

# Maryland Wastewater 5A Certification Exam Study Guide

## (125 total questions)

### 1. **Chemical Addition (1 question):**

- a. Chemical Feed - Coagulation / Flocculation; Evaluating performance / adjusting dose

### 2. **Collecting Samples (2 questions):**

- a. Activated Sludge – Sampling; such as MLSS / SSV sampling locations
- b. Sampling / Preservation; metals

### 3. **Disinfection (6 questions):**

- a. Disinfection – Chlorination; Dose/Demand/Residual/Contact Time
- b. Disinfection – Chlorination; Factors affecting disinfection performance
- c. Disinfection – UV; Method of microbial inactivation
- d. Disinfection - UV ; Routine maintenance of disinfection equipment
- e. Chemical Feed – Chlorine; Procedure for removal of chlorinator from service
- f. Chem Feed – Chlorine; Gas Chlorinator components / purpose of each

### 4. **Disinfection - Math (2 questions)**

- a. Chem Feed - Hypochlorite – Math; Cl<sub>2</sub> / CaOCl<sub>2</sub> / NaOCl dose conversions
- b. Disinfection - Chlorination – Math; Chlorine dose / demand / residual

### 5. **Electrical Equipment (1 question)**

- a. Pump Operation – causes of cavitation

### 6. **Evaluating Equipment - Math (2 questions)**

- a. Hydraulics – Math; Head (ft) / Pressure (psi) conversions
- b. Pumping – Math; Volume / Pumping Rate

### 7. **Evaluating Equipment (3 questions)**

- a. Flow Measurement; Open channel devices
- b. Pump / Equipment Maintenance – Electrical; Thermal overloads - function
- c. Pump Hydraulics; Total Dynamic Head (TDH) – Definition

### 8. **Evaluating Waste Stream (3 questions)**

- a. Industrial Pretreatment Programs; purpose?
- b. Nutrient Removal; Nutrients – What are they?
- c. Wastewater Characteristics; Influent quality most detrimental to conventional activated sludge processes

**9. Interpreting Laboratory Analysis (5 questions):**

- a. Nitrification / Denitrification; Interpreting Nitrogen test results
- b. pH; CO<sub>2</sub> effects
- c. pH / Alkalinity Control; Forms of alkalinity
- d. Wastewater Characteristics; COD
- e. Wastewater Characteristics; Components of TKN

**10. Operating Equipment (4 questions)**

- a. Cross Connections; Basic definition
- b. Pump Maintenance; Centrifugal pump components and function
- c. Pump Maintenance; Wear rings - purpose
- d. Pump Operation; Pump idle / spinning backwards

**11. Performing Laboratory Analysis (1 question)**

- a. Safety – Lab; Mixing acid and water

**12. Performing Laboratory Analysis Math (1 question)**

- a. Activated Sludge Process Control – Math; Oxygen Uptake Rate

**13. Performing Maintenance: (10 questions)**

- a. Pump / Equipment Maintenance; Stuffing box / packing gland
- b. Pump / Equipment Maintenance; Bearing lubrication procedures
- c. Pump / Equipment Maintenance; Causes of vibration
- d. Pump / Equipment Maintenance; Chain-drive adjustments
- e. Pump / Equipment Maintenance – Electrical; 3-Phase Motors / effects of phase loss
- f. Pump Operation; Worn impeller effects on amps/capacity/efficiency
- g. Pump Operation; Pipe Hydraulics - Elevation & Friction Head
- h. Pump Operation; Suction loss - causes
- i. Pump Operation; Effects on pump/motor w/ changes in discharge head
- j. Tanks – Maintenance; Dewatering procedures

**14. Performing Maintenance Math: (2 questions)**

- a. Pipes – Math; Volume calculation
- b. Pumping – Math; Basic Math - Average & Flow Rate conversion

**15. Phosphorus Removal (2 questions)**

- a. Chem Feed - Phosphorus Removal; FeCl<sub>3</sub> effects on alkalinity
- b. Chem Feed - Phosphorus Removal; Chemical options

### **16. Preliminary Treatment (2 questions)**

- a. Grit Removal; Cyclone degritter function
- b. Grit Removal - Aerated Grit Chambers; Effects of aeration failure

### **17. Primary Treatment (3 questions)**

- a. Clarifiers; Scum build-up
- b. Clarifiers; Hydraulic short-circuiting prevention
- c. Clarifiers; Settled sludge density control

### **18. Safety Procedures (6 questions):**

- a. Safety - Chem Handling; PPE
- b. Safety - Chem Handling; Polymers
- c. Safety - Confined Spaces; Required oxygen levels
- d. Safety - Confined Spaces; Pre-entry inspection / testing requirements
- e. Safety - Confined Spaces; Lighting
- f. Safety - Pump / Equipment Maintenance; LO/TO

### **19. Secondary Treatment (26 questions)**

- a. Activated Sludge - Basic Process Types; Advantages of Conventional, High Rate, Step Feed, etc
- b. Activated Sludge - Sequencing Batch Reactors; Operational Steps
- c. Activated Sludge Characteristics; Sludge quality - visual observations
- d. Activated Sludge Characteristics; Causes & effects of filamentous bacteria
- e. Activated Sludge Process Control; Clarifier effluent - Chlorine demand
- f. Activated Sludge Process Control; Anaerobic / Anoxic / Aerobic environments
- g. Activated Sludge Process Control; Causes & control of poor sludge settling
- h. Activated Sludge Process Control; Aeration tank foaming
- i. Activated Sludge Process Control; Filamentous bacteria - effects
- j. Activated Sludge Process Control; MCRT Increase - visual observations in secondary clarifier
- k. Activated Sludge Process Control; Seasonal adjustments
- l. Activated Sludge Process Control; Sludge Bulking
- m. Activated Sludge Process Control; BOD effect on DO / Aeration Requirement
- n. Activated Sludge Process Control; Filamentous bacteria - control
- o. Activated Sludge Process Control; Applying SSV results to operations
- p. Activated Sludge Process Control; Sludge Wasting Schedules - Pro's / Con's
- q. Activated Sludge Process Control; MLVSS - Definition and importance in AS
- r. Activated Sludge Process Control; Purpose of RAS
- s. Activated Sludge Process Control; Types of foam and causes on aeration tanks
- t. Activated Sludge Process Control; Mixed liquor quality analysis – microorganisms

- u. Activated Sludge Process Control; Process control options / purpose
- v. Activated Sludge Process Control; Effects of RAS/WAS rate on F:M, MCRT, SSV
- w. Clarifiers; Applying test results / observations to operations
- x. Clarifiers; Secondary Clarifier - Rising sludge
- y. Clarifiers; Effects of sludge bulking
- z. Nitrification; Effects on pH / Alkalinity

## **20. Secondary Treatment - Math (7 questions)**

- a. Activated Sludge Process Control – Math; F:M Ratio
- b. Activated Sludge Process Control – Math; Wasting rate calculation
- c. Activated Sludge Process Control – Math; Sludge wasting rate
- d. Activated Sludge Process Control – Math; Weir Overflow Rate
- e. Activated Sludge Process Control – Math; Detention time
- f. Lagoons – Math; Surface area conversion / chemical application
- g. Tank Capacity – Math; Volume calculation

## **21. Sludge Thickening (1 question)**

- a. Sludge Thickening – Gravity; Operation / stirring

## **22. Solids Handling (12 questions)**

- a. Aerobic Digestion; Dissolved Oxygen levels
- b. Aerobic Digestion; Effects on pH
- c. Anaerobic Digestion; Standard operational controls
- d. Anaerobic Digestion; Foaming control
- e. Anaerobic Digestion; Fixed cover type - supernatant withdrawal
- f. Anaerobic Digestion; Factors determining when digestion is complete
- g. pH / Alkalinity Control; Chemicals
- h. Sludge Dewatering - Belt Filter Press; Components & functions
- i. Sludge Thickening; Process type options. Pro's and Con's of each
- j. Sludge Thickening – Gravity; Flocculant Chemicals
- k. Sludge Thickening Processes; Air to Solids Ratio
- l. Wastewater Characteristics; Organic Solids - What are they?

## **23. Solids Handling - Math (1 question)**

- a. Solids Handling – Math; Pumping rate / proportions

## **24. Tertiary Treatment (22 questions)**

- a. Activated Sludge Process Control; Biological activity / seasonal effects
- b. Activated Sludge Process Control; Endogenous Respiration - Definition
- c. Chem Feed - Coagulation / Flocculation; Mixing for coagulation & floc formation
- d. Chem Feed - Coagulation / Flocculation; Chemicals
- e. Chem Feed - Coagulation / Flocculation; Rapid mix speed effects on floc formation
- f. Denitrification; Type environment / microorganisms required
- g. Denitrification; DO levels / effects
- h. Denitrification; Carbon Source / organics - options
- i. Filtration; Performance monitoring / Head-loss
- j. Filtration; Performance monitoring / Turbidity
- k. Filtration; Conventional Sand Fltrs - Operational sequence
- l. Filtration; Backwash sequence - Operational considerations
- m. Filtration; Head Loss
- n. Nitrification; Forms of nitrogen and conversion / removal sequence
- o. Nitrification; Effects on Alkalinity
- p. Nitrification / Denitrification; Factors affecting performance
- q. Nitrification / Denitrification; Internal nitrate recycle
- r. pH / Alkalinity Control; Chemicals
- s. Phosphorus Removal – Biological; Causes of biological phosphorus removal failure
- t. Phosphorus Removal – Biological; BPR sequence and requirements
- u. Phosphorus Removal – Chemical; Chemicals
- v. Phosphorus Removal – General; Effects of Phosphorus on the water environment

### **Further References:**

- Sacramento Manuals: <https://www.owp.csus.edu/>
- American Waterworks Assn: <https://www.awwa.org/>
- Water Environment Federation: <https://www.wef.org/>

**Note:** Technical categories in this guide established by the exam provider