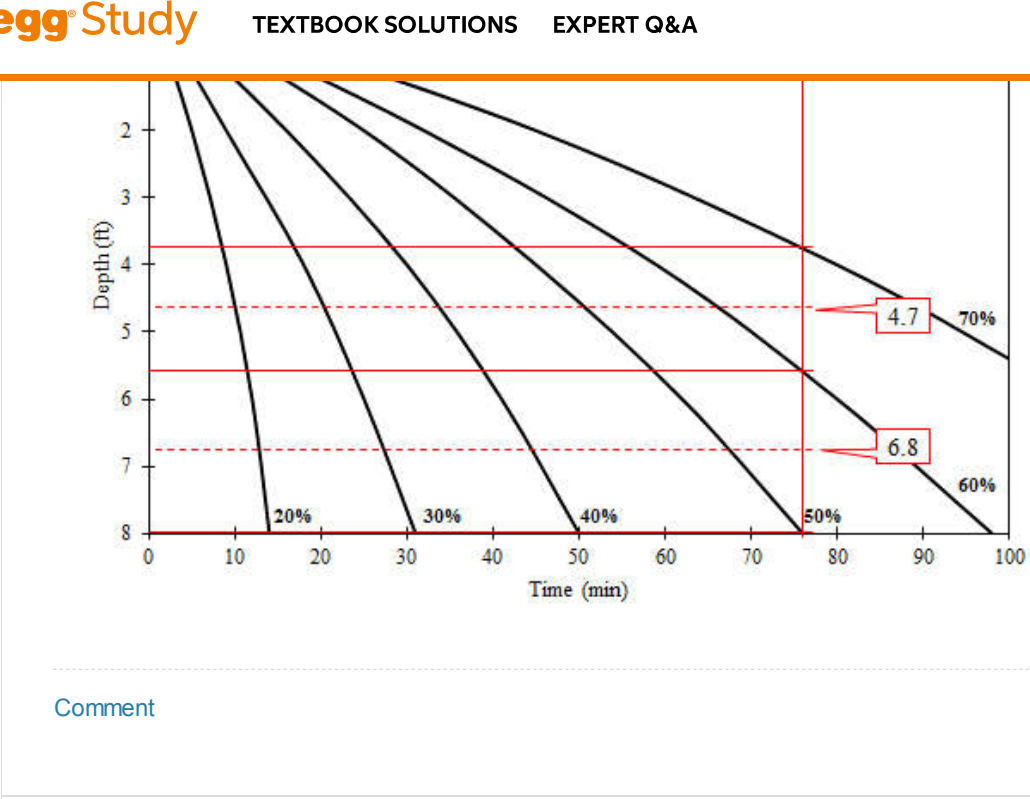




Comment

Step 17 of 32

The midpoint between the 50% and 60% curves is 6.8 ft and the 60–70 midpoint is 4.7 ft. The following table shows the calculation of R_T for the 50% line. Recall that $H = 8$ ft.

i	R_{i+1}	R_i	H_i	$\frac{H_i}{H}(R_i - R_{i+1})$
1	60%	50%	6.8	8.500%
2	70%	60%	4.7	5.875%
$\sum \frac{H_i}{H}(R_i - R_{i+1})$				14.375%
R_C				50.000%
R_T				64.375%

Thus, the overall percent removal (R_T) for the 50% curve is 64.375%.

Comment

Step 18 of 32

The quantities associated with the 50% curve are summarized in the following table.

Curve	H (ft)	t (hr)	v (ft/hr)	V_o (gal/day-ft ²)	R_T
50%	8	1.250	6.4	1149	64.375%

Comment

Step 19 of 32

Find quantities for the **60% removal curve**.

Compute the velocity using this data.

Substitute 8 ft for H and 1.633 hr for t hr in the equation (1). The 50% removal curve crosses the 8 ft line at 98 min, which is 1.633.

$$v = \frac{H}{t}$$

$$= \frac{8 \text{ ft}}{1.633 \text{ hr}}$$

$$= 4.9 \text{ ft/hr}$$

Use this to compute the overflow rate. This is accomplished by performing a unit conversion on the velocity.

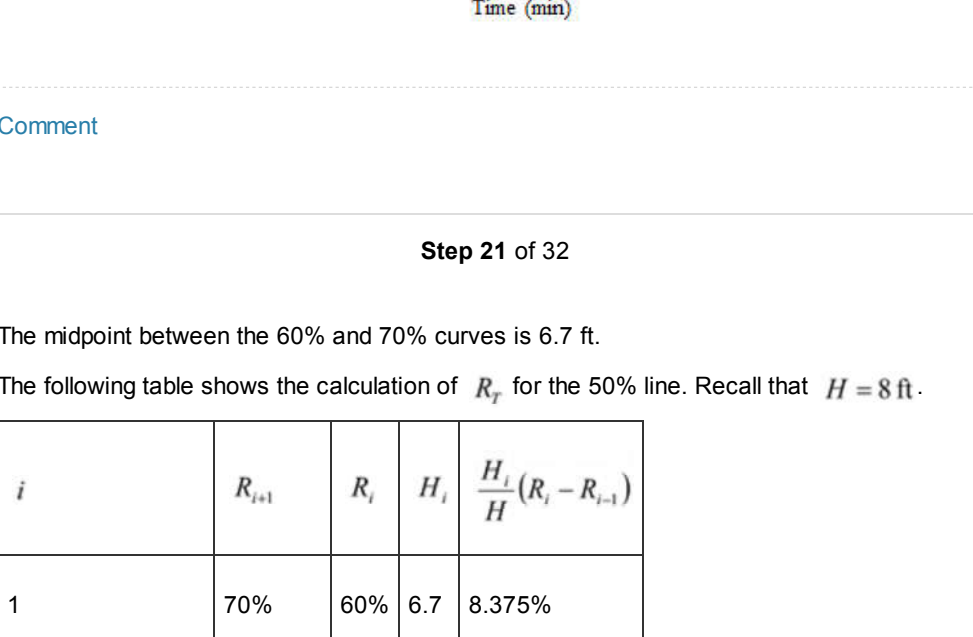
$$V_o = \left(\frac{4.9 \text{ ft}}{1 \text{ hr}} \right) \left(\frac{24 \text{ hr}}{1 \text{ day}} \right) \left(\frac{7.48 \text{ gal}}{1 \text{ ft}^3} \right)$$

$$= 879 \text{ gal/day-ft}^2$$

Comment

Step 20 of 32

Find the overall removal associated with 60%. Start by drawing a vertical line in the percent removal curve plot where the 60% line crosses the x-axis. Find the point where this vertical line crosses each percent removal curve. Find the depth associated with the midpoint between two intersections.



Comment

Step 21 of 32

The midpoint between the 60% and 70% curves is 6.7 ft.

The following table shows the calculation of R_T for the 60% line. Recall that $H = 8$ ft.

i	R_{i+1}	R_i	H_i	$\frac{H_i}{H}(R_i - R_{i+1})$
1	70%	60%	6.7	8.375%
$\sum \frac{H_i}{H}(R_i - R_{i+1})$				8.375%
R_C				60.000%
R_T				68.375%

Thus, the overall percentage removal (R_T) for the 60% curve is 68.375%.

Comment

Step 22 of 32

The quantities associated with the 60% curve are summarized in the following table.

Curve	H (ft)	t (hr)	v (ft/hr)	V_o (gal/day-ft ²)	R_T
60%	8	1.633	4.9	879	68.375%

Comment

Step 23 of 32

Comment

Step 24 of 32

Tabulate the data for the 20%, 30%, 40%, 50%, and 60% curves.

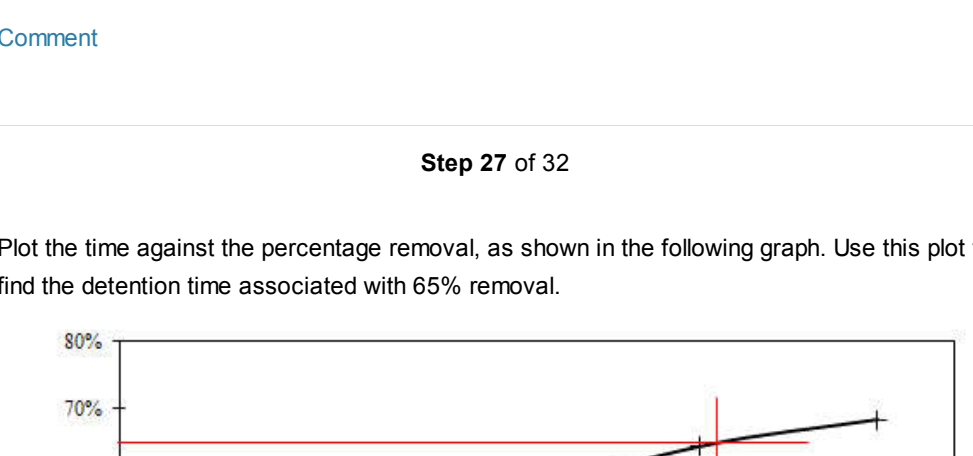
Curve	H (ft)	t (hr)	v (ft/hr)	V_o (gal/day-ft ²)	R_T
20%	8	0.233	34.3	6155	33.625%
30%	8	0.516	15.5	2780	46.500%
40%	8	0.833	9.6	1723	56.375%
50%	8	1.250	6.4	1149	64.375%
60%	8	1.633	4.9	879	68.375%

Comment

Step 25 of 32

a.

Plot percent removal against overflow depth, as shown in the following graph. Use this plot to find the overflow rate associated with 65% removal.



Comment

Step 26 of 32

From this plot, the 65% overflow rate is 1200 gal/day-ft². Apply a "scale-up" factor of 0.65 to adjust.

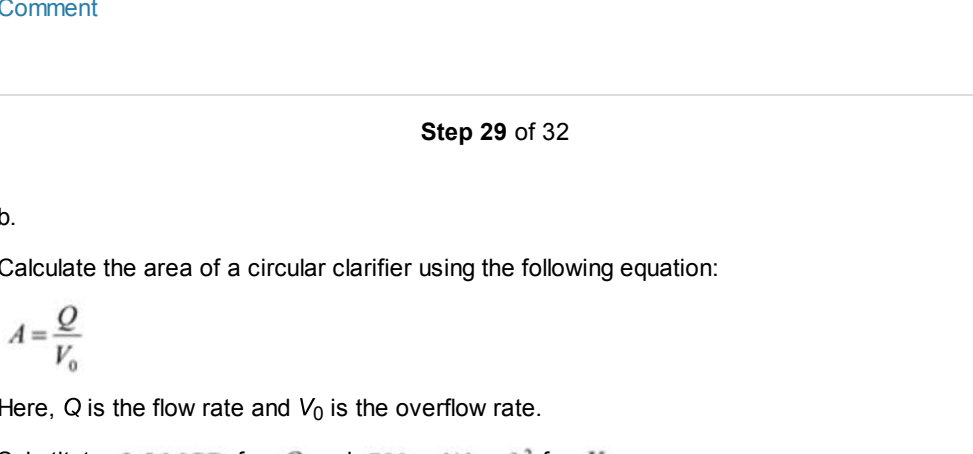
$$1200 \times 0.65 = 780 \text{ gal/day-ft}^2$$

Therefore, the design overflow rate is 780 gal/day-ft².

Comment

Step 27 of 32

Plot the time against the percentage removal, as shown in the following graph. Use this plot to find the detention time associated with 65% removal.



Comment

Step 28 of 32

From this plot, the 65% detention time is 1.3 hr. Apply a "scale-up" factor of 1.75 to adjust.

$$1.3 \times 1.75 = 2.3 \text{ hr}$$

Therefore, the design detention time is 2.3 hr.

Comment

Step 29 of 32

b.

Calculate the area of a circular clarifier using the following equation:

$$A = \frac{Q}{V_o}$$

Here, Q is the flow rate and V_o is the overflow rate.

Substitute 2.5 MGD for Q and 780 gal/day-ft² for V_o .

$$A = \frac{2.5 \text{ MG} \times \frac{1000000 \text{ gal}}{1 \text{ MG}}}{1 \text{ day} \times \frac{780 \text{ gal}}{1 \text{ day-ft}^2}}$$

$$= 3205 \text{ ft}^2$$

Determine the diameter of the clarifier using the following formula:

$$A = \frac{\pi}{4} D^2$$

$$D = \sqrt{\frac{4}{\pi} A}$$

Substitute 3205 ft² for A .

$$D = \sqrt{\frac{4}{\pi} (3205)}$$

$$= 63.9 \text{ ft}$$

Therefore, the diameter of the clarifier is 63.9 ft.

Comment

Step 30 of 32

c.

Round up to the nearest 5-ft increment. The next highest 5-ft increment beyond 63.8 ft is 65 ft. Therefore, the design diameter is 65 ft.

Comment

Step 31 of 32

d.

Compute the area based on the design diameter.

$$A = \frac{\pi}{4} D^2$$

Substitute 65 ft for D .

$$A = \frac{\pi}{4} (65)^2$$

$$= 3318 \text{ ft}^2$$

Compute the actual overflow rate from this area.

$$V_o = \frac{Q}{A}$$

Substitute 2.5 MGD for Q and 3318 ft² for A .

$$V_o = \frac{2.5 \text{ MG} \times \frac{1000000 \text{ gal}}{1 \text{ MG}}}{1 \text{ day} \times \frac{1}{3318 \text{ ft}^2}}$$

$$= 753 \text{ gal/day-ft}^2$$

Comment

Step 32 of 32

Calculate the depth using the following formula:

$$H = V_o t$$

Here, t is the time.

Substitute 753 gal/day-ft² for V_o and 2.3 h for t .

$$H = \left(\frac{753 \text{ gal}}{1 \text{ day-ft}^2} \right) \left(\frac{2.3 \text{ hr}}{1} \right) \left(\frac{1 \text{ day}}{24 \text{ hr}} \right) \left(\frac{1 \text{ ft}^3}{7.48 \text{ gal}} \right)$$

$$= 9.55 \text{ ft}$$

Therefore, the depth of the clarifier is 9.55 ft.

Comment

Was this solution helpful? 6 0

Recommended solutions for you in Chapter 9

