1. In order to disinfect a sedimentation basin measuring 20ft in width, 60 feet in length, and is 10 feet deep to obtain 50ppm would require how many lbs. of 65% available HTH ?
   a) 5.0lbs
   b) 41.3lbs
   c) 37.4lbs
   *d) 57.6lbs

2. How many Ibs. of HTH (65%) are required to treat 7 MG of water and satisfy a 2.8ppm demand as well as a 0.6ppm residual?
   a) 198.5lbs.
   b) 251.9lbs
   c) 288.7lbs.
   *d) 305.4lbs.

3. According to the scales 122lbs of chlorine was fed during that 24hr period. Free chlorine readings entering the clearwell read 0.8mg/l. What was the approximate chlorine demand of the raw water that day?
   a) 2.6mg/l
   *b) 1.0mg/1
   c) 3.2mg/l
   d) 4.1mg/l

4. A water plant treated their daily output of 4.5 MGD with 150 Ibs of gaseous chlorine. What is their dosage at that plant?
   a) 2.5ppm
   b) 3.0ppm
   c) 4.5ppm
   *d) 4.0ppm

5. Your treatment facility uses 97lbs of chlorine a day to disinfect the 4 MGD you treat. Those 97lbs results in a chlorine concentration of $2,9$ppm. When checking the furthest area of your system you discover that the residual is .6ppm chlorine. What is your demand?
   a) 3.5mg/l
   b) 1.7ppm
   c) 2.3ppm
   *d) 3.5ppm

6. If the chlorine demand was 1.2ppm and the chlorine residual was 0.4ppm what would the chlorine dosage be?
   a) 0.8ppm
   *b) 1.6ppm
   c) 2.0ppm
   d) 2.5ppm

7. Determine the chlorinator setting (lb/day) required to treat a flow of 4MGD with a chlorine dose of 5mg/L.

   Chlorine feed rate (lb/ day) = Chlorine (mg/L)× Flow (MGD) × 8.34lb/gal

   Chlorine feed rate (lb/ day) = 5mg/L × 4MGD × 8.34lb/gal

   Chlorine feed rate (lb/ day) = 167lb/ day

8. A pipeline that is 12 inches in diameter and 1400ft long is to be treated with a chlorine dose of 48mg/L. How many lb of chlorine will this require?

   First determine the gallon volume of the pipeline:

   Volume (gal) = 0.785 × D^2× length (ft) × 7.48gal/cuft

   Volume (gal) = 0.785 × $(1ft)^2$ × 1400ft × 7.48gal/cuft Volume (gal) = 8221gal

   Next calculate the amount of chlorine required:

   Chlorine feed rate (lb/ day) = Chlorine (mg/L) x Flow (MGD) ×8.34lb/gal

   Chlorine feed rate (lb/ day) = 48mg/L × 0.008221MGD × 8.34lb/gal

   Chlorine feed rate (lb/ day) = 3.3lb

   Example 3:
   A water sample is tested and found to have a chlorine demand of 1.7mg/L. If the desired chlorine residual is 0.9mg/L, what is the desired chlorine dose (in mg/L)?

   Chlorine Dose (mg/L) = Chlorine Demand + Chlorine Residual

   Chlorine Dose (mg/L) = 1.7mg/L + 0.9mg/L

   Chlorine Dose(mg/L) = 2.6mg/L

9. The chlorine dosage for water is 2.7mg/L. If the chlorine residual after a 30-minute contact time is found to be 0.7mg/L, what is the chlorine demand (in mg/L)?

   Chlorine Demand = Chlorine Dose − Chlorine Residual

   Chlorine Demand = 2.7mg/L − 0.7mg/L

   Chlorine Demand = 2.0mg/L

10. What should the chlorinator seting be (lb/day) to treat a flow of 2.35MGD if the chlorine demand is 3.2mg/L and a chlorine residual of 0.9mg/L is desired?

    First, determine the chlorine dosage (in mg/L):

    Chlorine Dose (mg/L) = Chlorine Demand + Chlorine Residual

    Chlorine Dose (mg/L) = 3.2mg/L + 0.9mg/L

    Chlorine Dose (mg/L) = 4.1mg/L

    Next calculate the chlorine dosage (feed rate) in lb/ day:

    Chlorine feed rate (lb/ day) = Chlorine (mg/L)× Flow (MGD) × 8.34lb/gal

Chlorine feed rate (lb/ day) = 4.1mg/L × 2.35MGD × 8.34lb/gal

Chlorine feed rate (lb/ day) = 80.4lb/ day

11. A chlorinator setting is increased by 2lb/ day. The chlorine residual before the increased dosage was 0.2mg/L. After the increased chlorine dose, the chlorine residual was 0.5mg/L. The average flow rate being chlorinated is 1.25MGD. Is the water being chlorinated beyond the breakpoint?

    First calculate the expected increase in chlorine residual:

    Chlorine feed rate (lb/ day) = Chlorine (mg/L) x Flow (MGD) × 8.34lb/gal

    2lb/ day = ×mg/L × 1.25MGD × 8.34lb/gal

    $x = 2/(1.25 \times 8.34)$

    x = 0.19mg/L

    Actual increase in residual is:

    0.5mg/L − 0.19mg/L = 0.31mg/L

12. A chlorinator setting of 18lb chlorine per 24 hours result in a chlorine residual of 0.3mg/L. The chlorinator setting is increased to 22lb per 24 hours. The chlorine residual increased to 0.4mg/L at this new dosage rate. The average flow being treated is 1.4MGD. On the basis of these data, is the water being chlorinated past the breakpoint?

    First calculate the expected increase in chlorine residual:

    Chlorine feed rate (lb/ day) = Chlorine (mg/L)× Flow (MGD) × 8.34lb/gal

    4lb/ day = xmg/L × 1.4MGD × 8.34lb/gal

    x = 4/(1.4 × 8.34)

    x = 0.34mg/L

    Next calculate the actual increase in residual:

    0.4mg/L − 0.3mg/L = 0.1mg/L

13. If the water in a tank with a 40-foot diameter has a chlorine demand of 0.70 mg/L and the pressure on the bottom of the tank measures 13 psi, how many gallons of 5.75% bleach would be needed to arrive at a residual of 2.5 mg/L?
    a. 7.5 gallons
    b. 130.9 gallons
    *c. 16 gallons
    d. 273 gallons
    e. not enough information to solve

14. What is the chlorine residual of a 2.5 MGD secondary effluent stream if its chlorine demand is 9 mg/l and is treated with 300 lbs/day chlorine?
    *a. 5.4
    b. 7.9

c. 18.2
d. 262

15. The chlorine demand is 4.8 mg/l and a chlorine residual is 0.75 mg/l is desired. For a flow of 2.8 MGD, how many pounds per day should the chlorinator be set to deliver.
*a. 130
b. 116
c. 112
e. 16

16. Chlorine is being fed at the rate of 75 pounds per day. Plant flow is 1.2 MGD. The chlorine residual is measured and found to be 2.6 mg/L Calculate chlorine demand.
*a. 4.9 mg/L
b. 5.7 mg/L
c. 7.5 mg/L
d. 8.3 mg/L

17. Assuming that a chlorine residual of 0.5 mg/L is being maintained and the chlorine demand is 19.5 mg/L, approximately how many pounds of chlorine per day will be required to treat a flow of 5.0 MGD?
a. 21 lbs
b. 792 lbs
c. 813 lbs
*d. 834 lbs

18. Chlorine is being fed at the rate of 75 pounds per day. Plant flow is 1.2 MGD. The chlorine residual is measured and found to be 2.6 mg/L Calculate chlorine demand.
*a. 4.9 mg/L
b. 5.7 mg/L
c. 7.5 mg/L
d. 8.3 mg/L

19. If 25 Ibs/day of chlorine is being applied to a wastewater effluent flow of 250,000 gpd. Calculate the chlorine demand in mg/L if the chlorine residue is 1.2 mg/L.
a. 2.5 mg/L
*b. 10.8 mg/L
c. 15.1 mg/L
d. 6.3 mg/L

20. Calculate how many pounds per day of chlorine should be used to maintain a dosage of 12 mg/L at 6.0 MGD flow
a. 60 lbs/day
b. 450 lbs/day
c. 500 lbs/day

*d. 600 lbs/day

e. 6,700 lbs/day

21. Chlorine is being fed at the rate of 200 pounds per day. Plant flow is 4 MGD. The chlorine residual is measured and found to be 3 mg/L Calculate chlorine demand.

*a. 3 mg/L

b. 2 mg/L

c. 16 mg/L

d. 9 mg/L

Solution:

$Chlorine\ \ dosage(lbs/day) = conc.(mg/l) * flow(MGD) * 8.34$

$\implies chlorine\ \ dosage\ \ conc.(mg/l) = \dfrac{lbs/day}{flow(MGD) * 8.34} = \dfrac{200}{4 * 8.34} = 6mg/l$

Chlorine dosage = chlorine demand + chlorine residual

$\implies chlorine\ \ demand = chlorine\ \ dosage - chlorine\ \ residual = 6 - 3 = \boxed{3mg/l}$

22. Jar testing shows that the chlorine demand of an effluent is 12.5 mg/l. In order to ensure disinfection, a residual of 1.0 mg/l is required. How many pounds per day of chlorine must be fed for a 1 MGD flow to ensure disinfection.

Solution:

$chlorine\ \ dosage = chlorine\ \ demand\ \ +\ \ chlorine\ \ residual$

$\implies chlorine\ \ dosage = (12.5\ \ +\ \ 1)mg/l = 13.5mg/l$

$lbs/day = 13.5\ \ mg/l * 1\ \ MGD * 8.34 = \boxed{112.6\ \ lbs/day}$

23. What should the setting be on a chlorinator in pounds per day if the dosage desired is 2.90mg/L and the pumping rate from the well is 975gpm ?

$$\frac{975}{69)^1} = 1.4MGD$$

$$1.4 \times 8.34 \times 2.90$$

24. A treatment plant uses 278lb/d of chlorine gas. If the chlorine demand is 0.85mg/L and the chlorine residual is 1.50mg/L, how many million gallons per day are being treated?

$$\frac{278}{8.34 \times 2 \times 35} =$$

dojarge ;

$$0.85 + 1.50 =$$

2.35mg/h

25. A water tank that is 105ft in diameter needs to be disinfected with a 5.0% sodium hypochlorite solution. If the tank is to be filled to only a depth of 5.0ft and the concentration required is 20.0mg/L,

how many gallons of sodium hypochlorite are needed? Assume the sodium hypochlorite solution weighs 8.92 lb/gal.

$$\frac{0.323MGP}{0.323 \times 8.34 \times 20} =$$

9/23/19

26. What is the chlorine residual in a treated water if the dosage is 2.1mgi1 and has a demand of 0.8mg/l
    a. 0.8mg/l
    b. 1mg/l
    c. 2.1mg/!
    d. 2.9mg/l

27. If the chlorine demand of water is 2.5mg/l and you want a residual of 0.5mg/l, how much chlorine would need to be fed to one million gallons?
    a. 25lbs.
    b. 30lbs.
    c. 34lbs.
    d. 38lbs.

28. If you need to feed chlorine at orate of 2.1mg/l and you treat $2,300,000$ gallons. How many pounds of chlorine should you use?
    a. 4lbs.
    b. 17lbs.
    c. 35lbs.
    d. 40lbs.

29. If a 3,000,000 gpd flow is to be dosed with 1.2mg/l, what should the chlorinator feed rate be set at in lbs. of chlorine per day?
    a. 3.0lbs./ day
    b. 4.5 1bs./day
    c. 10lbs./ day
    d. 30lbs./ day

30. If chlorine is being fed at a rate of 260 lb/day for a flow rate of 23 cfs, what should be the adjustment on the chlorinator when the flow rate is decreased to 16 cfs, if all other water parameters remain the same?
    a. 160 lb/day
    b. 180 lb/day
    c. 310 lb/day
    d. 370 lb/day

31. How many gallons of a sodium hypochlorite solution that contains 12.1% available chlorine are needed to disinfect a 1.5-ft diameter pipeline that is 283 ft long, if the dosage required is 50.0 mg/L? Assume the sodium hypochlorite is 9.92 lb/gal.

a. 0.87 gal sodium hypochlorite

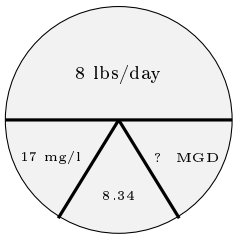
b. 1.0 gal sodium hypochlorite

c. 1.3 gal sodium hypochlorite

d. 1.5 gal sodium hypochlorite

32. A water treatment plant uses 8 pounds of chlorine daily and the dose is 17 mg/l. How many gallons are they producing?

Solution:



$$\frac{\text{lbs}}{\text{day}} = \text{Flow}\frac{\text{MG}}{\text{day}} * \text{Concentration}\frac{\text{mg}}{\text{l}} * 8.34$$

$$\implies \text{Flow}\frac{\text{MG}}{day} = \frac{\frac{\text{lbs}}{\text{day}}}{\text{Concentration}\frac{\text{mg}}{\text{l}} * 8.34} = \frac{8\frac{\text{lbs}}{\text{day}}}{17\frac{\text{mg}}{\text{l}} * 8.34} = 0.056425\frac{\text{MG}}{day}$$

$$0.056425\frac{\text{MG}}{day} * \frac{1,000,000 \text{ Gallons}}{\text{MG}} = \boxed{56,425 \text{ Gallons}}$$

33. A water treatment plant is feeding an average of 295lb/ day of chlorine. If the dosage is 2.25 mg/l, which is the number of millions of gallons per day (mgd) being treated?

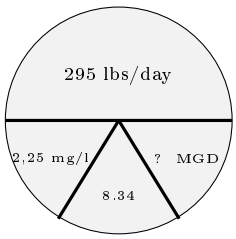
*a. 15.7mgd

b. 35.1mgd

c. 58.3mgd

d. 79.6mgd

Solution:

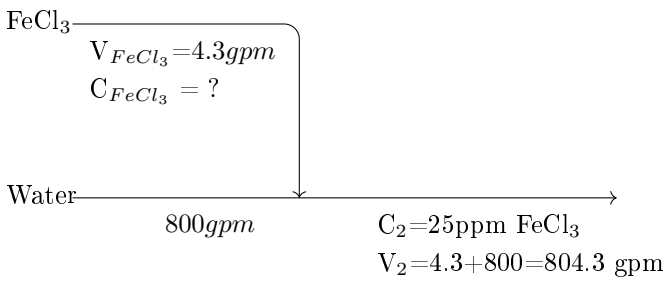


$$\frac{\text{lbs}}{\text{day}} = \text{Flow}\frac{\text{MG}}{\text{day}} * \text{Concentration}\frac{\text{mg}}{\text{l}} * 8.34$$

$$\implies \text{Flow}\frac{\text{MG}}{day} = \frac{\frac{\text{lbs}}{\text{day}}}{\text{Concentration}\frac{\text{mg}}{\text{l}} * 8.34} = \frac{295\frac{\text{lbs}}{\text{day}}}{2.25\frac{\text{mg}}{\text{l}} * 8.34} = \boxed{15.7\frac{\text{MG}}{day}}$$

34. Ferric chloride is being added as a coagulant to the raw water entering a plant. Sampling shows that the concentration of ferric in the raw water is 25 ppm. A quick check of the chemical metering pump shows that it is operating at a flow rate of 4.3 gpm. If the flow through the water plant is 800 gpm, what is the concentration of raw chemical in the dosing tank?

Solution:



$C_1 * V_1 = C_2 * V_2$

$C_{FeCl_3} * V_{FeCl_3} = C_2 * (V_{FeCl_3}+V_{Water})$

$C_{FeCl_3} * 4.3 = 25 * (804.3)$

$$C_{FeCl_3} = \frac{25 * (804.3)}{4.3} = \boxed{4,676 \text{ ppm or } 0.47\%}$$

35. A water plant is fed by two different wells. The first well produces water at a rate of 600 gpm and contains arsenic at 0.5 mg/L. The second well produces water at a rate of 350 gpm and contains arsenic at 12.5 mg/L. What is the arsenic concentration of the blended water?

Solution:

$C_1 * V_1 + C_2 * V_2 + = C_3 * V_3 = C_3 * (V_1 + V_2)$

$C_{Well\ 1} * V_{Well\ 1} + C_{Well\ 2} * V_{Well\ 2} = C_{Blend} * V_{Blend} = C_{Blend} * (V_{Well\ 1} + V_{Well\ 2})$

$$\implies C_{Blend} = \frac{C_{Well\ 1} * V_{Well\ 1} + C_{Well\ 2} * V_{Well\ 2}}{V_{Well\ 1} + V_{Well\ 2}} = \frac{0.5 * 600 + 12.5 * 350}{600 + 350} = \boxed{4.9 \text{ mg/l}}$$

36. How many pounds of a calcium hypochlorite that contains 64.3% available chlorine are needed to disinfect a water main that is 24in. in diameter, if the pipeline is 781 ft long and the dosage required is 50.0 mg/l ?

a. 5.95lb calcium hypochlorite

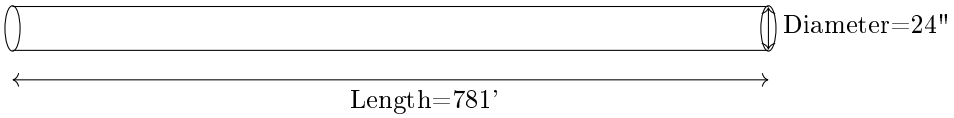
b. 8.25lb calcium hypochlorite

*c. 11.9lb calcium hypochlorite

d. 13.8lb calcium hypochlorite

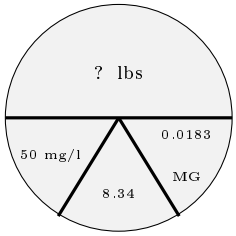
Solution:

First determine the volume of the pipeline in MG:



$$Volume = \frac{\pi}{4}D^2 * L = 0.785 * \left(\frac{24}{12}\right)^2 \cancel{ft^2} * 781\cancel{ft} * 7.48\frac{\cancel{gallons}}{\cancel{ft^3}} * \frac{MG}{1,000,000\cancel{gallons}} = 0.0183\ \ MG$$

Next calculate the amount of chlorine required using pounds formula:



Chlorine required (lbs)=Chlorine mg/l * Pipe Volume (MG) * 8.34

$$\Longrightarrow 50\text{mg/l} * 0.0183\text{MG} * 8.34\text{lb/gal} = \boxed{7.63\ \text{lbs chlorine}}$$

Calculate the lbs of calcium hypochlorite which will provide the 7.63 lbs chlorine

$$lbs\ \ Ca(OCl)_2 = \frac{lb\ \ Ca(OCl)_2}{0.643\ \cancel{lbs\ chlorine}} * 7.63\ \cancel{lbs\ chlorine} = \boxed{11.9\ \ lbs\ \ Ca(OCl)_2}$$

The above problem can be solved directly using the formula below given in the SWRCB Water Treatment Exam Formula Sheet.

$$\text{HTH Solids (lbs)} = \frac{(\text{Volume MG}) * (\text{ppm or mg/l}) * 8.34\ \text{lbs/gal}}{\%\ \ \text{strength}}$$

$$= \frac{0.0183 * 50 * 8.34}{0.643} = \boxed{11.9\ \ lbs\ \ Ca(OCl)_2}$$