

**EXAMINATION HANDBOOK**

**FOR THE**

**OPERATOR CERTIFICATION PROGRAM**

**COMPUTER BASED EXAMINATIONS**



**FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION**

**Operator Certification Program**  
**2600 Blair Stone Rd. MS 3506, Tallahassee, FL 32399-2400**  
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**[www.dep.state.fl.us/water/wff/ocp](http://www.dep.state.fl.us/water/wff/ocp)**

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## EXAMINATION OVERVIEW

The Drinking Water and Domestic Wastewater Treatment Plant Operator Examinations are composed of four levels - Class A, Class B, Class C, and Class D. The examination time allocated is **three (3)** hours for Class A, B, and C, with 100 multiple choice questions. The examination time allocated is **two (2)** hours for class D, with 50 multiple choice questions.

The Water Distribution System Operator examinations are composed of four levels – 1, 2, 3 and 4. The examination time allocated is **two (2)** hours for each level, with 50 multiple questions.

## EXAMINATION APPLICATION APPROVAL

All applications for examination must be submitted to the Department of Environmental Protection, Operator Certification Program (Department). Once your application has been reviewed and approved by the Department, you will be notified in writing. Your approval letter will contain your unique identification number for you to provide to AMP for scheduling purposes. For your security, the Department will not provide AMP with your Social Security Number as a means for personal identification. Once you receive your approval letter, you may contact AMP via the Internet or by phone to schedule your examination.

Please note that the approved training course you completed for your examination eligibility is only good for five (5) years from the date of completion. If you do not schedule and take your examination before this expiration date, you will not be permitted to test. You will be required complete a new training course and submit a new application to the Department with all required fees and supporting documentation.

## SCHEDULING AN EXAMINATION

Be prepared to confirm a date and location for testing and to provide your **PROFILE ID #** as your unique identification number. This ID number is located on the “Approval Letter” mailed to you by the Department. You may schedule an examination appointment by one of the following methods:

1. **Schedule Online:** The candidate may schedule an examination appointment online at any time by using the online scheduling service at [www.goAMP.com](http://www.goAMP.com). To use this service on our website, follow these easy steps:
  - Go to [www.goAMP.com](http://www.goAMP.com) and select “Candidates.”
  - Follow the step-by-step instructions choosing your examination program and scheduling the examination.

OR

**2. Telephone Scheduling:** Call AMP at **888-519-9901** to schedule an examination appointment. This toll-free number is answered from 7:00 a.m. to 9:00 p.m. (Central Time) Monday through Thursday, 7:00 a.m. to 9:00 p.m., Friday 7:00 a.m. to 7:00 p.m. (Central Time), and Saturday 8:30 a.m. to 5:00 p.m. (Central Time).

The examinations are administered by appointment only Monday through Saturday at 9:00 a.m. and 1:30 p.m. Individuals are scheduled on a first-come, first-served basis. Refer to the chart below.

If you contact AMP by 3:00 p.m. Central Time on...	Depending on availability, your examination may be scheduled as early as...
Monday	Wednesday
Tuesday	Thursday
Wednesday	Friday/Saturday
Thursday	Monday
Friday	Tuesday

When the appointment is made, the applicant will be given a time to report to the Assessment Center. Please make a note of it since an admission letter will not be sent. The applicant will only be allowed to take the examination for which the appointment has been made. No changes in examination type, class or level will be made at the Assessment Center. **UNSCHEDULED CANDIDATES (WALK-INS) WILL NOT BE ADMITTED** to the Assessment Center.

If special accommodations are being requested, you will need to have prior approval from the Department. AMP will not be able to assist with this matter until notification is received from the Department. Once you have received approval for special accommodations, please contact AMP at 888-519-9901 to schedule your examination.

## **ASSESSMENT CENTER LOCATIONS**

Examinations are administered by computer at over 160 AMP Assessment Centers geographically distributed throughout the United States. Assessment Centers are typically located in H&R Block offices. Assessment Center locations, detailed maps and directions are available on AMP's website, [www.goAMP.com](http://www.goAMP.com). Specific address information will be provided when a candidate schedules an examination appointment.

## **HOLIDAYS**

The examinations are not offered on the following holidays:

New Year's Day	Columbus Day
Martin Luther King Day	Veterans' Day
Presidents' Day	Thanksgiving Day (and the following Friday)
Good Friday	Christmas Eve Day
Memorial Day	Christmas Day
Independence Day (July 4)	New Year's Eve Day
Labor Day	

## **SPECIAL ARRANGEMENTS FOR CANDIDATES WITH DISABILITIES**

Both the Department and AMP comply with the Americans with Disabilities Act and strive to ensure that no individual with a disability is deprived of the opportunity to take the examination solely by reason of that disability. The Department and AMP will provide reasonable accommodations for candidates with disabilities. If special accommodations are being requested, you will need to have prior approval from the Department. AMP will not be able to assist with this matter until notification is received from the Department. Once you receive your approval for special accommodations may then contact AMP at 888-519-9901 to schedule your examination.

1. Wheelchair access is available at all established Assessment Centers. Candidates must advise AMP at the time of scheduling that wheelchair access is necessary.
2. Candidates with visual, sensory or physical disabilities that would prevent them from taking the examination under standard conditions may request special accommodations and arrangements.

Verification of the disability and a statement of the specific type of assistance needed must be made in writing to the Department at least **45** calendar days prior to your desired examination date. Please inform AMP of your approved need for special accommodations when scheduling your examination time.

## **TELECOMMUNICATION DEVICES FOR THE DEAF**

AMP is equipped with Telecommunication Devices for the Deaf (TDD) to assist deaf and hearing-impaired candidates. TDD calling is available Monday-Friday 8:30 a.m. to 5:00 p.m. (Central Time) at 913-895-4637. This TDD phone option is for individuals equipped with compatible TDD machinery.

## EXAMINATION APPOINTMENT CHANGES/FAILURE TO REPORT TO A SCHEDULED EXAMINATION

1. A candidate may reschedule an appointment for examination at no charge **only** one time by calling AMP at 888-519-9901 at least two business days prior to the scheduled testing session. (See table below.) **A second attempt to reschedule will be denied.** If you are unable to make your rescheduled appointment, you will be required to reapply and repay the applicable exam fee again.

To reschedule the examination, AMP must be contacted no later than 3:00 p.m. Central Time by the previous . . . . .	If the Examination is scheduled on
Monday	Wednesday
Tuesday	Thursday
Wednesday	Friday
Thursday	Monday
Friday	Tuesday

2. A candidate will forfeit the examination fee and must reapply to the Department under the following circumstances.
- The candidate wishes to reschedule an examination but fails to contact AMP at least two business days prior to the scheduled testing session.
  - The candidate wishes to reschedule a second time.
  - The candidate is more than 15 minutes late for their examination, or
  - The candidate fails to report for an examination appointment (no show).

## INCLEMENT WEATHER, POWER FAILURE OR EMERGENCY

In the event of inclement weather or unforeseen emergencies on the day of an examination, AMP will determine whether circumstances warrant the cancellation, and subsequent rescheduling, of an examination. The examination will usually not be rescheduled if the Assessment Center personnel are able to open the Assessment Center. If power to an Assessment Center is temporarily interrupted during an administration, your examination will restart where you left off and you may continue the examination.

Candidates may contact AMP’s Weather Hotline at 800-380-5416 (24 hours/day) prior to the examination to determine if AMP has been advised that any Assessment Centers are closed. Every attempt is made to administer the examination as scheduled; however, should an examination be canceled at an Assessment Center, all scheduled candidates will receive notification following the examination regarding rescheduling or reapplication procedures.

## ON THE DAY OF YOUR EXAMINATION

On the day of your examination appointment, report to the Assessment Center no later than your scheduled testing time. Once you enter the H&R Block office, look for the signs indicating AMP Assessment Center check-in. **A CANDIDATE WHO ARRIVES MORE THAN 15 MINUTES AFTER THE SCHEDULED TESTING TIME, WILL NOT BE ADMITTED.**

To gain admission to the Assessment Center, a candidate needs to present two forms of identification, one with a current photograph. Both forms of identification must be current and include the candidate's current name and signature. The candidate will also be required to sign a roster for verification of identity.

Please Note: **IF YOU FAIL TO BRING ACCEPTABLE FORMS OF IDENTIFICATION TO YOUR SCHEDULED APPOINTMENT, YOU WILL NOT BE PERMITTED TO TAKE THE EXAMINATION.**

Acceptable forms of identification include a current:

1. Driver's license with photograph
2. State issued identification card with photograph
3. Passport
4. Military identification card with photograph
5. Social security card (secondary form)

Employment ID cards, student ID cards and any type of temporary identification are **NOT** acceptable as primary identification, but may be used as secondary identification. Candidates are prohibited from misrepresenting their identities or falsifying information to obtain admission to the Assessment Center.

## SECURITY

The Department and AMP maintain examination administration and security standards that are designed to assure all candidates are provided the same opportunity to demonstrate their abilities. The Assessment Center is continuously monitored by audio and video surveillance equipment for security purposes.

The following security procedures apply during the examination:

- Examinations are proprietary. No cameras, notes, tape recorders, personal digital assistants (PDAs), pagers or cellular phones are allowed in the testing room.
- No guests, visitors or family members are allowed in the testing room or reception areas.
- No personal items, valuables, or weapons are allowed in the Assessment Center. Only keys and wallets may be taken into the testing room and AMP is not responsible for items left in the reception area.

- Only calculators that are silent, hand-held, non-printing, non-programmable, with no random access memory (RAM) and with no alphabetical key pads are allowed.

## **EXAMINATION RESTRICTIONS**

- No personal belongings will be allowed in the Assessment Center. Pencils will be provided during check-in. **Use of a cellular phone or other electronic devices is strictly prohibited and will result in dismissal from the examination.**
- You will be provided with scratch paper to use during the examination. You must sign and return the scratch paper to the supervisor at the completion of testing, or you will not receive a score report. No documents or notes of any kind may be removed from the examination room. If you need a second piece of scratch paper, you need to ask the test proctor for another piece of paper and turn in the one you used before.
- No questions concerning the content of the examination may be asked during the examination.
- Eating, drinking or smoking will not be permitted in the Assessment Center.
- You may take a break whenever you wish, but you will not be allowed additional time to make up for time lost during breaks.

## **MISCONDUCT**

Rule 62-602.530, Florida Administrative Code states the following:

*"Any individual found by the Department to have engaged in conduct which subverts or attempts to subvert the examination process may have his or her scores on the examination withheld and declared invalid. Individuals with an active or inactive license shall be subject to suspension or revocation of the license as stated in rule 62-602.870(1), F.A.C. Individuals that do not have an active or inactive license shall be disqualified from taking future exams for a period of two years. Conduct which subverts or attempts to subvert the examination process includes:*

*Conduct which violates the security of the examination materials, such as removing from the examination room any of the examination materials; reproducing or reconstructing any portion of the licensing examination; aiding by any means in the reproduction or reconstruction of any portion of the licensing examination; selling, distributing, buying, receiving or having unauthorized possession of any portion of, or information from, a future or current licensing examination.*

*Conduct which violates the standard of test administration, such as communicating with any other examinee during the administration of the examination; copying answers from another examinee or permitting one's answers to be copied by another examinee during the administration of the examination; having in one's possession during the administration of the licensing examination any book, notes, written or printed materials, or data of any kind,*

*other than examination materials distributed or specifically listed as approved materials for the examination room in the information provided to the examinee in advance of the examination date by the Department. Conduct which violates the credentialing process, such as falsifying or misrepresenting information required for admission to the examination; impersonating an examinee or having an impersonator take the licensing examination on one's own behalf."*

Any violation of the conduct rules or other irregularities will be documented in writing by the Department's agent(s) and the documentation of the violation or irregularity will be presented to the appropriate Departmental unit for consideration or action. The Department's agent(s) shall exercise extreme care in their documentation to ensure that the violation or irregularities are precisely recorded as they were witnessed.

## **COPYRIGHTED EXAMINATION QUESTIONS**

All examination questions are copyrighted property. It is forbidden under federal copyright law to copy, reproduce, record, distribute or display these examination questions by any means, in whole or in part. Doing so may subject you to severe civil and criminal penalties.

## **PRACTICE EXAMINATION**

After your identification has been confirmed, you will be directed to a testing carrel. You will be instructed on-screen to enter your **PROFILE ID#**. You will take your photograph which will remain on-screen throughout your examination session. This photograph will also print on your score report.

Prior to attempting the examination, you will be given the opportunity to practice taking an examination on the computer. The time you use for this practice examination is NOT counted as part of your examination time or score. When you are comfortable with the computer testing process, you may quit the practice session and begin the timed examination.

## **TIMED EXAMINATION**

Following the practice examination, you will begin the timed examination. Before beginning, instructions for taking the examination are provided on-screen. The computer monitors the time you spend on the examination. The examination will terminate if you exceed the time allowed. You may click on the TIME box in the lower right-hand corner of the screen or select the TIME key to monitor your time. A digital clock indicates the time remaining for you to complete the examination. The Time feature may be turned off during the examination. Only one examination question is presented at a time.

The question number appears in the lower right hand corner of the screen. Choices of answers to the examination question are identified as A, B, C, or D. You must indicate your

choice by either typing in the letter in the response box in the lower left hand of the computer screen or clicking in the option using the mouse. To change your answer, enter a different option by pressing the A, B, C, or D key or by clicking on the option using the mouse. You may change your answer as many times as you wish during the examination time limit.

To move to the next question, click on the forward arrow (>) in the lower right portion of the screen or select the NEXT key. This action will move you forward through the examination question by question. If you wish to review any question or questions, click the backward arrow (<) or use the left arrow key to move backward through the examination.

An examination question may be left unanswered for return later in the examination session. Questions may also be bookmarked for later review by clicking in the blank square to the right of the Time button. Click on the hand icon or select the NEXT key to advance to the next unanswered or bookmarked question on the examination. To identify all unanswered and bookmarked questions, repeatedly click on the hand icon or press the NEXT key. When the examination is completed, the number of examination questions answered is reported. If all questions were not answered and there is time remaining, return to the examination and answer those questions. Be sure to provide an answer for each examination question before ending the examination. There is no penalty for guessing.

## **CANDIDATE COMMENTS**

During the examination, online comments may be provided for any question by clicking on the button displaying an exclamation point (!) to the left of the TIME button. This opens a dialogue box where comments may be entered. This is your opportunity to provide the department with valuable information or concerns relevant to a particular examination question. Comments about a particular question are reviewed at a later date. Please note that no response will be mailed to you regarding your comment.

## **FOLLOWING THE EXAMINATION**

After completing the examination, candidates are asked to complete a short evaluation of their examination experience. Please take this opportunity to document any problem that you may have experienced during the exam. Candidates are then instructed to report to the examination proctor to receive their examination score report.

## **EXAMINATION SCORES**

Candidates will receive an on-site score report. In order to pass an examination, a minimum of **70%** must be achieved. Candidates that fail to achieve a passing score must wait at least **60** calendar days before they will be permitted to retake their exam.

## **SCORES CANCELLED BY THE DEPARTMENT OR AMP**

The Department and AMP are responsible for the validity and integrity of the scores they report. On occasion, occurrences, such as computer malfunction or misconduct by a candidate, may cause a score to be suspect. The Department and AMP reserve the right to void or withhold examination results if, upon investigation, violation of regulations is discovered.

## **DRINKING WATER AND WASTEWATER OPERATOR EXAMINATION SUBJECT AREA OVERVIEW**

The Drinking Water and Wastewater Treatment Plant Operator examinations are composed of four levels; Operators - Class A, Class B, Class C, and Class D. These examinations are given, for each type and level, on one day. The examination time allocated is three (3) hours for Class A, B, and C, with 100 questions. The examination time allocated is two (2) hours for Class D with 50 questions. All exams are composed of multiple choice questions.

### **Class A Drinking Water Treatment Plant Operators.**

Each examination item may be from one of the subject areas listed below:

- Chemical Treatment/Addition
- Clarification/Sedimentation
- Coagulation/Flocculation
- Facility Management
- Filtration
- Laboratory Sampling, Analysis & Interpretation
- Math
- Process Control
- Perform Safety & Security Procedures
- Residuals Disposal
- Regulations

### **Class B Drinking Water Treatment Plant Operators.**

Each examination item may be from one of the subject areas listed below:

- Characteristics of Source Water
- Chemical Treatment/Addition
- Coagulation and Flocculation
- Corrosion Control
- Clarification/Sedimentation
- Disinfection & Disinfectant Byproducts
- Distribution
- Facility Operation & Maintenance
- Filtration
- Fluoridation
- Iron and Manganese Control
- Laboratory Sampling, Analysis & Interpretation
- Maintain Equipment
- Math
- Operate Equipment
- Regulations
- Reservoir and Well-Field Management
- Softening
- Taste and Odor Control

**Class C Drinking Water Treatment Plant Operators.**

Each examination item may be from one of the subject areas listed below:

- Aeration
- Characteristics of Source Water
- Clarification/Sedimentation
- Coagulation and Flocculation
- Corrosion Control
- Disinfection
- Disinfection and Disinfectant Byproducts
- Distribution
- Filtration
- Facility Operation and Maintenance
- Evaluate Equipment
- Iron and Manganese Control
- Laboratory Sampling, Analysis & Interpretation
- Math
- Operate Equipment
- Perform Safety and Security Procedures
- Regulations
- Reservoir and Well Field Management
- Softening
- Taste and Odor Control
- Waste Handling and Disposal
- Water Process

**Class D Drinking Water Treatment Plant Operators.**

Each examination item may be from one of the subject areas listed below:

- Chemical Treatment/Addition
- Maintain Equipment
- Perform Safety and Security Procedures
- Plant Operation
- Regulations
- Reporting Requirements

**SUBJECT OUTLINE FOR WASTEWATER TREATMENT PLANT OPERATORS**

**Class A Wastewater Treatment Plant Operators.**

Each examination item may be from one of the subject areas listed below:

- Perform Administrative Duties
- Employment Skills
- Facility Management
- Math
- Secondary Processes
- Process Control
- Regulations

### **Class B Wastewater Treatment Plant Operators.**

Each examination item may be from one of the subject areas listed below:

- Disinfection
- Effluent Disposal
- Interpret Lab Analysis
- Math
- Primary Treatment
- Solids Handling
- Nutrient Removal
- Odor Control
- Perform Laboratory Analysis
- Regulations
- Perform Safety and Security Procedures
- Secondary Processes

### **Class C Wastewater Treatment Plant Operators**

Each examination item may be from one of the subject areas listed below:

- Disinfection
- Facilities & Collection Systems
- Laboratory Sampling, Analysis & Interpretation
- Maintenance
- Math
- Perform Safety and Security Procedures
- Primary Treatment
- Records & Reporting
- Regulations
- Secondary Processes
- Solids Handling

### **Class D Wastewater Treatment Plant Operators.**

Each examination item may be from one of the subject areas listed below:

- Disinfection
- Operate Equipment
- Package Plants & Disinfection
- Perform Safety and Security Procedures
- Regulations

## **WATER DISTRIBUTION SYSTEM OPERATOR EXAMINATION SUBJECT AREA OVERVIEW**

The Water Distribution System Operators examinations are composed of four levels; Operators – Level 1, Level 2, Level 3 and Level 4. These examinations are given, for each type and level, on one day. The examination time allocated is two (2) hours with 50 questions. All exams are composed of multiple choice questions.

### **Level 1 Water Distribution System Operators.**

Each examination item may be from one of the subject areas listed below:

- Perform Administrative Duties
- Drinking Water Regulations
- Install Equipment
- Maintain Equipment
- Disinfection
- Operate Equipment
- System Design
- System Inspection
- Water Quality
- Perform Safety and Security Procedures
- Math

### **Level 2 Water Distribution System Operators.**

Each examination item may be from one of the subject areas listed below:

- Perform Administrative Duties
- Drinking Water Regulations
- Install Equipment
- Maintain Equipment
- Disinfection
- Operate Equipment
- System Design
- System Inspection
- Water Quality
- Perform Safety and Security Procedures
- Math

### **Level 3 Water Distribution System Operators.**

Each examination item may be from one of the subject areas listed below:

- Perform Administrative Duties
- Drinking Water Regulations
- Evaluate Operation of Equipment
- Install Equipment
- Maintain Equipment
- Disinfection
- Operate Equipment
- System Design
- System Inspection
- Water Quality

Perform Safety and Security Procedures  
Math

**Level 4 Water Distribution System Operators.**

Each examination item may be from one of the subject areas listed below:

Perform Administrative Duties  
Drinking Water Regulations  
Install Equipment  
Maintain Equipment  
Disinfection  
Operate Equipment  
System Design  
System Inspection  
Water Quality  
Perform Safety and Security Procedures  
Math

**FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION  
DRINKING WATER A, B, C & D FORMULA SHEET AND CONVERSION FACTORS 10-09**

12 in = 1 ft	27 cu. ft. = 1 cu. yd	1000 mg = 1 gm	60 sec = 1 min
3 ft = 1 yd	7.48 gal = 1 cu. ft.	1000 gm = 1 kg	60 min = 1 hour
5280 ft = 1 mi	8.34 lbs = 1 gal	1000 ml = 1 liter	1440 min = 1 day
144 sq. in. = 1 sq. ft.	62.4 lbs = 1 cu. ft.	3.785L = 1 gal	10,000 mg/L = 1%
43,560 sq. ft. = 1 acre	1 grain / gal = 17.1 mg/L	2.31 ft water = 1 psi	454 gm = 1 lb.
		0.433 psi = 1 ft water	

L = Length    B = Base     $\pi = 3.14$     W = Width    H = Height    R = Radius

**AREA**

Rectangle:  $A = L \times W$       Triangle:  $A = 1/2 B \times H$       Circle: Area =  $\pi \times R^2$

**Volume**

Cylinder:  $V = \pi R^2 \times H$       Rectangle:  $V = L \times W \times H$       Cone:  $V = 1/3\pi \times R^2 \times H$

**TEMPERATURE CONVERSIONS**

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

$F^\circ \text{ to } C^\circ = \frac{(F^\circ - 32)}{1.8}$

**VELOCITIES and FLOW RATES**

1.  $V = \frac{\text{distance, feet}}{\text{time, min}}$

2.  $Q = V \times A$       Flow rate = (velocity, ft / sec x area, sq. ft.)

**DETENTION TIME**

1. Detention Time =  $\frac{(\text{tank, cap. gal}) \times (24 \text{ hours/day})}{\text{rate of flow (gal / time)}}$

2. Detention Time, Minutes =  $\frac{(\text{cap. gal.})(24 \text{ hr./day})(60 \text{ min./hr.})}{(\text{Flow, gal./day})}$

**PARTS PER MILLION / POUNDS**

1.  $\text{mg/L} = \frac{\text{pounds of chemical}}{(8.34 \text{ lbs / gal} \times \text{MG})}$

2.  $\text{lbs} = 8.34 \text{ lbs / gal} \times \text{mg/L} \times \text{MG}$

## LOADINGS

1. Weir overflow, gal / day / ft =  $\frac{\text{total flow, gal / day}}{\text{length of weir, ft.}}$
2. Surface loading, gal / day / sq.ft. =  $\frac{\text{flow, gal / day}}{\text{surface area, sq. ft.}}$
3. Rise rate, ft / min =  $\frac{\text{surface loading, gal / min / sq. ft.}}{7.48 \text{ gal / cu. ft.}}$

## CHEMICAL MIXING & SOLUTION STRENGTHS

1. Polymer, % =  $\frac{(\text{dry polymer, lbs}) \times (100\%)}{(\text{dry polymer, lbs} + \text{water, lbs})}$
2. Dry polymer, lbs =  $(\text{Water, Lbs}) / ((100 / \text{polymer \%}) - 1)$
3. Water, lbs =  $\frac{\text{dry polymer, lbs} \times 100\%}{\text{polymer \%}} - \text{dry polymer, lbs}$
4. Liquid polymer, gal =  $\frac{(\text{polymer solution, \%}) (\text{gal of solution})}{\text{liquid polymer, \%}}$
5. Scale setting, % =  $\frac{(\text{desired feed rate, gal / hr}) (100\%)}{\text{maximum feed rate, gal / hr.}}$
6. Feeder setting, % =  $\frac{(\text{desired feed rate, lbs / day}) (100\%)}{(\text{maximum feed rate, lbs / day})}$
7. Water added, gal =  $\frac{\text{hypo, gal} (\text{hypo, \%}) - (\text{hypo, gal}) (\text{desired hypo, \%})}{\text{desired hypo, \%}}$
8. Polymer feed, lbs/day =  $\frac{(\text{polymer conc., mg/L})(\text{vol. pumped, ml})(60 \text{ min/hr})(24 \text{ hr/day})}{(\text{time pumped, min.})(1,000 \text{ mg/L})(1,000 \text{ mg/gm})(454 \text{ gm/lb})}$

## FILTRATION

1. Filtration rate, gal / min / sq. ft. =  $\frac{\text{flow, gal / min}}{\text{surface area, sq. ft.}}$
2. Backwash pumping rate, gal / min = (filter surface area, sq. ft.) (BW rate, gal / min / sq. ft.)
3. Backwash rise, in/min. =  $\frac{(\text{backwash, GPM/sft})(12\text{in/ft})}{(7.48 \text{ gal/cft})}$
4. Backwash % =  $\frac{(\text{backwash water, gal})}{\text{water filtered, gal.}} (100\%)$
5. UFRV, gal / sq. ft. =  $\frac{\text{volume filtered, gal}}{\text{filter surface area, sq. ft.}}$
6. UFRV, gal/sq. ft. = (Filtration Rate, GPM/sq ft)(Filter Run, hr)(60 min/hr)

## SOFTENING & DEMINERALIZATION

1. Lime feed, mg/L =  $\frac{(A + B + C + D) \times 1.15}{\text{purity of lime as a decimal}}$

A = carbon dioxide, source water (mg/L as CO<sub>2</sub>) x (56 / 44)

B = bicarbonate alkalinity, source water (mg/L as Ca CO<sub>3</sub>) x (56 / 100)

C = hydroxide alkalinity, source water (mg/L as Ca CO<sub>3</sub>) x (56 / 100)

D = magnesium, source water (mg/L as Mg<sup>2+</sup>) x (56 / 24.3)

If hydrated lime is used instead of quicklime, substitute 74 for 56 in A, B, C, and D.

2. Lime demand, mg/L =  $\frac{[(2.27 \times \text{CO}_2) + (\text{Total Alkalinity}) + (4.12 \times \text{Mg}) \times 0.56] \times (\text{excess})}{\text{Calcium oxide purity (\% / 100)}}$

3. Lime demand, lbs / MG =  $\frac{(\text{lime demand, mg/L}) (1 \text{ MG}) (4.67 \text{ lb / MG / mg/L}) (\text{excess lime, \% / 100})}{\text{Calcium oxide purity (\% / 100)}}$

4. Exchange capacity, grains = (removal capacity, gr / cu. ft.) (media vol, cu. ft.)

5. Water treated, gal =  $\frac{\text{exchange capacity, grains}}{\text{hardness removed, grains / gal}}$

6. Bypass flow, gal / day =  $\frac{(\text{total flow, gal / day}) (\text{finished water hardness, grains / gal})}{\text{raw water hardness, grains / gal}}$

7. Salt, lbs = (salt req'd, lbs / 1000 grains) (hardness removed, grains)

8. Brine, gal =  $\frac{\text{salt needed, lbs}}{\text{salt sol'n, lbs / gal}}$

$$9. \quad \text{Mineral rejection, \%} = 1 - \left( \frac{\text{product TDS, mg/L}}{\text{feedwater TDS, mg/L}} \right) \times 100\%$$

$$10. \quad \text{Recovery, \%} = \left( \frac{\text{product flow}}{\text{feed flow}} \right) \times 100\%$$

$$11. \quad \text{Non-Carbonate Hardness} = \text{Mg/L as CaCO}_3$$

$$\text{Total Hardness} - \text{Total Alkalinity} = \text{Non-Carbonate Hardness}$$

$$\text{Raw Non-Carbonate Hardness} - \text{Finished Non-Carbonate Hardness} = \text{Non-Carbonate Hardness Removed}$$

$$12. \quad \text{Soda Ash} = (\text{Non-Carbonate Hardness}) \left( \frac{106}{100} \right)$$

### **FLUORIDATION**

$$1. \quad \text{Fluoride ion purity, \%} = \frac{\text{(molecular wt. of F in compound)}}{\text{molecular wt. of compound}} (100\%)$$

$$2. \quad \text{Feed rate, lbs / day} = \frac{\text{(flow, MGD)} \text{ (desired F, mg/L)} \text{ (8.34 lbs / gal)} \text{ (100\%)}}{\text{(acid sol'n, \%)} \text{ (purity \%)}}$$

$$3. \quad \text{Feed rate, gal / day} = \frac{\text{feed rate, lbs / day}}{\text{chemical sol'n, lbs / gal}}$$

$$4. \quad \text{Portion of F} = \frac{\text{(commercial chemical purity, \%)} \text{ (Fluoride ion, \%)}}{(100\%) (100\%)}$$

$$5. \quad \text{Feed rate, lbs / day} = \frac{\text{Fluoride, lbs / day}}{\text{fluoride, lbs / lb of commercial chemical}}$$

### **LABORATORY**

$$1. \quad \text{Dilute to mL} = \frac{\text{(Actual Weight, gm)}(1,000 \text{ mL})}{\text{(Desired Weight, gm)}}$$

$$2. \quad \text{Langelier Index (L.I.)} = \text{pH} - \text{pHs}$$

### **DISINFECTION**

$$\text{Chlorine Demand, mg/L} = \text{Chlorine Dosage, mg/L} - \text{Chlorine Residual, mg/L}$$

$$\text{Chlorine Dosage, mg/L} = \text{Chlorine Demand, mg/L} + \text{Chlorine Residual, mg/L}$$

**FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION**  
**WASTEWATER A, B, C & D FORMULA SHEET AND CONVERSION FACTORS 10-09**

12 in= 1 ft	27 cu. ft. = 1 cu. yd.	1000 mg = 1 gm
3 ft= 1 yd	7.48 gal= 1 cu. ft.	1000 gm = 1 kg
5280 ft= 1 mi	8.34 lbs= 1 gal	1000 ml = 1 liter
144 sq. in. = 1 sq. ft.	62.4 lbs= 1 cu. ft.	2.31 ft water = 1 psi
43,560 sq. ft.= 1 acre	1 grain / gal= 17.1 mg/L	0.433 psi = 1 ft water
60 sec = 1 min	60 min = 1 hour	1440 min = 1 day
10,000 mg/L = 1%	454 gm = 1 lb.	43,560 sq. ft.= 1 acre

**TEMPERATURE CONVERSIONS**

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

$$F^{\circ} \text{ to } C^{\circ} = \frac{(F^{\circ} - 32)}{1.8}$$

**VELOCITIES and FLOW RATES**

1.  $V = \frac{\text{distance, feet}}{\text{time, min}}$

2.  $Q = V \times A$  (Flow rate = velocity, ft / sec x area, sq. ft.)

**DETENTION TIME**

1. Det. Time =  $\frac{\text{tank cap. (gal)} \times (24 \text{ hours/day})}{\text{rate of flow (gal / time)}}$

**PARTS PER MILLION / POUNDS**

1.  $\text{mg/L} = \frac{\text{pounds of chemical}}{(8.34 \text{ lbs / gal} \times \text{MG})}$

2.  $\text{lbs} = 8.34 \text{ lbs / gal} \times \text{mg/L} \times \text{MG}$

**SEDIMENTATION AND LOADINGS**

1. Weir overflow, gal / day / ft =  $\frac{\text{total flow, gal / day}}{\text{length of weir, ft.}}$

2. Surface loading, gal / day / sq.ft. =  $\frac{\text{influent flow, gal / day}}{\text{surface area, sq. ft.}}$

3. Solids loading, lbs / day / sq. ft. =  $\frac{\text{solids applied, lbs / day}}{\text{surface area, sq. ft.}}$
4. Efficiency, % =  $\frac{(\text{in}) - (\text{out})}{(\text{in})} \times 100\%$
5. Hydraulic loading, gal / day / sq.ft. =  $\frac{\text{flow rate, gal / day}}{\text{surface area, sq. ft.}}$
6. Trickling Filter Organic loading, lbs CBOD /day / 1000 cu. Ft. =  $\frac{\text{CBOD applied, lbs /day}}{\text{vol. of media in 1000 cu. Ft.}}$
7. Soluble CBOD, mg/L = total CBOD, mg/L - (K x suspended solids, mg/L)  
(where K = 0.5 to 0.7 for most domestic wastewaters)
8. RBC Organic Loading, lbs CBOD/day/1000 sq.ft. =  $\frac{\text{soluble CBOD applied, lbs/day}}{\text{Surface area of media, 1000 sq.ft.}}$

### **ACTIVATED SLUDGE**

1. SVI =  $\frac{30 \text{ min settling, mL/L}}{\text{MLSS, mg/L}} \times 1,000$
2. SDI =  $\frac{100}{\text{SVI}}$
3. Solids inventory, lbs = (Tank cap, MG)x (MLSS, mg/L) x (8.34 lbs / gal)
4. Sludge age, days =  $\frac{\text{solids under aeration, lbs}}{\text{solids added, lbs / day}}$
5. F/M =  $\frac{(\text{inf CBOD, mg/L}) \times (\text{Flow, MGD}) \times (8.34 \text{ lbs / gal})}{(\text{Aeration tank cap, MG}) \times (\text{MLVSS, mg/L}) \times (8.34 \text{ lbs / gal})}$
6. MCRT =  $\frac{\text{solids inventory, lbs}}{(\text{effluent solids, lbs}) + (\text{WAS solids, lbs})}$
7. WAS, lbs / day =  $\frac{(\text{Solids inventory, lbs}) - (\text{Solids lost in effluent, lbs / day})}{\text{MCRT, days}}$
8. WAS flow, MGD =  $\frac{\text{WAS, lbs/day}}{(\text{WAS, mg/L}) \times (8.34 \text{ lbs / gal})}$
9. Change, WAS rate, MGD =  $\frac{(\text{current solids inventory, lbs}) - (\text{desired solids inventory, lbs})}{\text{WAS, mg/L} \times 8.34 \text{ lbs / gal}}$
10. Return sludge rate, MGD =  $\frac{(\text{set. Solids, mL}) \times (\text{flow, MGD})}{(1,000 \text{ mL}) - (\text{set. solids, mL})}$

## **SLUDGE DIGESTION**

1. Dry solids, lbs =  $\frac{(\text{raw sludge, gal}) \times (\text{raw sludge, \% solids}) \times (8.34 \text{ lbs / gal})}{100 \%}$
2. VS pumped, lbs / d =  $\frac{(\text{ret. sludge, gal / day}) (\text{ret. sludge solids, \%}) (\text{ret. sludge vol., \%}) (8.34 \text{ lbs / gal})}{(100\%) (100\%)}$
3. Seed Sludge, lbs volatile solids =  $\frac{\text{VS pumped, lbs VS / day}}{\text{loading factor, lbs VS / day / lb VS in digester}}$
4. Seed Sludge, gal =  $\frac{\text{seed sludge, lbs volatile solids}}{(\text{seed sludge, lbs / gal}) \times \frac{(\text{solids \%})}{100\%} \times \frac{(\text{VS \%})}{100\%}}$
5. Lime req'd, lbs = (sludge, MG) x (volatile acids, mg/L) x (8.34 lbs / gal)
6. Reduction of Volatile Solids, % =  $\frac{(\text{in} - \text{out}) \times 100\%}{\text{in} - (\text{in} \times \text{out})}$
7. VS destroyed, lbs / day / cu. ft. =  $\frac{(\text{VS added, lbs / day}) (\text{VS reduction, \%})}{(\text{digester volume, cu. ft.}) (100\%)}$
8. Gas production, cu. ft. / lb VS =  $\frac{\text{gas produced, cu. ft. / day}}{\text{VS destroyed, lbs / day}}$

## **HORSEPOWER, FORCE, CHEMICAL PUMPS**

1. Water HP =  $\frac{(\text{flow, gal / min}) \times (\text{head, ft})}{3,960}$
2. BHP =  $\frac{(\text{flow, gal / min}) \times (\text{head, ft.})}{(3,960 \times \text{Pump Efficiency, \%})}$
3. Motor HP =  $\frac{(\text{flow, gal / min}) \times (\text{head, ft})}{(3,960) \times (\text{Pump Efficiency, \%}) \times (\text{Motor Efficiency, \%})}$
4. Upward force, lbs = 62.4 lbs / cu. ft. x ground water height over tank bottom, ft x area, sq.ft.
5. Side wall force, lbs = (31.2 lbs / cu. ft.) x (height, ft)<sup>2</sup> x (length, ft)
6. Chemical sol = n, lbs / gal =  $\frac{(\text{sol'n \%}) \times (8.34 \text{ lbs / gal})}{100\%}$
7. Feed pump flow, gal / day =  $\frac{\text{chemical feed, lbs / day}}{\text{chemical solution, lbs / gal}}$
8. Scale setting, % =  $\frac{(\text{desired flow, gal / day}) (100 \%)}{\text{maximum feed rate, gal / day}}$
9. Brake Horsepower =  $\frac{(\text{Power to elec. motor}) (\text{Motor Eff.})}{\text{Hp}}$   
Hp = .746 kw/Hp

10. Pump Efficiency, % =  $\frac{\text{Water Horsepower, Hp} \times 100\%}{\text{Brake Horsepower, Hp}}$
11. Total Dynamic Head, ft. = Static Head, ft. + Friction Losses, ft.
12. Static Head = Suction Lift, ft. + Discharge Head, ft.

### **LAB PROCEDURES AND MEASUREMENTS**

1. TSS, mg/L =  $\frac{(\text{RDD} - \text{DD})}{\text{sample vol, mL}} \times 1 \text{ M}$
2. VSS, mg/L =  $\frac{(\text{RDD} - \text{FDD})}{\text{sample vol, mL}} \times 1 \text{ M}$

where: RDD = dried residue + dish + disc (filter), grams  
 DD = dish + disc, grams  
 FDD = fired residue + dish + disc, grams  
 1 M = 1,000,000

3. VSS, % =  $\frac{\text{volatile solids, mg/L}}{\text{total suspended solids, mg/L}} \times 100\%$
4. CBOD sample size, mL =  $\frac{1,200}{\text{estimated CBOD, mg/L}}$
5. Seed correction, mg/L, for 1 mL seed =  $\frac{\text{seed initial D.O.} - \text{seed final D.O.}}{\text{mL seed added}}$
6. CBOD, mg/L =  $\frac{[(\text{initial DO} - \text{Final DO}) - \text{seed correction factor}] \times (\text{bottle volume, mL})}{\text{sample volume, mL}}$

### **DISINFECTION**

Chlorine Demand, mg/L = Chlorine Dosage, mg/L – Chlorine Residual, mg/L

Chlorine Dosage, mg/L = Chlorine Demand, mg/L + Chlorine Residual, mg/L