

Studying for the Maine Wastewater Operator Certification Exam?

Here are Study Guides and other reference materials
that may be of assistance to you:

(click)

Biological Grades 1 and 2

Biological Grade 3

Biological Grade 4

Biological Grade 5

Physical Chemical

Spray Irrigation Treatment Grades 1 and 2

Resource/Reference Material Guide

Math Formulas

**Also, review practice questions on the monthly
Maine DEP O&M Newsletter**

WASTEWATER TREATMENT PLANT OPERATOR GRADE 1 & 2 EXAMINATION STUDY GUIDE

The following is a general outline to serve as a study guide in preparing for the Grade 1&2 Wastewater Treatment Plant Operators Certification Exam. All subjects may not be covered on every exam but the exam will contain the number of questions in each broad category shown in bold type.

- 1. General Need to Know - 25 questions**
 - E. Sources of Wastewater - Identification
 - B. Wastewater Characteristics - physical, chemical, biological
 - C. Wastewater Treatment Processes - sequence, purpose, goals, and impact of each process on wastewater.
 - D. Basic and Applied Math
 - E. Safety
 - F. General Laboratory and Chemical Knowledge
 - G. Common Parameters and Conversion between them
 - H. Electrical Concepts
 - I. Hydraulics
- 2. Support Systems- 20 questions**
 - A. Mechanical Equipment
 - B. Electrical Equipment
 - C. Engines
 - D. Plumbing
 - E. Measuring Systems & Instrumentation
 - F. Control Systems
 - G. Chemical Feeders
 - H. Heating/Ventilation/Air Conditioning\
 - I. Preventive Maintenance - Pumps
 - J. Preventive Maintenance - Motors
- 3. Treatment Unit Processes & Process Control - 45 questions**
 - A. Flow Equalization
 - B. Preliminary Treatment
 - C. Chemical Pretreatment/Treatment
 - D. Primary Treatment - Sedimentation
 - E. Secondary Treatment - Lagoons
 - F. Secondary Treatment - Activated Sludge
 - G. Secondary Treatment - Trickling Filters/RBC's
 - H. Disinfection
 - I. Advanced Treatment - Nitrification/Nitrogen Removal
 - J. Advanced Treatment General - Filtration/Phosphorous Removal/etc.
 - K. Effluent Disposal and Reuse
 - L. Sludge Treatment - Aerobic and Anaerobic Digestion
 - M. Sludge Treatment - Conditioning
 - N. Sludge Treatment - Thickening
 - O. Sludge Treatment - Dewatering
 - P. Sludge Treatment - Land Application
 - Q. Cross Connections/Collection Systems
 - R. Flow Measurement
 - S. Sampling & Analysis / Laboratory Tests
 - T. Record Keeping
- 4. Supervision & Management - 10**
 - A. Master Planning including Strategies, Objectives, Financial Support and Presentation to Key Personnel
 - B. Maintenance Management Systems
 - C. Emergency Response Systems
 - D. Safety Systems
 - E. Process Control Management Systems
 - C. Rules and Regulations (Clean Water Act, Pollution Discharge Elimination System Permits, Maine Wastewater Discharge License Requirements, Occupational Safety and Health Administration rules, etc.)

There are several publications which you may find useful as you study for the exam. It is not necessary to study all of these publications to do well on the test. This is by no means a complete list of publications which might help your studies.

Operation of Wastewater Treatment Plants, Volume 1 (*The Sacramento Course*)

Water Environment Federation (formerly the Water Pollution Control Federation) Manuals of Practice #'s 1,4,9,11,16,18,20
Standard Methods for the Examination of Water and Wastewater 16th edition (or later)

MWWCA Laboratory Manual

The NPDES Permit and Maine Wastewater Discharge License for a Wastewater Treatment Facility

The *Sacramento Course* can be obtained from:

The Office of Water Programs
California State University, Sacramento
6000 J Street
Sacramento, CA 95819-6025

1. WASTEWATER TREATMENT PLANT OPERATOR GRADE 3 EXAMINATION STUDY GUIDE

The following is a general outline to serve as a study guide in preparing for the Grade 3 Wastewater Treatment Plant Operators Certification Exam. All subjects may not be covered on every exam but the exam will contain the number of questions in each broad category shown in **bold** type.

1. General Need to Know - 20 questions

- | | |
|---|--|
| <ul style="list-style-type: none"> A. Sources of Wastewater - Identification B. Wastewater Characteristics - physical, chemical, biological C. Wastewater Treatment Processes - sequence, purpose, goals, and impact of each process on wastewater. D. Basic and Applied Math | <ul style="list-style-type: none"> E. Safety F. General Laboratory and Chemical Knowledge G. Common Parameters and Conversion between them H. Electrical Concepts I. Hydraulics |
|---|--|

2. Support Systems - 17 questions

- . Mechanical Equipment
- . Electrical Equipment
- . Engines
- . Plumbing
- . Measuring Systems & Instrumentation
- . Control Systems
- . Chemical Feeders
- . Heating/Ventilation/Air Conditioning
- . Preventive Maintenance - Pumps
- . Preventive Maintenance - Motors

3. Treatment Unit Processes & Process Control - 48 questions

- | | |
|---|--|
| <ul style="list-style-type: none"> A. Flow Equalization B. Preliminary Treatment C. Chemical Pretreatment/Treatment D. Primary Treatment - Sedimentation E. Secondary Treatment - Lagoons F. Secondary Treatment - Activated Sludge G. Secondary Treatment - Trickling Filters/RBC's H. Disinfection I. Advanced Treatment - Nitrification/Nitrogen Removal J. Advanced Treatment General - Filtration/Phosphorous Removal/etc. | <ul style="list-style-type: none"> K. Effluent Disposal and Reuse L. Sludge Treatment - Aerobic and Anaerobic M. Digestion N. Sludge Treatment - Conditioning O. Sludge Treatment - Thickening P. Sludge Treatment - Dewatering Q. P. Sludge Treatment - Land Application R. Cross Connections/Collection Systems S. Flow Measurement T. Sampling & Analysis / Laboratory Tests U. Record Keeping |
|---|--|

4. Supervision & Management - 15

- | | |
|--|--|
| <ul style="list-style-type: none"> A. Master Planning including Strategies, Objectives, Financial Support and Presentation to Key Personnel B. Maintenance Management Systems C. Management Information Systems D. Emergency Response Systems E. Safety Systems | <ul style="list-style-type: none"> F. Process Control Management Systems G. Rules and Regulations (Clean Water Act, National Pollution Discharge Elimination System Permits, Maine Wastewater Discharge License Requirements, Occupational Safety and Health Administration rules, etc.) |
|--|--|

There are several publications which you may find useful as you study for the exam. It is not necessary to study all of these publications to do well on the test. This is by no means a complete list of publications which might help your studies.

Operation of Wastewater Treatment Plants, Volume 1 & Volume 2 (The *Sacramento* Course)

Water Environment Federation (formerly the Water Pollution Control Federation) Manuals of Practice #'s 1,4,9,11,16,18,20
Standard Methods for the Examination of Water and Wastewater 16th edition (or later)

MWWCA Laboratory Manual

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California State University, Sacramento
6000 J Street
Sacramento, CA 95819-6025

Need to Know Topics

Grade 3
of Level of
Questions difficulty

1. General Need to Know

Wastewater Characteristics and Sources	20
Wastewater treatment processes, sequences, purpose, goals and impact on wastewater of each process	6 BL/IL
Basic and Applied Math	2 BL
Safety	2 BL
General Lab, Science and Chemical Knowledge	2 BL
Common Parameters and Conversions between them	4 BL/IL
Electrical Concepts	1 BL
8 Hydraulics	2 BL/IL
	1 BL

2. Support Systems

Mechanical Equipment	17
Electrical Equipment	3 BL/IL
Engines	3 BL/IL
Plumbing & Pipes	1 BL
Measuring systems, Instrumentation, Controls & Valves	1 IL
Chemical Feeders	3 BL/IL
Heating, Ventilation & Air Conditioning	1 BL
Maintenance - Pumps	1 BL
9 Maintenance - Motors	2 IL
	2 IL

3. Treatment Processes & Process Control

Flow Equalization	48
Preliminary Treatment - Grit & Screening	2 IL
Chemical Pretreatment/Treatment	2 IL
Primary Treatment/Sedimentation	4 BL/IL
Secondary Treatment - Lagoons	3 BL/IL
Secondary Treatment - Suspended Growth	6 IL
Secondary Treatment - Attached Growth	2 IL
Disinfection	3 IL
Advanced Treatment - Nitrification & Nitrogen Removal	1 IL
Advanced Treatment - Filtration & Phosphorous removal	1 IL
Effluent Disposal & Reuse	1 IL
Sludge Treatment - Digestion - Aerobic	1 IL
Sludge Treatment - Digestion - Anaerobic	1 IL
Sludge Treatment - Conditioning	1 IL
Sludge Treatment - Thickening	2 BL/IL
Sludge Treatment - Dewatering	2 BL/IL
Sludge Disposal - Land Spreading, Composting	2 BL/IL
Sludge Disposal - Incineration	2 BL/IL
Collection Systems/Cross Connections	1 IL
Flow Measurement	2 IL
Sampling & Analysis/Lab tests	8 IL/AL

22 Record Keeping 3-BL/IL

4. Supervision & Management

15

Master planning to include strategies, objectives, financial support, and presentation to key personnel	2 BL/IL
Personnel Systems	
Financial Systems	
Maintenance management systems	2 BL
Management information systems	1 BL
Emergency response systems	2 IL
Industrial pretreatment systems	1 BL
Public relations systems	
Safety systems & regulations	3 BL/IL/AL
Process control management systems	2 BL/IL
Direction and control (management theory)	
Planning (management theory)	
13 Rules & regulations	2 BL
52	
Total Questions	100
Questions Requiring Calculations	12

Notes:

BL = Basic Level

IL = Intermediate Level

AL = Advanced Level

WASTEWATER TREATMENT PLANT OPERATOR GRADE 4 EXAMINATION STUDY GUIDE

The following is a general outline to serve as a study guide in preparing for the Grade 4 Wastewater Treatment Plant Operators Certification Exam. All subjects may not be covered on every exam but the exam will contain the number of questions in each broad category shown in bold type.

1. General Need to Know - 15 questions

- . Sources of Wastewater - Identification
- . Wastewater Characteristics - physical, chemical, biological
- . Wastewater Treatment Processes - sequence, purpose, goals, and impact of each process on wastewater.
- . Basic and Applied Math
- . Safety
- . General Laboratory and Chemical Knowledge
- . Common Parameters and Conversion between them
- . Electrical Concepts
- . Hydraulics

2. Support Systems - 14 questions

- A. Mechanical Equipment
- B. Electrical Equipment
- C. Engines
- D. Plumbing
- E. Measuring Systems & Instrumentation
- F. Control Systems
- G. Chemical Feeders
- H. Heating/Ventilation/Air Conditioning
- I. Preventive Maintenance - Pumps
- J. Preventive Maintenance - Motors

3. Treatment Unit Processes & Process Control - 50 questions

- A. Flow Equalization
- B. Preliminary Treatment
- C. Chemical Pretreatment/Treatment
- D. Primary Treatment - Sedimentation
- E. Secondary Treatment - Lagoons
- F. Secondary Treatment - Activated Sludge
- G. Secondary Treatment - Trickling Filters/RBC's
- H. Disinfection
- I. Advanced Treatment - Nitrification/Nitrogen Removal
- K. Advanced Treatment General - Filtration/Phosphorous Removal/etc.
- L. Effluent Disposal and Reuse
- M. Sludge Treatment - Aerobic and Anaerobic Digestion
- N. Sludge Treatment - Conditioning
- O. Sludge Treatment - Thickening
- P. Sludge Treatment - Dewatering
- Q. Sludge Treatment - Land Application
- R. Cross Connections/Collection Systems
- S. Flow Measurement
- T. Sampling & Analysis / Laboratory Tests
- U. Record Keeping

4. Supervision & Management - 21

- A. Master Planning including Strategies, Objectives, Financial Support and Presentation to Key Personnel
- B. Personnel Systems
- C. Maintenance Management Systems
- D. Management Information Systems
- E. Emergency Response Systems
- F. Safety Systems
- G. Industrial Pretreatment Management
- H. Process Control Management Systems
- I. Direction & Control
 - . Rules and Regulations (Clean Water Act, National Pollution Discharge Elimination System Permits, Maine Wastewater Discharge License Requirements, Occupational Safety and Health Administration rules, etc.)

There are several publications which you may find useful as you study for the exam. It is not necessary to study all of these publications to do well on the test. This is by no means a complete list of publications which might help your studies.

Operation of Wastewater Treatment Plants, Volume 1 & Volume 2 (The *Sacramento* Course)

Water Environment Federation (formerly the Water Pollution Control Federation) Manuals of Practice #'s 1,4,9,11,16,18,20
Standard Methods for the Examination of Water and Wastewater 16th edition (or later)

MWWCA Laboratory Manual

The NPDES Permit and Maine Wastewater Discharge License for a Wastewater Treatment Facility

The *Sacramento Course* can be obtained from:

The Office of Water Programs
California State University, Sacramento
6000 J Street
Sacramento, CA 95819-6025

WASTEWATER TREATMENT PLANT OPERATOR GRADE 5 EXAMINATION STUDY GUIDE

The following is a general outline to serve as a study guide in preparing for the Grade 5 Wastewater Treatment Plant Operators Certification Exam. All subjects may not be covered on every exam but the exam will contain the number of questions in each broad category shown in bold type.

1. General Need to Know - 10 questions

- A. Sources of Wastewater - Identification
- B. Wastewater Characteristics - physical, chemical, biological
- C. Wastewater Treatment Processes - sequence, purpose, goals, and impact of each process on wastewater.
- D. Basic and Applied Math
- E. Safety
- F. General Laboratory and Chemical Knowledge
- G. Common Parameters and Conversion between them
- H. Electrical Concepts
- I. Hydraulics

2. Support Systems - 8 questions

- A. Mechanical Equipment
- B. Electrical Equipment
- C. Engines
- D. Plumbing
- E. Measuring Systems & Instrumentation
- F. Control Systems
- G. Chemical Feeders
- H. Heating/Ventilation/Air Conditioning
- I. Preventive Maintenance – Pumps
- J. Preventive Maintenance - Motors

3. Treatment Unit Processes & Process Control - 52 questions

- A. Flow Equalization
- B. Preliminary Treatment
- C. Chemical Pretreatment/Treatment
- D. Primary Treatment - Sedimentation
- E. Secondary Treatment - Lagoons
- F. Secondary Treatment - Activated Sludge
- G. Secondary Treatment - Trickling Filters/RBC's
- H. Disinfection
- I. Advanced Treatment - Nitrification/Nitrogen Removal
- J. Advanced Treatment General - Filtration/Phosphorous Removal/etc.
- K. Effluent Disposal and Reuse
- K. Sludge Treatment - Aerobic and Anaerobic
- K. Digestion
- K. Sludge Treatment - Conditioning
- K. Sludge Treatment - Thickening
- K. Sludge Treatment - Dewatering
- K. Sludge Treatment - Land Application
- K. Cross Connections/Collection Systems
- K. Flow Measurement
- K. Sampling & Analysis / Laboratory Tests
- K. Record Keeping

4. Supervision & Management - 30

- A. Master Planning including Strategies, Objectives, Financial Support and Presentation to Key Personnel & Public Relations
- B. Personnel Systems
- C. Maintenance Management Systems
- D. Management Information Systems
- E. Emergency Response Systems
- F. Safety & Plant Security Systems
- G. Industrial Pretreatment Management
- H. Process Control Management Systems
- I. Direction & Control
- F. Rules and Regulations (Clean Water Act National Pollution Discharge Elimination System Permits, Maine Wastewater Discharge License Requirements, Occupational Safety and Health Administration rules, etc.)

There are several publications which you may find useful as you study for the exam. It is not necessary to study all of these publications to do well on the test. This is by no means a complete list of publications which might help your studies.

Advanced Waste Treatment for California State University (The *Sacramento Courses*)

Industrial Waste Treatment for California State University (The *Sacramento Courses*)

Water Environment Federation (formerly the Water Pollution Control Federation) Manuals of Practice #'s 1,4,9,11,16,18,20
Standard Methods for the Examination of Water and Wastewater 16th edition (or later)

MWWCA Laboratory Manual

The NPDES Permit and Maine Wastewater Discharge License for a Wastewater Treatment Facility

The *Sacramento Courses* can be obtained from:

The Office of Water Programs
California State University, Sacramento
6000 J Street
Sacramento, CA 95819-6025

WASTEWATER TREATMENT PLANT OPERATOR GRADE 1 PHYSICAL/CHEMICAL EXAMINATION STUDY GUIDE

The following is a general outline to serve as a study guide in preparing for the Grade 1&2 Wastewater Treatment Plant Operators Certification Exam. All subjects may not be covered on every exam but the exam will contain the number of questions in each broad category shown in **bold type**.

1. General Need to Know - 35 questions

- A. Sources of Wastewater - Identification
- B. Wastewater Characteristics - physical, chemical, Wastewater Treatment Processes - sequence, purpose, goals, and impact of each process on wastewater.
- C. Basic and Applied Math
- D. Safety
- E. General Laboratory and Chemical Knowledge
- F. Common Parameters and Conversion between them
- G. Electrical Concepts
- H. Hydraulics

2. Support Systems- 20 questions

- A. Mechanical Equipment
- B. Electrical Equipment
- C. Engines
- D. Plumbing
- E. Measuring Systems & Instrumentation
- F. Control Systems
- G. Chemical Feeders
- H. Heating/Ventilation/Air Conditioning
- I. Preventive Maintenance - Pumps
- J. Preventive Maintenance - Motors

3. Treatment Unit Processes & Process Control – 35 questions

- A. Flow Equalization
- B. Preliminary Treatment
- C. Chemical Pretreatment/Treatment
- D. Primary Treatment - Sedimentation
- E. Disinfection
- F. Coagulation/Floculation/Sedimentation/Filtration
- G. Effluent Disposal and Reuse
- H. Sludge Treatment - Conditioning
- I. Sludge Treatment - Thickening
- J. Sludge Treatment - Dewatering
- K. Sludge Treatment - Land Application
- L. Cross Connections/Collection Systems
- M. Flow Measurement
- N. Sampling & Analysis / Laboratory Tests
- O. Record Keeping

4. Supervision & Management - 10

- A. Master Planning including Strategies, Objectives, Financial Support and Presentation to Key Personnel
- B. Maintenance Management Systems
- C. Emergency Response Systems
- D. Safety Systems
- E. Process Control Management Systems
- F. Rules and Regulations (Clean Water Act, Maine Wastewater Discharge License Requirements, Occupational Safety and Health Administration rules, etc.)
- G. Pollution Discharge Elimination System Permits,

There are several publications which you may find useful as you study for the exam. It is not necessary to study all of these publications to do well on the test. This is by no means a complete list of publications which might help your studies.

Operation of Wastewater Treatment Plants, Volume 1 or Industrial Waste Treatment, Volume I (*Sacramento Courses*)
Water Environment Federation (formerly the Water Pollution Control Federation) Manuals of Practice #'s 1,4,9,11,16,18,20
Standard Methods for the Examination of Water and Wastewater 18th edition (or later)

MWWCA Laboratory Manual

The NPDES Permit and Maine Wastewater Discharge License for a Wastewater Treatment Facility

The *Sacramento Course* can be obtained from:

The Office of Water Programs
California State University, Sacramento
6000 J Street
Sacramento, CA 95819-6025

WASTEWATER TREATMENT PLANT OPERATOR SPRAY IRRIGATION SYSTEM - GRADE 1 & 2 EXAMINATION STUDY GUIDE

The following is a general outline to serve as a study guide in preparing for the Spray Irrigation System - Grade 1&2 Wastewater Treatment Plant Operators Certification Exam. All subjects may not be covered on every exam but the exam will contain the number of questions in each broad category shown in bold type.

1. General Need to Know - 30 percent

- | | |
|---|--|
| A. Sources of Wastewater - Identification | D. Basic and Applied Math |
| B. Wastewater Characteristics - physical, chemical, biological | E. Safety |
| C. Wastewater Treatment Processes - sequence, purpose, goals, and impact of each process on wastewater. | F. Common Parameters and Conversion between them |
| | G. Electrical Concepts |
| | H. Hydraulics |

2. Support Systems- 25 percent

- | | |
|-------------------------|--|
| A. Mechanical Equipment | E. Measuring Systems & Instrumentation |
| B. Electrical Equipment | F. Control Systems |
| C. Engines | G. Preventive Maintenance - Pumps |
| D. Plumbing | H. Preventive Maintenance - Motors |

3. Treatment Unit Processes & Process Control - 30 percent

- | | |
|--------------------------------------|---|
| A. Primary Treatment - Sedimentation | D. Flow Measurement |
| B. Secondary Treatment - Lagoons | E. Sampling & Analysis / Laboratory Tests |
| C. Effluent Disposal and Reuse | F. Record Keeping |

4. Safety, Security and Administration – 15 percent

- | | |
|---|--|
| A. Planning including Strategies, Objectives, and Financial Support | E. Rules and Regulations (Clean Water Act, Maine Pollution Discharge Elimination System Permits, Maine Wastewater Discharge License Requirements, Occupational Safety and Health Administration rules, etc.) |
| B. Maintenance Management Systems | |
| C. Emergency Response Systems | |
| D. Safety Systems | |

There are several publications which you may find useful as you study for the exam. It is not necessary to study all of these publications to do well on the test. This is by no means a complete list of publications which might help your studies.

Operation of Wastewater Treatment Plants, Volumes I & II (The *Sacramento Course*)

- Chapters 3, 4, 5 & 9 Treatment unit processes
- Chapter 1 & 2 – General need to know
- Chapters 15 – Support systems
- Chapters 14 - Safety, security and administration

The MEPDES Permit and Maine Wastewater Discharge License for a Spray Irrigation Wastewater Treatment Facility

The *Sacramento Course* can be obtained from:

The Office of Water Programs
California State University, Sacramento
6000 J Street
Sacramento, CA 95819-6025

Reference Material for ABC Wastewater Treatment Examinations

Exam Topic	California State University, Sacramento Reference Source	Water Environment Federation Reference Source	Other Reference Source
Monitor, Evaluate, and Adjust Treatment Processes	Operation of Wastewater Treatment Plants, Volume I, Ch. 4 - 10 Operation of Wastewater Treatment Plants, Volume II, Ch. 11 - 13 Advanced Waste Treatment, Ch. 1 - 8	Operation of Municipal Wastewater Treatment Plants - Manual of Practice No. 11 Activated Sludge - Manual of Practice OM-9	Code of Federal Regulations, Title 40, Part 136 Standard Methods for the Examination of Water and Wastewater
Collect Samples and Interpret Analyses	Operation of Wastewater Treatment, Volume II, Ch. 16		Code of Federal Regulations, Title 40, Part 136 Standard Methods for the Examination of Water and Wastewater
Perform Laboratory Analysis	Operation of Wastewater Treatment, Volume II, Ch. 16		Code of Federal Regulations, Title 40, Part 136 Standard Methods for the Examination of Water and Wastewater
Evaluate Wastestream Characteristics	Operation of Wastewater Treatment Plants, Volume I, Ch. 2		
Operate Equipment	Operation of Wastewater Treatment Plants, Volume I, Ch. 10 Operation of Wastewater Treatment Plants, Volume II, Ch. 15 Advanced Waste Treatment, Ch. 9	Prime Movers: Engines, Motors, Turbines, Pumps, Blowers & Generators - Manual of Practice OM-5	
Evaluate and Maintain Equipment	Operation of Wastewater Treatment Plants, Volume I, Ch. 10 Operation of Wastewater Treatment Plants, Volume II, Ch. 15 Advanced Waste Treatment, Ch. 9	Prime Movers: Engines, Motors, Turbines, Pumps, Blowers & Generators - Manual of Practice OM-5	
Perform Security, Safety, and Administrative Procedures	Utility Management, Ch. 3 – 13 Operation of Wastewater Treatment Plants, Volume I, Ch. 10 Operation of Wastewater Treatment Plants, Volume II, Ch. 14 Manage for Success	Managing the Water and Wastewater Utility Safety and Health in Wastewater Systems - Manual of Practice No. 1	Code of Federal Regulations, Title 40 State/Provincial Regulations Protecting Your Community's Assets: A Guide for Small Wastewater Systems Supervisory Management in the Water/Wastewater Field

Ordering information:

California State University, Sacramento, Office of Water Programs, 6000 J Street, Sacramento, CA 95819, www.owp.csus.edu, phone (916) 278-6142

Code of Federal Regulations, Title 40, U.S. Government Printing Office, www.gpo.gov, phone (202) 512-0000

Protecting Your Community's Assets: A Guide for Small Wastewater Systems, NETCSC, www.nesc.wvu.edu/netcsc_index.htm, phone (800) 624-8301 (product TRBKMG03)

Standard Methods for the Examination of Water and Wastewater (latest EPA-approved edition), American Public Health Association, www.apha.org, phone (202) 777-2742

State or provincial regulations (contact information for certification programs is available on the Certification Contacts page of ABC's web site, www.abccert.org)

Supervisory Management in the Water/Wastewater Field, Michigan State University, www.vu.msu.edu/preview/smwfwf.html, phone (800) 356-5705

Water Environment Federation, 601 Wythe Street, Alexandria, VA 22314-1994, www.wef.org, phone: (800) 666-0206

**ABC Formula/Conversion Table for Wastewater Treatment,
Industrial, Collection and Laboratory Exams**

$$\text{Alkalinity, as mg CaCO}_3/\text{L} = \frac{(\text{Titrant Volume, mL}) (\text{Acid Normality}) (50,000)}{\text{Sample Volume, mL}}$$

$$\text{Amps} = \text{Volts/Ohms}$$

$$\text{Area of Circle} = (\pi/4) (\text{Diameter}) \text{ or } (\pi) (\text{Radius}^2)$$

$$\text{Area of a cone (lateral area)} = (\pi)(\text{Radius})\sqrt{\text{Radius}^2 + \text{Height}^2}$$

$$\text{Area of a cone (total surface area)} = (\pi)(\text{Radius})(\text{Radius} + \sqrt{\text{Radius}^2 + \text{Height}^2})$$

$$\text{Area of Cylinder (total outside surface area)} = [\text{Surface Area of End \#1}] + [\text{Surface Area of End \#2}] + [(\pi)(\text{Diameter})(\text{Height or Depth})]$$

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

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

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

$$\text{Average (geometric mean)} = (X_1 \times X_2 \times X_3 \times X_4 \times X_n)^{1/n} \text{ (The } n\text{th root of the product of } n \text{ numbers)}$$

$$\text{BOD, mg/L} = (\text{Initial DO, mg/L} - \text{Final DO, mg/L}) \left(\frac{\text{BOD Bottle Volume, mL}}{\text{Sample Volume, mL}} \right)$$

$$\text{Chemical Feed Pump Setting, \% Stroke} = \frac{(\text{Desired Flow}) (100\%/a)}{\text{Maximum Flow}}$$

$$\text{Chemical Feed Pump Setting, mL/min} = \frac{(\text{Flow, MGD}) (\text{Dose, mg/L}) (3.785 \text{ L/gal}) (1,000,000 \text{ gal/MG})}{(\text{Liquid, mg/mL}) (24 \text{ hr/day}) (60 \text{ min/hr})}$$

$$\text{Circumference of Circle} = (\pi) (\text{Diameter})$$

$$\text{Composite Sample Single Portion} = \frac{(\text{Instantaneous Flow}) (\text{Total Sample Volume})}{\text{Number of Portions} (\text{Average Flow})}$$

$$\text{Degrees Celsius} = (\text{Degrees Fahrenheit} - 32) (5/9) \text{ or } (^\circ\text{F} - 32)/1.8$$

$$\text{Degrees Fahrenheit} = (\text{Degrees Celsius}) (9/5 \text{ } ^\circ\text{C}) + 32 \text{ or } (^\circ\text{C})(1.8) + 32$$

$$\text{Detention Time} = \frac{\text{Volume}}{\text{Flow}}$$

$$\text{Electromotive Force (E.M.F), volts} = (\text{Current, amps}) (\text{Resistance, ohms}) \text{ or } E = IR$$

$$\text{Feed Rate, lbs/day} = \frac{(\text{Dosage, mg/L})(\text{Capacity, MGD})(8.34 \text{ lbs/gal})}{(\text{Purity, decimal percentage})}$$

$$\text{Filter Backwash Rate, gpm/sq ft} = \frac{\text{Flow, gpm}}{\text{Filter Area, sq f}}$$

$$\text{Filter Yield, lbs/hr/sq ft} = \frac{(\text{Solids Loading, lbs/day})(\text{Recovery, \% / 100\%})}{(\text{Filter Operation, hr/day})(\text{Area, sq ft})}$$

Flow Rate, cfs = (Area, sq ft) (Velocity, ft/sec) or $Q = AV$ where: Q = flow rate, A = area, V = velocity

$$\text{Food/Microorganism Ratio} = \frac{\text{BOD, lbs/day}}{\text{MLVSS, lbs}}$$

Force, pounds = (Pressure, psi) (Area, sq in)

$$\text{Gallons/Capita/Day} = \frac{\text{Volume of Wastewater Produced, gpd}}{\text{Population}}$$

$$\text{Hardness, as mg CaCO}_3\text{/L} = \frac{(\text{Titration Volume, mL})(1,000)}{\text{mL of Sample}} \quad \text{Only when the titration factor is 1.00 of EDTA}$$

$$\text{Horsepower, Motor} = \frac{(\text{Flow, gpm})(\text{Head, ft})}{(3,960)(\text{Decimal Pump Efficiency})}$$

$$\text{Horsepower, Motor} = \frac{(\text{Flow, gpm})(\text{Head, ft})}{(3,960)(\text{Decimal Pump Efficiency})(\text{Decimal Motor Efficiency})}$$

$$\text{Horsepower, Water} = \frac{(\text{Flow, gpm})(\text{Head, ft})}{3,960}$$

$$\text{Hydraulic Loading Rate} = \frac{\text{Total Flow Applied}}{\text{Area}}$$

$$\text{Leakage, gpd} = \frac{\text{Volume, gallons}}{\text{Time, days}}$$

Mass, lbs/day = (Flow, MGD) (Concentration, mg/L) (8.34 lbs/gal)

$$\text{Mean Cell Residence Time (MCRT), days} = \frac{\text{Aeration Tank SS, lbs} + \text{Clarifier SS, lbs}}{\text{Total SS Wasted, lbs/day} + \text{Effluent SS, lb/day}}$$

$$\text{Molarity} = \frac{\text{Moles of Solute}}{\text{Liters of Solute}}$$

$$\text{Normality} = \frac{\text{Number of Equivalent Weights of Solute}}{\text{Liters of Solution}}$$

$$\text{Number of Equivalent Weights} = \frac{\text{Total Weight}}{\text{Equivalent Weight}}$$

$$\text{Number of Moles} = \frac{\text{Total Weight}}{\text{Molecular Weight}}$$

$$\text{Organic Loading Rate} = \frac{\text{Organic Load, lbs BOD/day}}{\text{Volume}}$$

$$\text{Oxygen Uptake/Consumption Rate} = \frac{\text{Oxygen Usage}}{\text{Time}}$$

$$\text{Population Equivalent, Organic} = \frac{(\text{Flow, MGD})(\text{BOD, mg/L})(8.34 \text{ lbs/gal})}{\text{lbs BOD/day/person}}$$

$$\text{Recirculation Ratio - Trickling Filter} = \frac{\text{Recirculated Flow}}{\text{Primary Effluent Flow}}$$

$$\text{Reduction in Flow, \%} = \frac{(\text{Original Flow} - \text{Reduced Flow})(100\%)}{\text{Original Flow}}$$

$$\text{Reduction of Volatile Solids \%} = \frac{(\text{In} - \text{Out})(100\%)}{\text{In} - (\text{In} \times \text{Out})} \quad \text{All information (In and Out) must be in decimal form}$$

$$\text{Removal, \%} = \frac{(\text{In} - \text{Out})(100)}{\text{In}}$$

$$\text{Return Sludge Rate - Solids Balance} = \frac{(\text{MLSS})(\text{Flow Rate})}{\text{Return Activated Sludge Suspended Solids} - \text{MLSS}}$$

$$\text{Return Rate, \%} = \frac{(\text{Return Flow Rate})(100\%)}{\text{Flow Rate}}$$

$$\text{Slope, \%} = \frac{\text{Drop or Rise} \times 100}{\text{Distance}}$$

$$\text{Sludge Age, days} = \frac{\text{Mixed Liquor Solids, lbs}}{\text{Primary Effluent Solids, lbs/day}} \text{ or } \frac{\text{Solids Under Aeration, lbs}}{\text{Solids Added, lbs/day}}$$

$$\text{Sludge Density Index} = \frac{100}{\text{SVI}}$$

$$\text{Sludge Volume Index, ml/g} = \frac{(\text{Settled Volume, mL/L})(1,000 \text{ mg/g})}{\text{MLSS, mg/L}}$$

$$\text{Solids, mg/L} = \frac{(\text{Dry Solids, grams})(1,000,000)}{\text{Sample Volume, ml}}$$

$$\text{Solids Concentration, mg/L} = \frac{\text{Weight, mg}}{\text{Volume, L}}$$

$$\text{Solids Loading, lbs/day/sq ft} = \frac{\text{Solids Applied, lbs/day}}{\text{Surface Area, sq ft}}$$

$$\text{Specific Gravity} = \frac{\text{Specific Weight of Substance, lbs/gal}}{\text{Specific Weight of Water, lbs/gal}}$$

$$\text{Surface Loading Rate, gpd/sq ft} = \frac{\text{Flow, gpd}}{\text{Area, sq ft}}$$

$$\text{Three Normal Equation} = (N_1 \times V_1) + (N_2 \times V_2) = (N_3 \times V_3), \text{ where } V_1 + V_2 = V_3$$

Two Normal Equation = $(N \times V 1) = (N 2 \times V 2)$ where N = Concentration, V = volume or flow

$$\text{Velocity, ft/sec} = \frac{\text{Flow Rate, cu ft / sec}}{\text{Area, sq ft}} \quad \text{or} \quad \frac{\text{Distance, ft}}{\text{Time, sec}}$$

$$\text{Volatile Solids, \%} = \frac{(\text{Dry Solids, g} - \text{Fixed Solids, g}) (100)}{\text{Dry Solids, g}}$$

$$\text{Volume of Cone} = (1/3) (\pi/4) (\text{Diameter}^2) (\text{Height})$$

$$\text{Volume of Cylinder} = (\pi/4) (\text{Diameter}^2) (\text{Height})$$

$$\text{Volume of Rectangular Tank} = (\text{Length}) (\text{Width}) (\text{Height})$$

$$\text{Waste Milliequivalent} = (\text{mL}) (\text{Normality})$$

$$\text{Watts} = (\text{Volts}) (\text{Amps})$$

$$\text{Weir Overflow Rate, gpd/ft} = \frac{\text{Flow, gpd}}{\text{Weir Length, ft}}$$

Conversion Factors:

1 acre = 43,560 square

1 acre foot = 326,000 gallons

1 cubic foot = 7.48 gallons

1 cubic foot = 62.4 pounds

1 cubic foot per second = 0.646 MGD

1 foot = 0.305 meters

1 foot of water = 0.433 psi

1 gallon = 3.79 liters

1 gallon = 8.34 pounds

1 grain per gallon = 17.1 mg/L

1 horsepower = 0.746 kW or 746 watts or 33,000 ft. lbs./min.

1 million gallons per day = 694 gallons per minute

1 million gallons per day = 1.55 cubic feet per second

1 mile = 5,280 feet

1 pound = 0.454 kilograms

1 pound per square inch = 2.31 feet of water

1% = 10,000 mg/L

$\pi = 3.14$

Abbreviations:

BOD biochemical oxygen demand

cfs cubic feet per second

COD chemical oxygen demand

DO dissolved oxygen

ft feet

F/M ratio food to microorganism ratio

g grams

gpd gallons per day

gpg grains per gallon

gpm gallons per minute

in inches

kW kilowatt

lbs pounds

mg/L milligrams per liter

MCRT mean cell residence time

MGD million gallons per day

ml, milliliter

MLSS mixed liquor suspended solids

MLVSS mixed liquor volatile suspended solids

ORP oxygen reduction potential

OUR oxygen uptake rate

ppb parts per billion

ppm parts per million

psi pounds per square inch

PE population equivalent

Q flow

RAS return activated sludge

SDI sludge density index

SS suspended solids

SVI sludge volume index

TOC total organic carbon

TSS total suspended solids

VS volatile solids

WAS waste activated sludge