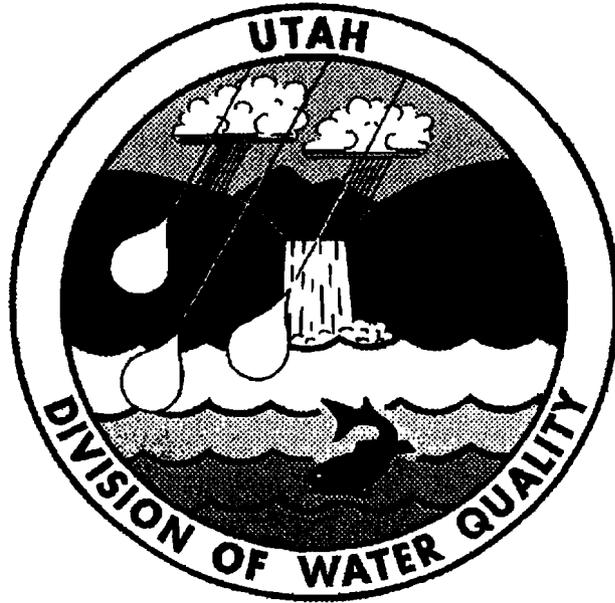


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Lagoon System Math - CEU Problems Answer Key

*The Division of Water Quality
makes no claim as the accuracy of
any answers provided herein.*

Chapter 13—Achievement Test

1. The BOD concentration of the wastewater entering a pond is 190 mg/L. If the flow to the pond is 360,000 gpd, how many lbs/day BOD enter the pond?

$$\text{Load} = 8.34 (190 \text{ mg/L}) (0.36 \text{ MGD})$$

$$\text{Load} = 570 \text{ lbs/day}$$

(Section 13.1)

ANS 570 $\frac{\text{lbs}}{\text{day}}$

2. A 8.5-acre pond receives a flow of 280,000 gpd. If the influent flow has a BOD content of 240 mg/L, what is the organic loading rate in lbs/day/ac on the pond?

$$\text{Load} = 8.34 (240 \text{ mg/L}) (0.28 \text{ MGD})$$

$$\text{Load} = 560 \text{ lbs/day}$$

$$\text{OLR} = \frac{560 \text{ lbs/day}}{8.5 \text{ ac}}$$

$$\text{OLR} = 66 \frac{\text{lbs} \cdot \text{ac}}{\text{day}}$$

ANS 66 $\frac{\text{lb} \cdot \text{ac}}{\text{day}}$

(Section 13.2)

3. The BOD entering a waste treatment pond is 210 mg/L. If the BOD concentration in the pond effluent is 43 mg/L, what is the BOD removal efficiency of the pond?

$$\text{efficiency} = \frac{210 \text{ mg/L} - 43 \text{ mg/L}}{210 \text{ mg/L}} \cdot 100 \%$$

$$\text{efficiency} = 80 \%$$

(Section 13.3)

ANS 80%

4. A 22-acre pond receives a flow of 3.6 acre-feet/day. What is the hydraulic loading on the pond in in./day?

$$\text{area} = 22 \text{ acres}$$

$$\text{Flow} = 3.6 \frac{\text{ac. ft}}{\text{day}}$$

(Section 13.4)

$$\text{HLR} = \frac{\text{Flow}}{\text{area}}$$

$$\text{HLR} = \frac{3.6 \frac{\text{ac. ft}}{\text{day}}}{22 \text{ acres}}$$

$$\text{HLR} = 0.16 \frac{\text{ft}}{\text{day}} \cdot 12 \frac{\text{in}}{\text{ft}}$$

ANS 2.0 $\frac{\text{in}}{\text{day}}$

$$\text{HLR} = 2.0 \frac{\text{in}}{\text{day}}$$

5. The BOD entering a waste treatment pond is 162 mg/L. If the BOD concentration in the pond effluent is 71 mg/L, what is the BOD removal efficiency of the pond?

$$\text{efficiency} = \frac{162 \text{ mg/L} - 71 \text{ mg/L}}{162 \text{ mg/L}} \cdot 100\%$$

$$\text{efficiency} = 56\%$$

(Section 13.3)

ANS 56%

6. The flow to a waste treatment pond is 200 gpm. If the BOD concentration of the water is 218 mg/L, how many pounds of BOD are applied to the pond daily?

$$\text{Flow} = \frac{200 \frac{\text{g}}{\text{min}} \cdot 60 \frac{\text{min}}{\text{hr}} \cdot 24 \frac{\text{hr}}{\text{day}}}{1,000,000}$$

$$\text{Flow} = 0.29 \text{ MGD}$$

$$\text{Load} = 8.34 (218 \text{ mg/L}) (0.29 \text{ MGD})$$

$$\text{Load} = 524 \text{ lbs/day}$$

ANS 524 $\frac{\text{lbs}}{\text{day}}$

(Section 13.1)

Chapter 13—Achievement Test—Cont'd

7. The flow to a pond is 75,000 gpd with a BOD content of 138 mg/L. The pond has an average width of 230 ft and an average length of 390 ft. What is the organic loading rate in lbs/day/ac on the pond?

$$\text{area} = \frac{230 \text{ ft} \cdot 390 \text{ ft}}{43,560 \text{ ft}^2} \quad (\text{Section 13.2})$$

$$\text{area} = 2.1 \text{ acres}$$

$$\text{Load} = 8.34 (138 \text{ mg/L}) (0.075 \text{ MGD})$$

$$\text{Load} = 86 \frac{\text{lbs}}{\text{day}}$$

$$\text{OLR} = \frac{86 \text{ lbs/day}}{2.1 \text{ ac}}$$

$$\text{OLR} = 41.1 \frac{\text{lbs.ac}}{\text{day}}$$

$$\text{ANS } \underline{41.1 \frac{\text{lbs.ac}}{\text{day}}}$$

8. A waste treatment pond receives a flow of 1,960,000 gpd. If the surface area of the pond is 19 acres, what is the hydraulic loading in in./day?

$$\text{area} = 19 \text{ acres } (43,560 \text{ ft}^2/\text{ac})$$

$$\text{area} = 827,640 \text{ ft}^2$$

$$\text{Flow} = \frac{1,960,000 \frac{\text{g}}{\text{d}}}{7.48 \frac{\text{g}}{\text{ft}^3}}$$

$$\text{Flow} = 262,032 \text{ ft}^3/\text{day}$$

$$\text{HLR} = \frac{262,032 \text{ ft}^3/\text{d}}{827,640 \text{ ft}^2} \cdot 12 \frac{\text{in}}{\text{ft}}$$

$$\text{HLR} = 3.8 \frac{\text{in}}{\text{day}}$$

$$\text{ANS } \underline{3.8 \frac{\text{in}}{\text{day}}}$$

9. A wastewater pond serves a population of 6000 people. If the area of the pond is 20 acres, what is the population loading on the pond?

$$\text{area} = 20 \text{ acres}$$

$$\text{pop.} = 6000 \text{ people}$$

$$\text{PE} = \frac{6000 \text{ people}}{20 \text{ acres}}$$

$$\text{PE} = 300 \frac{\text{person}}{\text{ac}}$$

$$\text{ANS } \underline{300 \frac{\text{person}}{\text{ac}}}$$

10. A waste treatment pond has a total volume of 18.2 ac-ft. If the flow to the pond is 0.51 ac-ft/day, what is the detention time of the pond, in days?

$$\text{area} = 18.2 \text{ ac. ft}$$

$$\text{Flow} = 0.51 \frac{\text{ac. ft}}{\text{day}}$$

(Section 13.6)

$$\text{DT} = \frac{18.2 \text{ ac. ft}}{0.51 \frac{\text{ac. ft}}{\text{day}}}$$

$$\text{DT} = 35.7 \text{ days}$$

ANS 35.7 days

11. A 0.7-MGD wastewater flow has a BOD concentration of 2840 mg/L. Using an average of 0.2 lbs/day BOD/person, what is the population equivalent of this wastewater flow?

$$\text{Load} = 8.34 (2840 \text{ mg/L}) (0.7 \text{ MGD})$$

$$\text{Load} = 16,580 \frac{\text{lbs}}{\text{day}}$$

(Section 13.5)

$$\text{PE} = \frac{16,580 \text{ lbs/day}}{0.2 \text{ lbs/day/person}}$$

$$\text{PE} = 82,900 \text{ persons}$$

ANS 82,900 persons

12. A waste treatment pond is operated at a depth of 5 feet. The average width of the pond is 420 ft and the average length is 710 ft. If the flow to the pond is 0.35 MGD, what is the detention time, in days?

$$\text{Volume} = 420 \text{ ft} \cdot 710 \text{ ft} \cdot 5 \text{ ft} \cdot 7.48 \frac{\text{g}}{\text{ft}^3}$$

$$\text{Volume} = \frac{11,152,680 \text{ g}}{1,000,000}$$

(Section 13.6)

$$\text{Volume} = 11.15 \text{ MG}$$

$$\text{DT} = \frac{11.15 \text{ MG}}{0.35 \text{ MGD}}$$

$$\text{DT} = 31.9 \text{ days}$$

ANS 31.9 days