1. Your water treatment plant uses 39.6lbs. of cationic polymer to treat a flow of 2.71 MGD. What is the polymer dosage?
   a) 0.07ppm
   *b) 1.75ppm
   c) 14.61ppm
   d) 3.23ppm

2. The flow through a water plant is 5.25 MGD. Jar tests have indicated that the desired dosage of lime is 150mg/l. What would the correct lime feeder setting per day and per minute?
   a) 3294.0lbs a day/ 2.29lbs a minute
   *b) 6567.8lbs a day/ 4.56lbs a minute
   c) 4930.9lbs a day/ 3.42lbs a minute
   d) 6587.8lbs a day/ 274.5lbs a minute

3. 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

4. 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

5. 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

6. 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

7. 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

8. 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

9. 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

10. 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

11. 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

12. 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

13. 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

14. 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

15. 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

16. 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

17. 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
    $\implies chlorine\ \ demand = chlorine\ \ dosage - chlorine\ \ residual = 6 - 3 = \boxed{3mg/l}$

18. 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:

    $chlorine\ \ dosage = chlorine\ \ demand\ \ +\ \ chlorine\ \ residual$
    $\implies chlorine\ \ dosage = (12.5\ \ +\ \ 1)mg/l = 13.5mg/l$
    $lbs/day = 13.5\ \ mg/l * 1\ \ MGD * 8.34 = \boxed{112.6\ \ lbs/day}$

19. 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 ?
    $$\frac{975}{69)^1} = 1.4MGD$$
    $$1.4 \times 8.34 \times 2.90$$

20. 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

21. 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.

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

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22. 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

23. 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.

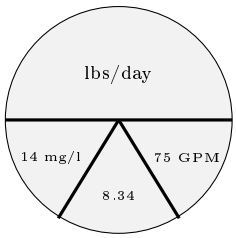
24. If you need to feed chlorine at orate of 2.1mg/l and you treat $2,300,000$ gallons. How many pounds of chlorine should you use?
    a. 4lbs.
    b. 17lbs.
    c. 35lbs.
    d. 40lbs.

25. 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

26. 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

27. 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

28. A water treatment plant operates at the rate of 75 gallons per minute. They dose soda ash at 14 mg/L. How many pounds of soda ash will they use in a day? Solution:



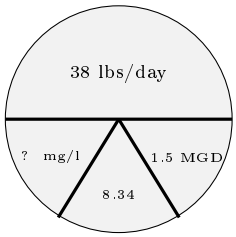

$$\frac{\text{lbs}}{\text{day}} = \text{Flow}\frac{\text{MG}}{\text{day}} * \text{Concentration}\frac{\text{mg}}{\text{l}} * 8.34$$

$$\frac{\text{lbs}}{\text{day}} = 75\frac{\cancel{\text{gallons}}}{\cancel{\text{min}}} * 1440\frac{\cancel{\text{min}}}{\text{day}} * \frac{\text{MG}}{1,000,000\ \cancel{\text{gallons}}} * 14\frac{\text{mg}}{\text{l}} * 8.34 = \boxed{12.6\frac{lbs}{day}}$$

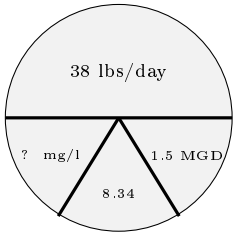
29. A water treatment plant is producing 1.5 million gallons per day of potable water, and uses 38 pounds of soda ash for pH adjustment. What is the dose of soda ash at that plant?
    Solution:

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

$$\frac{38\frac{\text{lbs}}{\text{day}}}{1.5\frac{\text{MG}}{\text{day}} * 8.34} = \boxed{3\frac{\text{mg}}{\text{l}}}$$




30. A water treatment plant produces 150,000 gallons of water every day. It uses an average of 2 pounds of permanganate for iron and manganese removal. What is the dose of the permanganate?
Solution:




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

$$\frac{2\frac{\text{lbs}}{\text{day}}}{\left(150,000\frac{\cancel{\text{Gallons}}}{\text{day}} * \frac{\text{MG}}{1,000,000\ \cancel{\text{Gallons}}} * 8.34\right)} = \boxed{3\frac{\text{mg}}{\text{l}}}$$

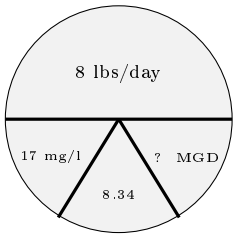
31. A water treatment plant uses 8 pounds of chlorine daily and the dose is 17 mg/l. How many gallons are they producing?
Solution:

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

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

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

32. Determine the chlorinator setting in pounds per day if a water plant produces 300gpm and the de-




sired chlorine dose is 2.0mg/L.

33. The finished water chlorine demand is 1.2mg/L and the target residual is 2.0mg/L. If the plant flow is 5.6mgd, how many pounds per day of 65% hypochlorite solution will be required?

34. Fluoride is added to finished water at a dose of 4mg/L. Find the feed rate setting for a fluoride saturator in gal/min if the water plant produces 5mgd.

35. If chlorine costs $0.21 per pound, what is the daily cost to chlorinate a 5mgd flow rate at a dosage of 2.6mg/L ?

36. One gallon of sodium hypochlorite laundry bleach, with 5.25% available chlorine, contains how many pounds of active chlorine?

37. How much sodium hypochlorite, in gallons, is required to obtain a residual of 100mg/L in a well? The casing diameter is 18 -inches and the length is 80 feet. Sodium hypochlorite contains 5.25% available chlorine. Assume a demand of 15mg/L.

38. A water company uses an average of 600gpm of water. The water contains 0.30mg/L of manganese and 0.06mg/L of iron. How many pounds of iron and manganese are pumped into the distribution system each year?

39. How many pounds of copper sulfate will be needed to dose a reservoir with 0.6mg/L of copper? The reservoir holds 30 million gallons. The copper sulfate is 25% copper by weight.

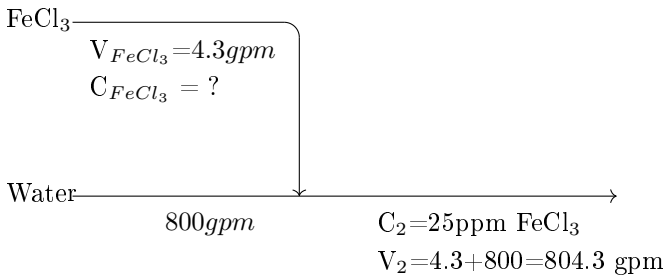
40. Liquid alum delivered to a water treatment plant contains 642.3 milligrams of aluminum per milliliter of liquid solution. Jar tests indicate that the best alum dose is 9mg/L. Determine the setting on the liquid alum feeder in ml/min when the plant flow is 3.2mgd.

41. The raw water supply contains 1.8mg/L of fluoride. The flow rate is 400gpm. The target fluoride dose for the finished water is 3mg/L. Find the desired feed rate in gpm for a fluoride saturator.

42. The raw water alkalinity is 50mg/L as calcium carbonate. The water is treated by adding 15 mg/L of alum. What is the alkalinity of the finished water?

43. 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:




$C_1 * V_1 = C_2 * V_2$

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

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

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

44. 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:

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

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

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