

**DW Module 15:
Direct Filtration**
Answer Key- Revised 4/4/18



How many of the monthly samples of all filters must be less than or equal to 0.3 NTU?

Ans: 171 Samples—If a minimum of six samples per day are required (one every four hours), then 180 samples are collected each month. 95% of the 180 samples equal 171 samples.



EXERCISE:

Unit 1 – Exercise

Multiple Choice – Choose the best answer

1. Which of the following pretreatment/treatment processes are parts of direct filtration? (Choose all that apply)

- a. rapid mixing (coagulation)
- b. flocculation
- c. sedimentation/clarification
- d. direct filtration

Answer: a., b., and d.

2. Select the characteristics of source water that are appropriate for direct filtration. (Choose all that apply)

- a. Turbidity is less than 2 NTU
- b. True color is less than 40 c.u.
- c. Algal blooms are less than 20,000 asu/ml
- d. Iron is less than 0.3 mg/L
- e. Manganese is less than 0.05 mg/L
- f. Coagulant demand is below 15 mg/l

Answer: a., d., e, and f.

3. One of the mechanisms at work in granular media filtration is the particle attachment to the _____ grains. (Choose the best answer to fill in the blank)

- a. media
- b. turbidity
- c. organic

Answer: a. media

4. Some of the criteria of safe and aesthetically pleasing drinking water are: (Select all that apply)

- a. Free of toxic substances
- b. Free of disease-causing organisms

- c. Disagreeable taste and odor.

Answer: a. and b.

5. To verify that a source water can be treated with direct filtration, the DEP requires that _____ testing be performed prior to the design of the facility. (*Choose the best answer to fill in the blank*)

- a. pressure
- b. sedimentation
- c. pilot

Answer: c. pilot



EXERCISE:

Unit 2 – Exercise

Multiple Choice – Choose the best answer

1. In drinking water terminology, “pretreatment” is any treatment process that occurs before the filter. For the process of direct filtration, this can involve which of the following: (*Choose all that apply*)

- a. chemical addition
- b. coagulation (rapid mixing)
- c. flocculation (slow mixing)
- d. sedimentation

Answer: a., b., and c.

2. Overdosing of _____ can result in a residual that may contribute to the formation of disinfection by-products. (*Choose the best answer*)

- a. Potassium permanganate
- b. Soda ash
- c. Chlorine

Answer: c. – chlorine

3. The most common chemicals for raising pH are: (*Choose all that apply*)

- a. potassium permanganate
- b. lime
- c. caustic soda
- d. soda ash

Answer: b., c, and d.

4. Alum, ferric chloride, and PAC are the most common chemicals used in the pretreatment process of:

- a. coagulation
- b. flocculation

- c. sedimentation

Answer: a. coagulation

5. A ____ pH is necessary for most effective coagulation of organics.

- a. high
- b. low

Answer: b. low

6. The pretreatment step during which a slow, mechanical mixing process promotes the formation of floc particles is called:

- a. coagulation
- b. flocculation
- c. oxidation

Answer: b. flocculation

PRACTICE: try and solve

7. If 1,000 pounds of dry alum are required to treat 15 million gallons of water, what is the dosage?

- a. 0.125 mg/L
- b. 8 mg/L
- c. 566 mg/L
- d. 1799 mg/L

Answer: b. 8 mg/L – 1000 lbs./ (15 MGD * 8.34 lbs/gal)

8. The surface of a sand bed of a filter measures 15 by 25 feet. What is rated total capacity for a rate of 10 gpm/sq ft?

- a. 37.5 gpm
- b. 375 gpm
- c. 3,750 gpm
- d. 3,075 gpm

Answer: c. 3750 gpm -- 15ft * 25ft * 10 gpm/sqft.

9. A filter is 5 feet wide and 15 feet long. The desired backwash rate is 5 gallons per minute per square foot. What backwash flow is needed?

- a. 7,075 gpm
- b. 3,075 gpm
- c. 750 gpm
- d. 375 gpm
- e. 75.5 gpm

Answer: d. – 375 gpm -- 5ft * 15ft * 5 gpm/sqft

10. What is the weight of a 3 gallon solution which has a specific gravity of 1.05?

- a. 10 lbs.

- b. 10 mg/L
- c. 26 lbs.
- d. 26 mg/L

Answer: c. 26 lbs -- $3 \text{ gal} * 1.05 \text{ s.p.} * 8.34 \text{ lbs/gal}$

11. A filter 5 feet wide by 5 feet long is permitted to operate at a rate of 2 gpm/ft.². What is the maximum flow rate within the permit limitations?

- a. .035gpm
- b. .07 mgd
- c. 3.5 mgd
- d. 7.0 gpm

Answer: b .07 mgd -- $2\text{gpm/sqft} * 1440 \text{ min/day} * 1\text{mgd}/1000000 \text{ gal} * 25\text{sqft}$



EXERCISE:

Unit 3 – Exercise

Matching: Match the letter of the corresponding filter system component with the number of the correct statement.

- A. mono media-type filter
- B. dual media filter
- C. mixed media filter

1. A Commonly has a single media which is anthracite.
2. C Typically has a top layer of anthracite or GAC, a middle layer of silica sand, and a bottom layer of garnet sand.
3. B Has a has a top layer of anthracite or GAC, and a bottom layer of silica sand.

Listing:

4. List the four criteria of water quality that direct filtration plant operators must take into account.

- filter effluent turbidity
- filter particle counts
- quality vs. run-time and headloss
- microscopic particulate analysis

True or False: Select the best answer

5. The quality of the filtration process changes over run time.

- a. True
- b. False

Answer: a. – True

6. Increased flow rates make filtration less susceptible to breakthrough.

- a. True
- b. False

Answer: b. – False – Increased flow rates make filtration MORE susceptible to breakthrough due to higher shearing forces on the previously retained material.



EXERCISE:

Unit 4 – Exercise

True or False: Select the best answer

1. Depth of media and filter rate are two factors which can affect filter headloss.

- a. True
- b. False

Answer: a. True

2. A common filter backwash criteria is to terminate the backwash rinse and return the filter to service when turbidity falls below 10 NTU.

- a. True
- b. False

Answer: b. False. A common rinse criterion is to terminate the rinse and return the filter to service when turbidity falls below 0.10 NTU.

Fill in the blanks:

3. Some indicators of abnormal direct filtration operations are:

- a. Rapid changes in filtered water _____ during normal filter operations.
- b. Short _____ runs.

Answers: a. turbidity; b. filter

4. Some adjustments that can be made if a direct filtration plant is operating abnormally are:

- a. Make _____ modifications as necessary.
- b. Inspect the _____ bed, including depths and conditions of media.

Answers: a. pretreatment; b. filter

5. Accurate water quality process records should be kept of the following:
Temperature, _____, alkalinity, _____, color, iron, manganese, and hardness.
Answers: a. pH; b. turbidity

6. Accurate process operations records should be kept of the following:
Filters in service, filtration rates, loss of head, length of _____ runs,
frequency of filter _____, auxiliary scour, and backwash rates and durations.
Answer: a. filter; b. backwash