

WWOA Operator Competition – Process Control Test

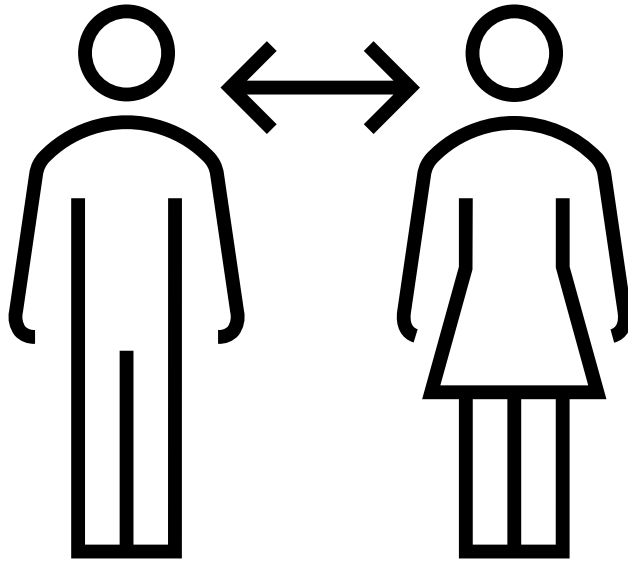
Training



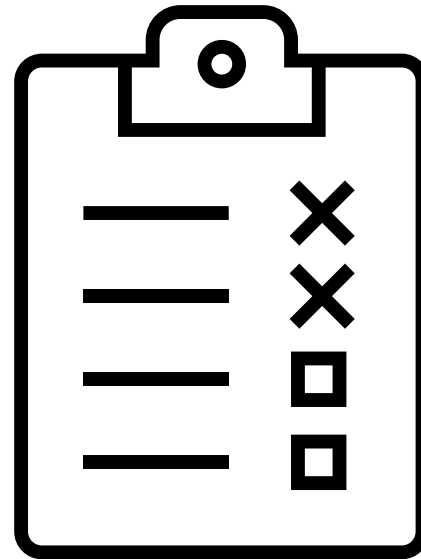
Agenda

- Introductions
- Review of Test Elements
- Tips/Resources
- Group Test Review and Discussion
- Questions/Comments/Discussion

Introduction



Review of Test Elements



Multiple Choice

- Captures general knowledge within the wastewater industry.
- Best answer yields 10 points each.
- Scores generally good.

3	In an extended aeration activated sludge process, the typical solids retention time (SRT) is _____?	A	40 - 60 days
		B	2 - 8 days
		C	8 - 15 days
		D	15 - 40 days

Official Time:	
Team Name:	
Team Number:	
Team Captain:	
For Official Scorer	
Total Event Points:	
Multiple Choice Section	
5 Pages 30 Questions 10 Points per question; Total Possible Score = 300 pts	
Math Multiple Choice Section	
4 Pages 10 Questions 30 Points per question; Total Possible Score = 300 pts <i>50% Partial Credit Possible 0 points if work not shown</i>	
Extended Multiple Choice Section	
3 Pages 15 Questions 25 Points per question; Total Possible Score = 375 pts	
Process Scenarios Section	
5 Pages 4 Questions 100 points per question, Total Possible = 400 points 50% Partial Credit Possible 0 points if work not shown	
Remember that you may be penalized if you don't show your work, even if the answer is correct! All team members must participate. BONUS POINTS FOR RETURNING SHEETS IN ORDER	
Judges Initials Captains Initials	

300

300

375

400

125

1500

Math Multiple Choice

- Formulas not provided.
- Based on General Wastewater Math
- BRING YOUR OWN CALCULATOR
- SHOW YOUR WORK

3	The BOD level of the wastewater entering an aeration tank is 220 mg/L. If the flow to the tank is 1.65 MGD, what is the lbs/day of BOD loading?	A	3,596 lbs/day
		B	4,515 lbs/day
		C	5,299 lbs/day
		D	3,027 lbs/day

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125 1500	

Extended Multiple Choice

- General wastewater trivia
- Match 5 responses to the best answers from 20 options
- Points to be had here!!!

Choices		#	Question	Answer	pt 25	answer
A	Nitrification	1	Phosphorus species removed by filters.		_____	_____
B	S2EBPR					
C	Reactive Phosphorus					
D	Conventional EBPR					
E	Volatile Acids					
F	Densification	2	Process that selects for PAOs in a side stream tank.		_____	_____
G	Glycogen Accumulating Organism					
H	Modelling					
I	Particulate Phosphorus					
J						
K	Deammonification	3	Biological process that involves partial nitritation and anaerobic ammonium oxidation.		_____	_____
L	SND					
M	Accumulibacter					
N	Flocculent Activated Sludge					
O	rbCOD					
P	Soluble Non Reactive Phosphorus	4	Activated Sludgedesign/ operation to select for the fastest settling activated sludge particles.		_____	_____
Q	Centrifugal Force					
R	Hydro cyclone					
S	Denitrification					
T	Tetrasphaera					
		5	Group of bacteria known to compete against phosphorus accumulating bacteria, particularly in warmer weather.		_____	_____

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*Judges Initials
Captains Initials*

Process Scenario

- High Risk – High Reward
 - Difficult but with high point totals
- Math and situation from actual facility design criteria

1	Maximum point value for this question	100	A	8.2 lbs/d/sf
	Based on the information from above, what would the solids loading rate to the listed clarifier be if the MLSS concentration is 2800 mg/L, the RAS flow rate is 0.52 MGD and the influent flow is 0.6 MGD assuming both clarifiers are in operation?			
			B	5.1 lbs/d/sf
			C	22.5 lbs/d/sf
			D	12.1 lbs/d/sf

ANYTOWN, WI DESIGN CRITERIA	
Oxidation Ditches	
Type	A2O process
Number of Ditches	2
Volume, Total	994,000 gal
Number of Anaerobic Zones	4 (2 per train)
Anaerobic Zone Volume (total)	49,000 gal
Number of Anoxic Zones	2 (1 per train)
Anoxic Zone Volume (total)	155,000 gal
Number of Oxic Zones	2 (1 per train)
Aerated Zone Volume (total)	790,000 gal
Mechanical Surface Aerators	
Type	Low speed mechanical impeller
Number	4 (2 each aerated tank)
Speed	1,800 rpm
Motor Horsepower (each)	30 hp
Drive	Variable frequency
Organic Loading Rate (Average) (Oxic/Anoxic)	15 lbs BOD/day/1,000 ft ³
Hydraulic Detention Time (Average) (Oxic/Anoxic)	28.7 hrs
Standard Oxygen Requirement	7,671 lbs/day (excludes denitrification credit)
Design Horizontal Velocity	1.0 ft/sec
Aerator Impeller Submergence Control	Liquid level adjustment via DOW gates. Submergence controls DO concentration and horizontal velocity of ML.
Final Clarifiers	
Type	Circular, center feed
Number	2
Diameter	45 ft
SWD	15 ft
Total Weir Length	283 ft
Surface Overflow Rate	248 gpd/sq ft @ 0.79 mgd
Solids Loading Rate (MLSS = 3,000 mg/L)	893 gpd/sq ft @ 3.16 mgd 0.8 lbs/sq ft @ RAS=200% ADE (1.58 mgd), Forward Flow=DME (1.77 mgd) 0.94 lbs/sq ft @ 0.79 mgd + 1.19 mgd RAS 1.29 lbs/sq ft @ 3.16 mgd + 0.79 mgd RAS 6.254 gpd/sq ft
Weir Loading Rate @ DME = 1.77 mgd	10.9 lbs @ 0.79 mgd
Hydraulic Detention Time	2.7 hrs @ 3.16 mgd

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1500

Return on time and in order...

- Points for simply returning in order
- Don't forget names etc, some initial each page
- No bonus for getting done early so keep harvesting points

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Where do the questions come from?

- WEF Test Examples
- Water and Wastewater Courses
- WEF Manuals
 - Activated Sludge
 - MOP 11
 - Other
- WDNR Study Guide
- Troy Larson

Tips/Resources



Resources

Water Environment Federation - WEF Skills Builder

- <https://www.wef.org/SkillsBuilder/>

Water Environment Federation – WEF Operations Challenge Team Resource Center

- https://rmwea.org/oc_process.php

Wisconsin Department of Natural Resources Wastewater Operator Certification

- <https://dnr.wisconsin.gov/topic/opcert/wastewater.html>

Wastewater Treatment Mathematical Formulas

EPA Math for Wastewater Operators

- <https://www.epa.gov/compliance/math-wastewater-operators#materials>

Tennessee Department of Environment & Conservation

- https://www.tn.gov/content/dam/tn/environment/water/ftc/references/formula-conversions/ftc_op-cert-formula-manual_ww.pdf

Minnesota Pollution Control Agency Training and Certification Unit

- <https://www.pca.state.mn.us/sites/default/files/wq-wwtp8-02.pdf>

Preparation Strategy and Tips

- Exam will have more questions than your team will have an opportunity to complete in the given time allowed.
- How to obtain the most points both effectively & efficiently.
 - Breakup responsibilities

	Teammate 1	Teammate 2	Teammate 3
Primary Focus	Scenario	Multiple Choice	Multiple Choice Math
Secondary Focus	Multiple Choice Math	Multiple Choice Math	Scenario
Tertiary Focus	Multiple Choice	Scenario	Multiple Choice

- Internal Clock
- Don't know the Answer? Circle the Question.

Conversion Constants

Weight / Mass

- 8.34 lbs./gallon

Volume

7.48 gallons/ft³

Area

Acre= 43,560 ft²

Pressure/Head

2.31 ft. water/psi

Power

- 3,960 water hp efficiency
- 1 hp = 746 watts

Temperature

$$^{\circ}\text{C} = 0.556(^{\circ}\text{F} - 32^{\circ})$$

$$^{\circ}\text{F} = 1.8(^{\circ}\text{C}) + 32^{\circ}$$

Solving Math Problems

- Read the problem carefully.
- Draw and label a picture of the problem.
- Think about the information you are given and what you want to know.
- Choose a formula (some problems may require more than one formula).
- Write down the formula as it is given. Rearrange if it is not in the form you need.
- Replace the words in the formula with numbers and units from the information you have been given. (Sometimes you may be given information you do not need – do not let that fool you!)
- If needed, add conversion factors to end up with the requested units.
- Calculate the equation. Multiply and/or add all the numbers in the numerator (top part of fraction) and denominator (bottom part of fraction) then divide the numerator by the denominator.
- Ask yourself if the final answer is reasonable for the question being asked.
- Double check to make sure your answer is in the correct units being asked for.

Reference: State of Minnesota, Minnesota Pollution Control Agency Math Concepts Review 2008

Preparation Strategy and Tips

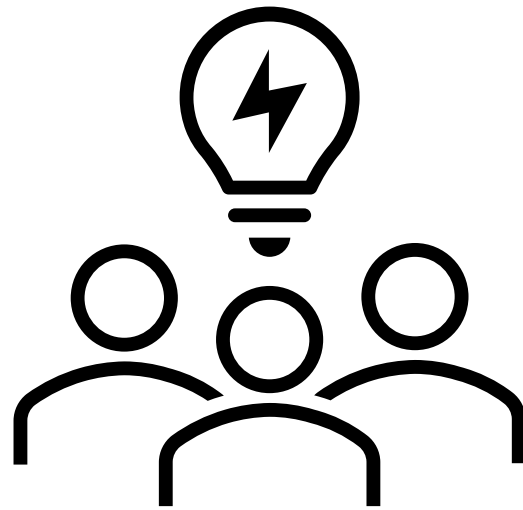
Approach to Answering Multiple Choice

- Exclude 1 or 2 options to increase your chances.

Approach to Answering Scenario

- Interdependent: Answer from Q1 required to solve Q2. Q2 answer needed for Q3 etc.
- Independent: Q3 may be worth more points than either Q1, Q2 or Q4. Begin with Q3 to maximize points.
- Avoid over thinking, read and react to the question and use the “givens” after understanding the question.

Group Test and Review



Multiple Choice – Group Test

CIRCLE THE BEST CHOICE		10 or 20 PTS PER CORRECT RESPONSE
#	Question	Choices
1	If a hazardous gas has a specific gravity of 1.5, where is it likely to be found if it leaks from a container in a room?	A Near the floor
		B equally distributed through the space
		C near the ceiling
		D in a cloud right around the leak
2	When sludge does not settle properly, the condition is commonly referred to as _____.	A denitrification
		B nitrification
		C bulking
		D blowdown
3	In an extended aeration activated sludge process, the typical solids retention time (SRT) is _____?	A 40 - 60 days
		B 2 - 8 days
		C 8 - 15 days
		D 15 - 40 days
4	The wavelength of UV light used to disinfect wastewater effluent is _____.	A 253.7 nm
		B 274.9 nm
		C 286.5 nm
		D 225.2 nm
5	What is the typical removal efficiency of settleable solids in a primary clarifier?	A 10 to 15%
		B 20 to 50%
		C 40 to 60%
		D 95 to 99%
6	What impact does the injection of chlorine gas have on the pH of wastewater?	A Increase pH
		B Decreases pH
		C Does not affect pH
		D Fluctuate pH

Extended Multiple Choice – Group Test

Choices		#	Question	Answer
A	acid and water at the same time	1	When diluting acids with water the proper technique is to pour _____.	B
B	acid into a container containing water			
C	activated sludge			
D	anaerobiasis			
E	ashing			
F	bulking	2	What type of treatment process typically includes aeration basins and mixed liquor?	C
G	clarifier			
H	colloids			
I	disinfection system			
J	double stack			
K	filter	3	Before wastewater treatment begins, flow typically passes through a _____.	R
L	fluidized bed			
M	induced draft			
N	it does not matter			
O	multiple-hearth			
P	overland flow	4	Which type of incinerator uses graded silica?	L
Q	rotating biological contactors			
R	screen			
S	trickling filters			
T	water into a container containing acid			
		5	An excessive amount of small, light particles floating on the surface of a secondary clarifier is referred to as _____.	E

Math Multiple Choice – Group Test

3	The BOD level of the wastewater entering an aeration tank is 220 mg/L. If the flow to the tank is 1.65 MGD, what is the lbs/day of BOD loading? $220 \text{ mg/L BOD} * 1.65 \text{ mgd} * 8.34 =$ 3027	A	3,596 lbs/day
		B	4,515 lbs/day
		C	5,299 lbs/day
		D	3,027 lbs/day

Operations Scenario

With a RAS rate of 0.8 mgd and an influent flow rate of 1.1 mgd what would the solids loading rate to the clarifier be with a mixed liquor concentration of 3,500 mg/L?

Assume both clarifiers are in service.

$$\frac{3,500 \text{ mg/L TSS} * (0.8 + 1.1 \text{ mgd}) * 8.34}{2,512 \text{ sq ft}} =$$

22 lbs/sq ft/d

Final Clarifiers No. 1 and No. 2

Type	Circular/covered, suction biosolids withdrawal
Number	2
Diameter	40 ft (each)
Side Water Depth	15 ft (each)
Surface Area	1,256 sq ft (each tank)
Total Surface Area	2,512 sq ft
Volume	141,000 gal (each tank)
Total Volume	282,000 gal
Surface Overflow Rate	
@ 0.46 mgd	183 gpd/sq ft
@ 2.512 mgd	1,000 gpd/sq ft
Hydraulic Detention Time	
@ 0.46 mgd	14.7 hrs
@ 1.487 mgd	4.6 hrs

RAS Pumping

Number	3 (2 + 1 standby)
Type	Centrifugal, variable speed
Capacity (each)	320 gpm
Capacity (firm)	640 gpm

Questions/Comments/Discussion

