INTRODUCTION TO WATER/WASTEWATER OPERATION COURSE

PART I (90 Hours)

A. MATHEMATICS:

1. Basic Math (12 Hours)

   a. Fractions and Decimals
   b. Ration and Proportions
   c. Percent and Unit Analysis
   d. Graphs and Significant Numbers
   e. Review of Addition, Subtraction, etc.
   f. Conversions and Averaging
   g. Usage of Scientific Calculator
   h. Metric System

2. Basic Algebra (15 Hours)

   a. Simple Algebraic Equations
   b. Exponentials, Logarithm, Scientific Notation
   c. Formulas for Process Control

3. Geometric Figures (9 Hours)

   a. Circle, Cone and Cylinder
   b. Frustrum
   c. Rectangles
   d. Triangles and Trapezoid
   e. Prismoidal Basin

*****TEST*****

B. PHYSICS

1. Hydraulics (12 Hours)

   a. Basic Hydraulics-Detention Time, Force, Head, Velocity, etc.
   b. Flow Calculation-Channels, Parshall Flume, Weirs, etc.
   c. Pumps:
      1. Types and Application
      2. Pump Curves and Computations
      3. Static and Dynamic Head and Calculations
      4. Valves and Related Equipment
      5. Maintenance

B. PHYSICS (Cont'd.)

2. Electricity (12 Hours)

a. Basic Electricity
1. Ohm's Law
2. Parallel and Series Circuits
3. Basic Generator and Power Transmission
4. Transformers
5. Power Requirements and Calculations

b. Motors and Name Plate Data
1. Basic Components
2. Horse Power Requirements and Efficiencies

c. Instrumentation
1. Types and Application

3. Simple Machines (2 Hours)
a. Pulleys
b. Levers

C. CHEMISTRY (11 Hours)

1. Basic Chemistry
a. Atomic Structure and components
b. Elements and Compounds
c. Chemical Symbols and Equations
d. Periodic Table
e. Balancing of Equations
f. pH Values
g. solution Preparation for Laboratory and Process Application

D. MICROBIOLOGY (11 Hours)

1. Cell Structure
2. Cell Metabolism-Reproduction
3. Microorganisms-Bacteria, Algae
4. Nitrogen and other Cycles
5. Environmental Factors Affecting Microorganisms
6. Classification
a. Aerobic
b. Anaerobic
c. Facultaive
7. Pathogens
8. Typical Microorganisms Related to Water and Wastewater

E. MISCELLANEOUS (6 Hours)

1. Terminology
2. Laboratory Equipment Familiarization
3. Basic Laboratory Testing
   a. pH and temperature
   b. Chlorine Residual
   c. Settleable Solids

*****TEST*****

NOTE: At least two (2) tests are to be administered for Part I with a minimum average of 70 for passing and certification. Other tests or quizzes may be given at the instructor's discretion. Certificates are to be issued after the successful completion of Part I and Part II.

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OPERATION COURSE

PART II (45 Hours) – WATER SECTION

A. ADMINISTRATIVE: (6 Hours)

1. Rules and Regulations
2. Reporting to Regulatory Agencies
3. Budgeting
4. Record Keeping
5. Safety-P.E.O.S.H.A.

B. WATER SOURCES AND CHARACTERISTICS: (3 Hours)

1. Hydrological Cycle
2. Surface Water Supply
3. Ground Water Supply and Others

C. WELLS: (3 Hours)

1. Types and Construction
2. Operation and Treatment
3. Monitoring and Record Keeping

D. WATER TREATMENT (12 Hours)

1. Sedimentation and Precipitation
   a. Operation and Records
   b. Operation Parameters and Problems
   c. Applied Math
2. Filtration
   a. Gravity and Pressure Filters
   b. Construction
   c. Operation Parameters and Problems
   d. Applied Math
3. Aeration and Air Stripping
4. Reverse Osmosis
5. Water Softening
6. Iron Removal
7. Distillation

*****TEST*****

E. DISINFECTION: (3 Hours)

1. Types-Chlorination, Ultra-Violet Light, others
2. Method of Application
3. Operation

F. WATER ANALYSIS AND INTERPRETATION: (3 Hours)

1. Drinking Water Standards
2. Process Evaluation

G. DISTRIBUTION SYSTEM: (9 Hours)

1. Types of Pumps and Pipe
2. Main Installation and Repair
3. Water Meters and Valves
4. Hydrant Installation and Repairs
5. Physical and Cross-Connections

H. SAFETY: (3 Hours)

*****TEST*****

I. FIELD TRIP: (3 Hours)

NOTE: At least two (2) tests are to be administered for this section with a minimum average of 70 for passing. Other tests or quizzes may be given at the instructor's discretion.

INTRODUCTION TO WATER/WASTEWATER
OPERATION COURSE

PART II (45 Hours) – WASTEWATER SECTION

A. ADMINISTRATIVE: (4 Hours)

1. Rules and Regulations
2. Reporting to Regulatory Agencies
3. Safety

B. WASTEWATER SOURCES AND CHARACTERISTICS: (2 Hours)

1. Domestic
2. Industrial
3. Parameter Ranges
4. Flows

C. TREATMENT METHODS:

1. Preliminary (3 Hours)
   a. Screening
   b. Grit Removal
   c. Comminution, Grinders, etc.
   d. Pre-Chlorination and Pre-aeration

2. Primary (3 Hours)
   a. Septic Tanks
   b. Imhoff Tanks
   c. Clarifiers
      1. Construction
      2. Operation Parameters and Problems
      3. Applied Math
   d. Chemical Precipitation

3. Secondary (10 Hours)
   a. Trickling Filters and RCB's (2 Hours)
      1. Construction
      2. Operation Parameters and Problems
      3. Applied Math
   b. Activated Sludge Systems (8 Hours)
      1. Conventional, Step-aeration, Extended, etc.
         a. Construction
         b. Operation Parameters and Problems
         c. Applied Math

b. Activated Sludge Systems (cont'd)
2. Secondary Clarification
a. Construction
b. Operation Parameters and Problems
c. Applied Math

*****TEST*****

4. Sludge Handling (6 Hours)
a. Sludge Thickening
1. Gravity
2. Flotation
3. Gravity Belt
b. Sludge Digestion
1. Aerobic
2. Anaerobic
c. Sludge Dewatering
1. Mechanical Methods
2. Drying Beds
d. Sludge Disposal
1. Incineration
2. Composing
3. Land Application
5. Advanced Treatment (3 Hours)
a. Ammonia Removal
b. Phosphorus Removal
c. Stabilization Lagoons

D. DISINFECTION: (2 Hours)

1. Types – Chlorination, Ultra-Violet Light, etc.
2. Method of Application
3. Dechlorination
4. Operation

E. WASTEWATER ANALYSIS AND INTERPRETATION: (3 Hours)

1. Process Control
2. Laboratory Testing
a. BOD
b. Solids-Total, Suspended, Dissolved
c. Sludge Analysis
d. Others

F. COLLECTION SYSTEM: (6 Hours)

1. Gravity Systems
    a. Types and Size of Pipes
    b. Slope and Velocity Requirements
    c. Manhole
        1. Standard
        2. Drop
    d. House Connection
    e. Maintenance

2. Pumping Station and Force Main
    a. Sizing of Force Main
    b. Pumps and Controls
    c. Standby Power (Generator)
    d. Odor Control
    e. Screenings and Grease Control
    f. Maintenance

3. Pretreatment
    a. Local and State Regulations
    b. Treatment Impact

4. Safety

*****TEST*****

G. FIELD TRIP: (3 Hours)

NOTE: At least two (2) tests are to be given with a minimum average of 70 for passing. Other tests or quizzes may be given at the instructor's discretion.

PROCESSING FORMULAS

Grit Chambers

Flow Velocity (ft/sec) = $\frac{\text{Length of Grit Chamber (ft)}}{\text{Time for sewage to pass through G.C. (sec)}}$

Flow Velocity (ft/sec) = $\frac{\text{Rate of Flow to Grit Chamber (ft}^3\text{/ sec)}}{\text{Cross sectional area of sewage in the channel (ft}^2\text{)}}$

Detention Time (sec) = $\frac{\text{Volume of Grit Chamber (ft}^3\text{)}}{\text{Rate of flow to Grit Chamber (ft}^3\text{/sec)}}$

Clarifiers

Detention Time (hrs) = $\frac{\text{Volume of Clarifier (gal)}}{\text{Rate of Flow to Clarifier (gal/hr)}}$

Weir Overflow Rate (gal/ft/day) = $\frac{\text{Rate of Flow to Clarifier (gal/day)}}{\text{Length of Weir (ft)}}$

Surface Settling Rate (gal/ft^2/day) = $\frac{\text{Rate of Flow to Clarifier (gal/day)}}{\text{Surface Area of Clarifier (ft}^2\text{)}}$

Anaerobic Digesters

Volatile Acids/Alkalinity Ratio = $\frac{\text{Volatile Acids Analysis (mg/l)}}{\text{Alkalinity Analysis (mg/l)}}$

Digester Loading (lbs/ft^3/day) = $\frac{\text{Volatile Suspended Solids Fed (lbs/day)}}{\text{Volume digester used (ft}^3\text{)}}$

Chlorination

Dose (mg/l) = Demand (mg/l) + Residual (mg/l)

Rate of Feed (lbs/day) = Dose (mg/l) X 8.34 $\frac{\text{lbs/mg}}{\text{mg/l}}$ X Flow (MGD)

Detention Time (min) = $\frac{\text{Vol. Tank (gal) X 24 (hrs/day) X 60 (min/hr)}}{\text{Flow (gal/day)}}$

Percent Efficiency

Efficiency (Removal) = $\frac{\text{Input-Output}}{\text{Input}}$ X 100

Efficiency = $\frac{\text{Influent (mg/l) – Effluent (mg/l)}}{\text{Influent (mg/l)}}$ X 100

Efficiency = $\frac{\text{\% Vol. Solids (Raw) - \% Vol. Solid (Digested)}}{\text{\% Vol. Solids (Raw) - (\% Vol. Solids Raw))}}$ X \% Vol. Solids (Digested)

PROCESSING FORMULAS

Trickling Filters

$$\text{Hydraulic Loading (MGAD)} = \frac{\text{Flow (MGD) X 43,560 (ft}^2\text{/A)}}{\text{Surface Area (ft}^2\text{)}}$$

$$\text{Hydraulic Loading (gal/ft}^2\text{/day)} = \frac{\text{Flow (gal/day)}}{\text{Surface Area (ft}^2\text{)}}$$

$$\text{Organic Loading (lbs/1000 ft}^3\text{/day)} = \frac{\text{B.O.D. to Trickling filter (lbs/day)}}{\frac{\text{Volume Filter Media (ft}^3\text{)}}{1000}}$$

Activated Sludge

$$\text{Inf. B.O.D. (lbs)} = \text{B.O.D. Anal. (mg/l) X 8.34} \frac{\text{(lbs/MG)}}{\text{mg/l}} \text{X Flow (MG)}$$

$$\text{Inf. S.S. (lbs)} = \text{S.S. Anal. (mg/l) X 8.34} \frac{\text{(lbs/MG)}}{\text{mg/l}} \text{X Flow (MG)}$$

$$\text{Wgt MLSS (lbs)} = \text{MLSS Anal. (mg/l) X 8.34} \frac{\text{(lb/MG)}}{\text{mg/l}} \text{X Vol. Aer. Tank (MG)}$$

$$\text{Food/Mass Ratio} = \frac{\text{Influent B.O.D. (lbs)}}{\text{MLSS in Aeration Unit (lbs)}}$$

$$\text{Sludge Age (days)} = \frac{\text{Suspend Solids in Aeration Tank (MLSS)(lbs)}}{\text{Suspend Solids in Influent (lbs/day)}}$$