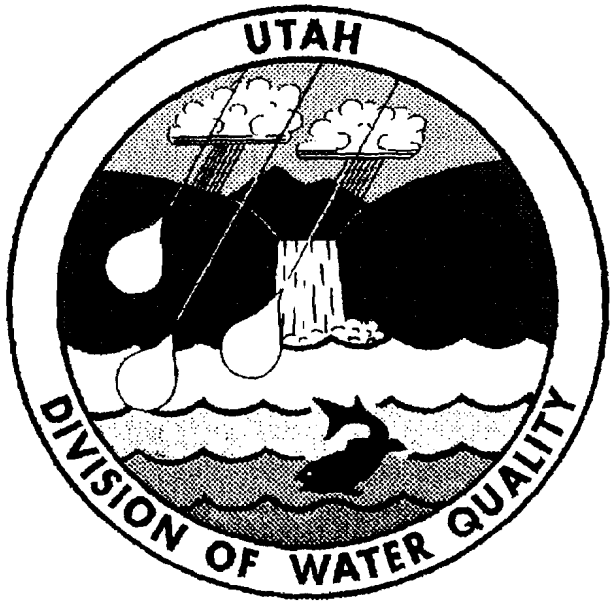

Trickling Filter Math - CEU Problems
Answer Key

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

Chapter 10—Achievement Test

1. A standard-rate filter, 90 ft in diameter, treats a primary effluent flow of 540,000 gpd. If the recirculated flow to the trickling filter is 120,000 gpd, what is the hydraulic loading rate on the filter in gpd/sq ft?

$\text{Area} = \frac{\pi}{4}(90\text{ ft})^2 = 6362\text{ ft}^2$

$\text{Flow} = 660{,}000\text{ gpd}$

$\text{HLR} = \frac{660{,}000\text{ gpd}}{6362\text{ ft}^2}$

ANS 104 $\frac{\text{gpd}}{\text{ft}^2}$

2. A trickling filter, 85 ft in diameter with a media depth of 5 ft, receives a flow of 1,200,000 gpd. If the BOD concentration of the primary effluent is 160 mg/*L*, what is the organic loading on the trickling filter in lbs BOD/day/1000 cu ft?

$\text{Volume} = \frac{\pi}{4}(85\text{ ft})^2 \cdot 5\text{ ft} = 28{,}373\text{ ft}^3$

$\text{Load} = 8.34(160\text{ mg/L})(1.2\text{ MGD}) = 1601\text{ lbs/day}$

$\text{OLR} = \frac{1601\text{ lbs/day}}{28{,}373\text{ ft}^3} \cdot 1000$

ANS 56 $\frac{\text{lbs/day}}{1000\text{ ft}^3}$

3. If 113 mg/*L* suspended solids are removed by a trickling filter, how many lbs/day suspended solids are removed when the flow is 2,668,000 gpd?

$\text{Load} = 8.34(113\text{ mg/L})(2.668\text{ MGD})$

ANS 2514 $\frac{\text{lbs}}{\text{day}}$

4. The suspended solids concentration entering a trickling filter is 210 mg/*L*. If the suspended solids concentration in the trickling filter effluent is 67 mg/*L*, what is the suspended solids removal efficiency of the trickling filter?

$\text{Efficiency} = \frac{210\text{ mg/L} - 67\text{ mg/L}}{210\text{ mg/L}} \cdot 100\%$

ANS 68. %

5. The flow to a trickling filter is 1.33 MGD. If the primary effluent has a BOD concentration of 231 mg/*L* and the trickling filter effluent has a BOD concentration of 83 mg/*L*, how many pounds of BOD are removed?

Load = 8.34 (231 mg/L - 83 mg/L) (1.33 MGD)

ANS 1642 $\frac{lbs}{day}$

6. A high-rate trickling filter receives a combined primary effluent and recirculated flow of 2.75 MGD. If the filter has a diameter of 80 ft, what is the hydraulic loading rate on the filter in gpd/sq ft?

Area = $\frac{\pi}{4}(80 ft)^2 = 5027 ft^2$

Flow = 2,750,000 gpd

HLR = $\frac{2,750,000 \text{ gpd}}{5027 ft^2}$

ANS 547 $\frac{gpd}{ft^2}$

7. The influent of a primary clarifier has a BOD content of 205 mg/*L*. The trickling filter effluent BOD is 20 mg/*L*. What is the BOD removal efficiency of the treatment plant?

Efficiency = $\frac{205 mg/L - 20 mg/L}{205 mg/L} \cdot 100\ \%$

ANS 90 %

8. A 80-ft diameter trickling filter with a media depth of 7 ft receives a flow of 2,180,000 gpd. If the BOD concentration of the primary effluent is 139 mg/*L*, what is the organic loading on the trickling filter in lbs BOD/day/1000 cu ft?

Volume = $\frac{\pi}{4}(80 ft)^2 \cdot 7 ft = 35,186 ft^3$

Load = 8.34 (139 mg/L) (2.18 MGD) = 2527 lbs/day

OLR = $\frac{2527 \text{ lbs/day}}{35,186 ft^3} \cdot 1000$

ANS 72 $\frac{lbs/day}{1000 ft^3}$

Chapter 10—Achievement Test—Cont'd

9. A trickling filter has a diameter of 90 feet and an average media depth of 7 feet. The primary effluent has a BOD concentration of 140 mg/*L*. If the total flow to the filter is 1.05 MGD, what is the organic loading in lbs per acre-ft? (Round acres to the nearest hundredth.)

$$\text{Volume} = \frac{\pi}{4}(90\text{ ft})^2 7\text{ ft} = \frac{44{,}532\text{ ft}^3}{43{,}560\text{ ft}^2/\text{ac}} = 1.0\text{ ac·ft}$$

$$\text{Load} = 8.34\,(140\text{ mg/L})\,(1.05\text{ MGD}) = 1226\text{ lbs/day}$$

$$\text{OLR} = \frac{1226\text{ lbs/day}}{1.0\text{ ac·ft}}$$

ANS 1226 $\frac{\text{lbs/day}}{\text{ac·ft}}$

10. The flow to a trickling filter is 4.11 MGD. If the trickling filter effluent has a BOD concentration of 19 mg/*L* and the primary effluent has a BOD concentration of 197 mg/*L*, how many pounds of BOD are removed daily?

$$\text{Load} = 8.34\,(197\text{ mg/L} - 19\text{ mg/L})\,(4.11\text{ MGD})$$

ANS 6101 $\frac{\text{lbs}}{\text{day}}$

11. A treatment plant receives a flow of 3.3 MGD. If the trickling filter effluent is recirculated at the rate of 3.6 MGD, what is the recirculation ratio?

$$\text{Ratio} = \frac{3.6\text{ MGD}}{3.3\text{ MGD}} = 1.1$$

ANS 1.1

12. A high-rate trickling filter receives a daily flow of 1.7 MGD. What is the hydraulic loading rate in MGD/acre if the filter is 90 ft in diameter?

$$\text{Area} = \frac{\pi}{4}(90\text{ ft})^2 = \frac{6362\text{ ft}^2}{43{,}560\text{ ft}^2/\text{ac}} = 0.15\text{ ac}$$

$$\text{Flow} = 1.7\text{ MGD}$$

$$\text{HLR} = \frac{1.7\text{ MGD}}{0.15\text{ ac}}$$

ANS 11.6 $\frac{\text{MGD}}{\text{ac}}$

13. The total influent flow (including recirculation) to a trickling filter is 1.89 MGD. If the trickling filter is 80 ft in diameter, what is the hydraulic loading in gpd/sq ft on the trickling filter?

$$\text{Area} = \frac{\pi}{4}(80\text{ ft})^2 = 5027\text{ ft}^2$$

$$\text{Flow} = 1{,}890{,}000\text{ gpd}$$

$$\text{HLR} = \frac{1{,}890{,}000\text{ gpd}}{5027\text{ ft}^2}$$

ANS 376 $\frac{\text{gpd}}{\text{ft}^2}$

14. A trickling filter, 70 ft in diameter with a media depth of 6 ft, receives a flow of 0.78 MGD. If the BOD concentration of the primary effluent is 167 mg/*L*, what is the organic loading on the trickling filter in lbs BOD/day/1000 cu ft?

$$\text{Volume} = \frac{\pi}{4}(70\text{ ft})^2 \cdot 6\text{ ft} = 23{,}091\text{ ft}^3$$

$$\text{Load} = 8.34\,(167\text{ mg/L})(0.78\text{ MGD}) = 1086\text{ lbs/day}$$

$$\text{OLR} = \frac{1086\text{ lbs/day}}{23{,}091\text{ ft}^3} \cdot 1000$$

ANS 47 $\frac{\text{lbs/day}}{1000\text{ ft}^3}$

15. The influent to the trickling filter is 1.61 MGD. If the recirculated flow is 2.27 MGD, what is the recirculation ratio?

$$\text{ratio} = \frac{2.27\text{ MGD}}{1.61\text{ MGD}}$$

ANS 1.4

16. The suspended solids concentration entering a trickling filter is 236 mg/*L*. If the suspended solids concentration of the trickling filter effluent is 33 mg/*L*, what is the suspended solids removal efficiency of the trickling filter?

$$\text{Efficiency} = \frac{236\text{ mg/L} - 33\text{ mg/L}}{236\text{ mg/L}} \cdot 100\,\%$$

ANS 86 %