden Nelsonite. Geological Society of America, Binghamton, NY.

La Force, M.J and S.E. Fendorf. 1996. Trace element dynamics in the Coeur d'Alene Basin. Northwest Science Association. Spokane, WA.

La Force, M.J, G.C. Li, and S.E. Fendorf. 1996. Trace element cycling from dredging of Lake Coeur d'Alene, Idaho. Pacific Division American Association for Advancement of Science. San Jose, CA.

La Force, M.J, G.C. Li, and S.E. Fendorf. 1996. Trace element mobility as a consequence of dredging Lake Coeur d'Alene, Idaho. American Association for Advancement of Science. Seattle, WA.

La Force, M.J, G.C. Li, and S.E. Fendorf. 1997. Trace element mobility from flooding and nutrient loading of Coeur d'Alene River sediments. Soil Science Society of America. Anaheim, CA.

La Force, M.J, G.C. Li, E.A. Rochette, and S.E. Fendorf. 1998. Trace element attenuation within a mine waste contaminated wetland. Soil Science Society of America. Baltimore, MD.

Bostick, B.C., La Force, M.J, C. M. Hansel, and S.E. Fendorf. 1998. Localized structure of Zn in reducing environments. Soil Science Society of America. Baltimore, MD.

La Force, M.J, C. M. Hansel, and S.E. Fendorf. 1999. Iron and As mobility in a contaminated wetland. Stanford Synchrotron Radiation Laboratory Users Conference. Stanford, CA

La Force, M.J, B. Wielinga, G.C. Li, and S.E. Fendorf. 1999. Redox dynamics of trace elements in wetland soils. Soil Science Society of America. Salt Lake City, UT.

La Force, M.J., and S.E. Fendorf. 2000. Arsenic speciation, seasonal transformations, and co-distribution with iron in a mine waste palustrine emergent wetland. Western Soil Science Society of America. Ashland, OR.

La Force, M.J. M. Barnett, P.J. Jardine, and S.E. Fendorf. 2000. The effects of residence time on contaminant bioavailability. Soil Science Society of America. Minneapolis, MN.

La Force, M.J. M. Barnett, P.J. Jardine, and S.E. Fendorf. 2001. The effects of residence time on contaminant bioavailability. Western Soil Science Society of America. Moscow, Id.

Jim Neiss, M.J. LaForce. 2002. Influences of non native plants on the geochemical influences of a serpentinite soil. Presidio, San Francisco, Ca. Geological Society of America. Corvallis, OR

Erdmann Rogge and Matthew J. La Force. 2002. Hydrostratigraphy of the Westside Groundwater Basin, San Francisco and San Mateo Counties, California American Geophysical Union. San Francisco California.

Erdmann Rogge and Matthew J. La Force. 2003. Hydrostratigraphic Units of the Westside Groundwater Basin, San Francisco and San Mateo Counties, California. American Association for Advancement of Science Pacific Division and Western Soil Science Society of America Abstract and Programs. San Francisco State University, Ca 19.

Charlotte Hedlund and Matthew J. La Force. 2003. Hydrogeology and Geochemistry of the Montara Moss Beach Aquifer System Geological Society of America. Geologic Society of America Abstract and Programs. Puerto Vallarta, Mx. A-25.

Matthew J. La Force and Megan Simpson. 2004. Background Trace Element Concentrations in the Franciscan Complex. WSSA/PDAAAS, Logan Utah.

GRANTS

M. La Force. 2011. $28,000. Future Connects. City of Portland. Funded

Nurmi, J.T and La Force, M.J. 2012. $129,481. EPA Small Water System Grant. CCC WET Online Course for Small water systems. Submitted.

M. LaForce and J. Lewis. 2008. $~2,500. CCC Foundation Mini-grant for multiprobe use at ELC. Funded and then funding rescinded by CCC.

M. La Force and K. Grove. 2006. $24,948. Hydrostratigraphic investigation of the North Westside Basin of San Francisco and northern San Mateo Counties. San Francisco Public Utilities Commission.

L. White, K. Grove, M. La Force, R. Pestrong, D. Dempsey, O. Garcia, and T. Garfield, 2005. $205,218. Opportunities to Enhance Diversity in the Geosciences program,"Reaching Out to Communities and Kids with Science in San Francisco-SF-ROCKS". National Science Foundation. Funded

M.J. LaForce, B.Manning, A. Ichimura, and S. Bollens. 2005. $192,100. Acquisition of a powder X-ray diffraction instrument for environmental analysis and educational outreach. National Science Foundation: Major Research Instrumentation program. Funded.

L. White, K. Grove, M. La Force, R. Pestrong, D. Dempsey, O. Garcia, and T. Garfield, 2004. $279,118. Opportunities to Enhance Diversity in the Geosciences program,"Reaching Out to Communities and Kids with Science in San Francisco-SF-ROCKS". National Science Foundation. Funded

M.J. LaForce. 2004. $5,000. Determination of the pre-1890 paleolake bottom of the eastern arm of Mountain Lake, Presidio, California. Presidio Trust. Funded.

L. White, K. Grove, M. La Force, R. Pestrong, D. Dempsey, O. Garcia, and T. Garfield, 2003. $263,863. Opportunities to Enhance Diversity in the Geosciences program,"Reaching Out to Communities and Kids with Science in San Francisco-SF-ROCKS". National Science Foundation. Funded

M.J. LaForce and J. Caskey. 2002. $20,600. Geochemical and Surficial soils/geologic boundary mapping at the Presidio. Presidio Trust. Funded.

M.J. LaForce. 2001. 5,000$. Evaluation of nutrient levels in Elkhorn Slough. SFSU mini grant. Funded.

M.J. LaForce and K. Strathmann. 2001. 10,465$. Study of soils and geologic boundaries at Inspiration Point, Presidio Ca. Presidio Trust. Funded.

C. Oze, M.J. LaForce, R. Coleman, and D.K. Bird. 2001. 6,740$. Assessing mineral weathering and chromium geochemistry in the Willow Core, Santa Clara County, CA. United States Geologic Survey. Funded.

M.J. LaForce. 2001. 306,022$. Assessing benthic and planktonic habitats via microbial enumerations coupled with sediment and porewater geochemical analysis of Elkhorn Slough. Monterey Bay National Marine Sanctuary. Not Funded.

M.J. LaForce and B. Manning. 2001. 279,032$. Field and laboratory investigation of selenium cycling and speciation in the San Joaquin River. United States Department of Agriculture-National Research Initiative. Not Funded.

M.J. LaForce and B. Manning. 2001. 1,042,984$. Field and laboratory investigation of selenium cycling and speciation in San Francisco Bay and the San Joaquin River. CALFED. Not Funded.

M.J. LaForce, B.Manning, A. Ichimura, and S. Bollens. 2004. $192,100. Acquisition of a Powder X-ray Diffraction Instrument for Environmental Analysis and Educational Outreach. NSF:MRI program. Funded.

L. White, K. Grove, R. Pestrong. N. Garfield, D. Dempsey, and M.J. LaForce. 2003. 1,200,000$. Reaching Out to Communities and Kids with Science in San Francisco: SF ROCKS. NSF. Funded.

M.J. LaForce. 2001. 306,022$. Assessing benthic and planktonic habitats via microbial enumerations coupled with sediment and porewater geochemical analysis of Elkhorn Slough. Monterey Bay National Marine Sanctuary. Not Funded.

M.J. LaForce and L. White. 2001. 208,901$. Hydrologic Investigation of the Islais Creek Watershed. Prop 13 CALFED Drinking Water Program. Not Funded.

M.J. LaForce and B. Manning. 2001. 279,032$. Field and laboratory investigation of selenium cycling and speciation in the San Joaquin River. United States Department of Agriculture-National Research Initiative. Not Funded.

STUDENT ADVISING-* committee member

Erdmann Rogge. 2003. MS thesis: Hydrostratigraphy of the Westside Groundwater Basin, San Francisco and San Mateo Counties, California

Charlotte Hedlund. 2003. MS thesis: Hydrogeology and Geochemistry of the Northern Groundwater Basin, San Mateo County, California

Megan Simpson. 2004. MS thesis: Investigating Background Trace Element Concentrations in the Franciscan Complex San Francisco, California

Peter Gorman. 2004. MS thesis: Temporal and Spatial Variability of Hydraulic Conductivity in the Russian River Streambed, Sonoma County, California.

Andrew Matthew. Expected 2005. MS thesis: A Geochemical and Geophysical Investigation of the Serpentine Soils at the Presidio, San Francisco, Ca.

*Kasha Parker. Fall 2004. MS thesis: Surficial Sediment Distribution and Changes in the Central San Francisco Bay Along the Southeastern Tiburon Peninsula.

*Chimi Yi. Expected Fall 2004. Depositional and Deformational History of the Colma and uppermost Merced Formations along the coast of San Francisco

Doug Wood. Senior Thesis 2001. Determination of the bioavailability to humans of the metals As, Cr, and Pb with respect to soil ingestion.

Jim Neiss. Senior Thesis 2002. The geochemistry of serpentine soils at Inspiration Point Presidio, San Francisco, Ca. Fall 2002.

*Joe Petsche. Senior Thesis 2003. Delineation of Sub-surface Serpentinite Boundaries with the San Francisco Presidio.

*Mahasringha M. Monroe. Senior Thesis 2003. Late Pleistocene Uplift Along the Seal Cove Fault Using Emergent Marine Terraces, Moss Beach, California.

Jane Duxbury. Senior Thesis 2004. Determination of the Pre-1890 Paleolake Bottom of the Eastern Arm of Mountain Lake, Presidio, California.

REFERENCES

John Lewis
Emeritus Engineering Science Department Chair
Clackamas Community College
19600 South Molalla Dr
Oregon City OR 97045

Dr. James Nurmi
Water Quality Instructor
Engineering Science Department Chair
Clackamas Community College
19600 South Molalla Dr
Oregon City OR 97045