WASTEWATER OPERATOR TRAINING

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OVERVIEW

• Introduction
• Expectations/Conditions of Each Class of License
• Technical Content per the ABC Need-to-Know Criteria
MAINE WASTEWATER OPERATOR CLASSIFICATION
(Maine DEP CH. 531)

- Five Classifications – Biological Treatment
  - Grade I
  - Grade II
  - Grade III
  - Grade IV
  - Grade V

- Three Classifications – Physical/Chemical Treatment (I-III)

- Two Classifications – Spray Irrigation Treatment (Sm/Lg)

- Collection Systems – Voluntary Licensing?
2. Classification of Wastewater Treatment Plants

A. Classification of Biological Treatment Plants. A biological wastewater treatment plant is classified on a population equivalent (P.E.) of 0.2 lbs. of Biochemical Oxygen Demand (BOD) and 100 gallons per person per day. The treatment plant design capacity will be the major classification criteria in determining such population equivalent. Plant grade will be determined on the following basis except as noted in Section 2(C).

<table>
<thead>
<tr>
<th>Size (P.E.)</th>
<th>Secondary-Biological</th>
<th>Advanced Treatment*</th>
<th>Other Defined Treatment**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 5,000</td>
<td>II</td>
<td>III</td>
<td>I</td>
</tr>
<tr>
<td>5,000 to 15,000</td>
<td>III</td>
<td>IV</td>
<td>II</td>
</tr>
<tr>
<td>15,000 to 50,000</td>
<td>IV</td>
<td>V</td>
<td>III</td>
</tr>
<tr>
<td>50,000 and over</td>
<td>V</td>
<td>V</td>
<td>IV</td>
</tr>
</tbody>
</table>

*Advanced treatment includes one or more of the following.
1. Advanced biological/chemical methods;
2. Ion Exchange, Reverse Osmosis or Electrodialysis; or,
3. Chemical recovery or Carbon regeneration.

**Other defined treatment includes one or more of the following.
1. Separate sludge digestion with gas collection; or,
2. Mechanical sludge dewatering or sludge incineration.
B. Qualifications for Certification. Each applicant shall satisfy the experience requirements for the grade of certification requested. Education may be substituted for experience as set forth below. Educational substitutions will be based on the following.

(1) High school education or equivalent is credited for two years of experience.

(2) Post high school education in approved areas of engineering, science and/or related fields. 30 semester hours, or equivalent, equals 1 year.

(3) Specialized training courses will be evaluated on the basis of training credits; six classroom hours of approved courses equals one credit, 45 credits equals one year. Examples. 36 hour course = 6 credits; Sacramento Course = 15 credits per volume.

(4) A person attending a course approved by the Department where attendance credit is given in Continuing Education Units (C.E.U.s) is credited with 10 training hours for each C.E.U. earned.

(5) All experience or education submitted in support of applications that is not specified in this section shall be evaluated on an individual basis.
OPPORTUNITIES FOR EMPLOYMENT

Operations and Management

Treatment Systems Operators
Collection Systems Operators
Superintendent/General Manager
Technical Support Staff

Administrative Staff
Maintenance Staff
Laboratory Staff
Construction Crew

Engineering Staff
CONDITIONS OF EMPLOYMENT

• Certification – 3 E’s (Education, Experience, Examination)
  • Mandatory, Voluntary
  • Full Certification, Provisional, Operator in Responsible Charge

• Education – Primary and Continuing
  • Minimum for Consideration: GED, High School
  • Trade Group & College Programs Exist
  • Education can be used in Place of Experience

• Experience – Direct or Related
  • Summer Worker
  • Intern/Apprentice
  • Military
  • Industry

• Examination – Sequential or Direct-Entry
CONDITIONS OF EMPLOYMENT

- **Skill Sets – One, Some, All**
  - Mechanical – Construction, Operations, Maintenance
  - Science – Biology, Chemistry, Hydraulics
  - Math
  - Communication – Verbal and Written
  - Management & Leadership
  - Laboratory
  - Technology – Computers, PLCs
EXPECTATIONS & CONDITIONS

Grade I: High school diploma or 2 years direct experience

100 question exam

May Operate a Grade I Plant

18 TCHs per 2 Years
EXPECTATIONS & CONDITIONS

Grade II: 4 years direct experience (education may be substituted for up to 3 years experience)

100 question exam

May Operate a Grade I or II Plant

18 TCHs per 2 Years
EXPECTATIONS & CONDITIONS

Grade III: 5 years direct experience (education may be substituted for up to 3 years experience)

100 question exam

May Operate a Grade I, II or III Plant

18 TCHs per 2 Years
EXPECTATIONS & CONDITIONS

Grade IV: 6 years direct experience, with 3 years at Grade II or higher plant (education may be substituted for up to 3 years experience)

100 question exam

May Operate Grade I - IV Plants

18 TCHs per 2 Years
EXPECTATIONS & CONDITIONS

Grade V: 8 years direct experience, with 4 years at Grade III or higher plant (education may be substituted for up to 4 years experience)

100 question exam

May Operate Grade I - V Plants

18 TCHs per 2 Years
Three Types of Questions per Topic

• Recall

• Application

• Analysis

As Grade Level Increases, Fewer Recall Questions, More Analysis Questions (in general)

As Grade Level Increases, Fewer Basic Questions, More Intermediate & Advanced Questions
TECHNICAL CONTENT

Treatment Process

• Disinfection
• Chemical Dose Calculations (Pounds Formula)
• Chemical Handling & Storage
• SCADA
• Solids Handling
• Troubleshooting & Process Adjustments

(30 – 5, 10, 15; 30 – 5, 10, 15; 30 – 5, 10, 15; 35 – 5, 15, 15)
Laboratory Analysis

- Wastewater Sample Analysis – biological, chemical, physical
- Sample Collection & Preservation
- Equipment – Use, Calibration, Maintenance
- Data Interpretation
- Laboratory for Process Control

(10 – 2, 7, 1; 15 – 3, 9, 3; 15 – 2, 8, 5; 20 – 3, 10, 7)
TECHNICAL CONTENT

Equipment Evaluation & Maintenance

- Pumps & Motors
- Meters & Sensors
- SOPs - Preventive Maintenance
- Chemical Feed
- Piping – water, chemical, air
- Aeration Systems

(25 – 12, 10, 3; 20 – 8, 9, 3; 20 – 6, 11, 3; 15 – 4, 6, 5)
TECHNICAL CONTENT

Equipment Operation

• Pumps & Motors
• Meters & Sensors
• SOPs – Start Up/Shutdown
• Chemical Feed
• Piping – water, chemical, air
• Aeration Systems

(25 – 8, 14, 3; 25 – 5, 15, 5; 25 – 5, 10, 10; 20 – 2, 10, 8)
Security, Safety, & Administrative Procedures

- Safety Procedures
- Scheduling/Budgeting
- Emergency Planning
- Regulatory Compliance
- Asset Management
- Develop and Maintain SOPs
- Maintain System Records

(10 – 7, 3, 0; 10 – 6, 4, 0; 10 – 4, 6, 0; 10 – 2, 4, 4)
TECHNICAL CONTENT

Further Research to Help Prepare

- Association of Boards of Certification (ABC) Need-to-Know Criteria (8 documents — 4 for treatment, 4 for collection) — Collection System Operator Certification is not Mandatory
- ABC Formula/Conversion sheets
- www.abccert.org
Exam Content

The Wastewater Collection Operator Class III 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

<table>
<thead>
<tr>
<th>Content Area</th>
<th>Number of Questions</th>
<th>Job Task Complexity Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment Operation, Evaluation, &amp; Maintenance</td>
<td>25</td>
<td>5 5 5</td>
</tr>
<tr>
<td>Collection System Operation, Maintenance, &amp; Restoration</td>
<td>25</td>
<td>3 9 3</td>
</tr>
<tr>
<td>Lift Station Operation &amp; Maintenance</td>
<td>15</td>
<td>3 9 3</td>
</tr>
<tr>
<td>Collection System Monitoring, Evaluation, &amp; Adjustment</td>
<td>15</td>
<td>3 9 3</td>
</tr>
<tr>
<td>Security, Safety, &amp; Administrative Procedures</td>
<td>20</td>
<td>4 12 4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>20 60 20</strong></td>
</tr>
</tbody>
</table>

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

This exam includes 12 calculation questions.
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.

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<thead>
<tr>
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<tbody>
<tr>
<td>Aerobic and Anaerobic principles (e.g., wetwells, diffusers, surge basins, available oxygen)</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Intermediate</td>
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<tr>
<td>Backflow cross-connection and prevention</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td></td>
<td>Intermediate</td>
<td>Intermediate</td>
</tr>
<tr>
<td>Biology (e.g., bloodborne pathogens, hydrogen sulfide formation, odors, wastewater characteristics)</td>
<td>Intermediate</td>
<td></td>
<td></td>
<td>Intermediate</td>
<td>Intermediate</td>
</tr>
<tr>
<td>Biological laboratory testing (e.g., BOD, COD, DO, pH sampling, identification, oil, grease)</td>
<td>Intermediate</td>
<td></td>
<td></td>
<td></td>
<td>Intermediate</td>
</tr>
<tr>
<td>Chemistry (e.g., chemical addition, odor and corrosion control)</td>
<td>Intermediate</td>
<td></td>
<td></td>
<td></td>
<td>Intermediate</td>
</tr>
<tr>
<td>Hydraulic principles (e.g., pump operation, pressures, pipe capacity, velocity, storage time, surcharging)</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td></td>
<td></td>
<td>Intermediate</td>
</tr>
<tr>
<td>Laboratory techniques (e.g., grab and composite sampling, sample preservation)</td>
<td>Intermediate</td>
<td></td>
<td></td>
<td></td>
<td>Intermediate</td>
</tr>
<tr>
<td>Mechanical principles (e.g., lift station pumps, engines, air exchangers, continuous readers)</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td></td>
<td></td>
<td>Intermediate</td>
</tr>
<tr>
<td>Blueprint reading (e.g., service connections, as built plans, process and instrumentation diagrams)</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td></td>
<td></td>
<td>Intermediate</td>
</tr>
<tr>
<td>Building codes (e.g., easements/plot-of-ways and sewer use ordinances, pipe specifications and inspections)</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td></td>
<td></td>
<td>Intermediate</td>
</tr>
<tr>
<td>Chemical properties (e.g., chlorine, hydrogen sulfide, methane, carbon monoxide, oxygen)</td>
<td>Intermediate</td>
<td></td>
<td></td>
<td></td>
<td>Advanced</td>
</tr>
</tbody>
</table>
Formula/Conversion Table
Wastewater Treatment, Collection, Industrial Waste,
& Wastewater Laboratory Exams

Alkalinity, mg/L as CaCO₃ = \frac{(Titrant \ Volume, \ mL)(Acid \ Normality)(50,000)}{Sample \ Volume, \ mL}

Amps = \frac{Volts}{Ohms}

Area of Circle* = (0.785)(\text{Diameter}^2)

Area of Circle = (3.14)(\text{Radius}^2)

Area of Cone (lateral area) = (3.14)(\text{Radius})\sqrt{\text{Radius}^2 + \text{Height}^2}

Area of Cone (total surface area) = (3.14)(\text{Radius})(\text{Radius} + \sqrt{\text{Radius}^2 + \text{Height}^2})

Area of Cylinder (total exterior surface area) = [\text{End #1 SA} + \text{End #2 SA}] + [(3.14)(\text{Diameter})(\text{Height or Depth})]

Where \text{SA} = \text{surface area}

Area of Rectangle* = (\text{Length})(\text{Width})

Area of Right Triangle* = \frac{(\text{Base})(\text{Height})}{2}

Average (arithmetic mean) = \frac{\text{Sum of All Terms}}{\text{Number of Terms}}

Average (geometric mean) = [(X_1)(X_2)(X_3)(X_4)(X_n)]^{1/n} \quad \text{The nth root of the product of n numbers}

Biochemical Oxygen Demand (seeded), mg/L = \frac{[\text{Initial \ DO, mg/L} - \text{Final \ DO, mg/L} - \text{Seed \ Correction \ Factor, mg/L}][300 \ mL]}{\text{mL \ of \ Sample}}

Biochemical Oxygen Demand (unseeded), mg/L = \frac{[\text{Initial \ DO, mg/L} - \text{Final \ DO, mg/L}][300 \ mL]}{\text{mL \ of \ Sample}}
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ft</td>
<td>feet</td>
</tr>
<tr>
<td>ft lb</td>
<td>foot-pound</td>
</tr>
<tr>
<td>g</td>
<td>grams</td>
</tr>
<tr>
<td>gal</td>
<td>US gallons</td>
</tr>
<tr>
<td>gfd</td>
<td>US gallons flux per day</td>
</tr>
<tr>
<td>gpcd</td>
<td>US gallons per capita per day</td>
</tr>
<tr>
<td>gpd</td>
<td>US gallons per day</td>
</tr>
<tr>
<td>gpg</td>
<td>grains per US gallon</td>
</tr>
<tr>
<td>gpm</td>
<td>US gallons per minute</td>
</tr>
<tr>
<td>hp</td>
<td>horsepower</td>
</tr>
<tr>
<td>hr</td>
<td>hours</td>
</tr>
<tr>
<td>in</td>
<td>inches</td>
</tr>
<tr>
<td>kg</td>
<td>kilograms</td>
</tr>
<tr>
<td>km</td>
<td>kilometers</td>
</tr>
<tr>
<td>kPa</td>
<td>kilopascals</td>
</tr>
<tr>
<td>kW</td>
<td>kilowatts</td>
</tr>
<tr>
<td>kWh</td>
<td>kilowatt-hours</td>
</tr>
<tr>
<td>L</td>
<td>liters</td>
</tr>
<tr>
<td>lb</td>
<td>pounds</td>
</tr>
<tr>
<td>Lpcd</td>
<td>liters per capita per day</td>
</tr>
<tr>
<td>Lpd</td>
<td>liters per day</td>
</tr>
<tr>
<td>Lpm</td>
<td>liters per minute</td>
</tr>
<tr>
<td>LSI</td>
<td>Langeliers Saturation Index</td>
</tr>
<tr>
<td>m</td>
<td>meters</td>
</tr>
<tr>
<td>MCRT</td>
<td>mean cell residence time</td>
</tr>
<tr>
<td>MG</td>
<td>million US gallons</td>
</tr>
</tbody>
</table>

**Conversion Factors**

1 acre = 43,560 ft² = 4,046.9 m²
1 acre foot of water = 326,000 gal
1 atm = 33.9 ft of water = 10.3 m of water = 14.7 psi = 101.3 kPa
1 cubic foot of water = 7.48 gal = 62.4 lb
1 cubic foot per second = 0.646 MGD = 448.8 gpm
1 cubic meter of water = 1,000 kg = 1,000 L = 264 gal
1 foot = 0.305 m
1 foot of water = 0.433 psi
1 gallon (US) = 3.785 L = 8.34 lb of water
1 grain per US gallon = 17.1 mg/L
1 hectare = 10,000 m²
1 horsepower = 0.746 kW = 746 W = 33,000 ft lb/min
1 inch = 2.54 cm
1 liter per second = 0.0864 MLD
1 meter of water = 9.8 kPa
1 metric ton = 2,205 lb
1 mile = 5,280 ft = 1.61 km
1 million US gallons per day = 694 gpm = 1.55 ft³/sec
1 pound = 0.454 kg
1 pound per square inch = 2.31 ft of water
1 square meter = 1.19 yd²
1 ton = 2,000 lb
1% = 10,000 mg/L
π or pi = 3.14

**Population Equivalent, hydraulic** = 100 gal/person/day

**Population Equivalent, organic** = 0.17 lb BOD/person/day = 0.077 kg BOD/person/day
QUESTIONS?

2. Determine if the following integrals converge or diverge:

(a) \[ \int_{1}^{\infty} \frac{7 \cos^2(x)}{3 + x^2} \, dx \]

(b) \[ \int_{0}^{\pi/2} \frac{2}{x \sin(x)} \, dx \]

(c) \[ \int_{1}^{\infty} \frac{2}{\sqrt{4x^2 - 2}} \, dx \]