Study Guide for Grade IA, I & II
Wastewater Collection System Operators

The study guide is for wastewater collection system operator practices involving primary skill and knowledge levels. The outline topics are the general subjects which are the basis for examination questions. The applicant should be knowledgeable of the subject matter outlined and contained in the reference material list.

I. WASTEWATER AND ITS CHARACTERISTICS

- A. Sources and types – domestic and industrial
- B. Physical and chemical composition of wastewater
  - 1. Solids
  - 2. pH
  - 3. Biochemical oxygen demand (BOD)
  - 4. Total suspended solids (TSS)
- C. Biological composition
  - 1. Coliform bacteria
  - 2. Pathogenic bacteria

II. TYPES OF SEWERS AND FUNCTIONS

- A. Define sewer
- B. Sanitary sewer
  - 1. Building and house connection
  - 2. Collectors
  - 3. Interceptors
- C. Storm sewer
- D. Combined sewer

III. HYDRAULICS OF SEWERS

- A. Type of flow – gravity or force main
- B. Factors affecting friction – grease, obstructions, roughness
- C. Velocities – prevent deposition of solids and erosion of pipe material
  - 1. Minimum velocity – 2 feet per second

    Minimum grades:
    10”-line .28 foot per 100 feet
    8”-line .40 foot per 100 feet
    6”-line .63 foot per 100 feet
  - 2. Maximum velocity – erosion velocities
- D. Variance in sewage flows – night vs. day
- E. Effects of infiltration and exfiltration
- F. Effects of illegal connections to sanitary sewers – roof drains

IV. DESIGN

A. Connection of house to sewer main
   1. Use of proper materials – PVS, vitrified clay, asbestos cement
   2. Proper grade – 1/4 inch per foot for 3-inch line
      – 1/8 inch per foot for 4-inch line
B. Location in relation to storm sewers and potable water lines

C. Manholes
   1. Located where sewer line changes in direction, grade, pipe size, or intersection of sewers
   2. Spacing of manholes – no greater than 400 feet when 8-inch, 10 inches, or 12-inch lines are used
   3. Proper and safe cleaning techniques
D. Prevent admittance of large surface runoff
E. Prevent cross-connections (backflow & back siphonage)

V. INSTALLATION

A. Proper site preparation
B. Use proper excavation and backfilling techniques
C. Trenching and shoring
D. Proper bedding
E. Proper pipe materials
F. Correct joint fitting and sealing
G. Proper grade and alignment

VI. LIFT STATIONS AND PUMPING STATIONS

A. Wet well design – storage capacity, detention time, level for positive prime
B. Dry well design
C. Screening devices
D. Pumping equipment
   1. Pumps – different types
   2. Operation of pumps
   3. Maintenance of pumps
E. Proper ventilation

VII. SAFETY

A. Good housekeeping practices
B. Trenching and shoring
C. Electrical hazards and shocks

D. Protective clothing
E. Protective equipment
F. Manhole and lift station hazards
G. Protection against hydrogen sulfide, methane, and other hazardous gases – proper ventilation

VIII. RULES AND REGULATIONS

A. Submission of plans and specifications
B. "Recommended Standards for Sewage Works," 10 States

IX. RECORDS

A. Need for
B. Maps – sewer size and location, manholes, water mains, storm sewers
C. Card index system for equipment
D. Card index system for maintenance performed
E. Budgeting
F. Public relations

REFERENCES:

1. "Manual for Instruction for Sewage Treatment Plant Operator"
2. "Environmental Data Sheets for Municipal Utilities"
3. "Recommended Standards for Sewage Works," 10 States

TYPICAL EXAMINATION QUESTIONS

Class I and II Wastewater Collection System

1. Methane gas in sewer systems is dangerous because it:

   a. Can be flammable
   b. Is corrosive
   c. Is extremely irritating to the eyes
   d. Is heavier than air.

2. The recommended minimum velocity for a gravity sewer is:

   a. 0.5 feet per second
   b. 1.0 feet per second
   c. 2.0 feet per second
   d. 4.0 feet per second

3. Which of the following is the most common factor leading to the generation of hydrogen sulfide in sewers?

   a. Anaerobic conditions
   b. Frequently high storm flows
   c. High velocity of flow in sewers
   d. Low concentrations of ferrous sulfide
   e. Presence of highly soluble fats and oils

4. The primary purpose of forced draft ventilation in lift stations is to:

   a. Cool the pumps
   b. Keep air pressure equalized
   c. Lower the water level
   d. Prevent odors
   e. Remove dangerous gases

PROBLEMS:

1. A centrifugal pump at a lift station is pumping 200 gallons per minute (gpm). How long will it take to empty the wet well containing 10,000 gallons?

   a. 25 minutes
   b. 40 minutes

c. 110 minutes
d. 50 minutes
e. 1 hour

2. A trench 2.5 feet wide, 6.5 feet deep, and 65 feet long is to be filled with select backfill. How many cubic yards of backfill are required? (V = l wh) (1 cubic yard = 27 cubic feet)

a. 39 cubic yards
b. 78 cubic yards
c. 18.5 cubic yards
d. 50.5 cubic yards
e. 100 cubic yards

ANSWERS:

1. a 2. c 3. a 4. E

PROBLEM ANSWERS:

1. d. 50 minutes Divide the number of gallons contained in the wet well (10,000 gallons) by the number of gallons being pumped per minute (200 gallons per minute)

$$\frac{10{,}000 \text{ gallons}}{200 \text{ gallons/min.}} = 50 \text{ minutes}$$

2. a. 39 cubic yards Find the volume of the trench in cubic feet by using the formula: V = l wh. Then divide the number ____ cubic feet by 27 cubic feet/cubic yard to find the number of cubic yards in the trench.

V = l wh
V = (65 feet) (2.5 feet) (6.5 feet)
V = 1056 cubic feet OR
1056 $feet^3$

Convert cubic feet to cubic yards

$$\frac{1056 \text{ cubic feet}}{27 \text{ cubic feet/cubic yard}} = 39 \text{ cubic yards}$$ OR
39 $yards^3$