NORTH Dakota | Environmental Quality
Be Legendary.™

CONVERSION PROBLEMS

1. 20 ft3 = __149.6__ gallons $20\ ft^3 \times \frac{7.48\ gal}{1\ ft^3} = 149.6\ gal$

2. 100 gallons = __13.37__ ft^3 $100\ gal \times \frac{1\ ft^3}{7.48\ gal} = 13.37\ ft^3$

3. 70 lbs = __8.39__ gallons $70\ lbs \times \frac{1\ gal}{8.34\ lbs} = 8.39\ gal$

4. 200 gallons = __1,668__ lbs $200\ gal \times \frac{8.34\ lbs}{1\ gal} = 1{,}668\ lbs$

5. 158,400 inches = __2.5__ miles $158{,}400\ ins \times \frac{1\ ft}{12\ in} \times \frac{1\ mile}{5{,}280\ ft} = 2.5\ miles$

6. 1,500 ft^3 = __93,575__ lbs $1{,}500\ ft^3 \times \frac{7.48\ gal}{1\ ft^3} \times \frac{8.34\ lbs}{1\ gal} = 93{,}575\ lbs$

7. 25 ft^3 = __0.93__ yd^3 $25\ ft^3 \times \frac{1\ yd^3}{27\ ft^3} = 0.93\ yd^3$

8. 3.5 acres = __152,460__ ft^2 $3.5\ acres \times \frac{43{,}560\ ft^2}{1\ acre} = 152{,}460\ ft^2$

9. 261,360 ft^2 = __6__ acres $261{,}360\ ft^2 \times \frac{1\ acres}{43{,}560\ ft^2} = 6\ acres$

10. 130 ft^3 = __8,109.82__ lbs $130\ ft^3 \times \frac{7.48\ gal}{1\ ft^3} \times \frac{8.34\ lbs}{1\ gal} = 8{,}109.816\ lbs$

1. A stabilization pond is to be enclosed by a barbwire fence. Due to regulations, the fence must consist of three separate strands. The area that is to be enclosed measures 400 feet wide by 600 feet long. What length of wire will the city have to purchase to enclose the pond with three strands?

L= 600 ft W= 400 ft

Step 1: $2(600\ ft) + 2(400) = 2{,}000\ ft$

Step 2: $2{,}000\ ft \times 3\ strands = \mathbf{6{,}000\ ft}$

2. Calculate the total acreage of a stabilization pond that measures 350 feet long by 550 feet wide.

L= 550 ft W= 350 ft

Step 1: $550\ ft \times 305\ ft = 192{,}500\ ft^2$

Step 2: $192{,}500\ ft^2 \times \frac{1\ acre}{43{,}560\ ft^2} = \mathbf{4.42\ acres}$

3. A rectangular shaped container is 60 feet long, 30 feet wide, and 10 feet deep.
   A. How many gallons of water can this container hold?
   B. How much would the water weigh?
   C. How many minutes would it take to empty the full tank at a pumping rate of 5 gallons/second?

L= 60 ft W= 30 ft Depth= 10 ft

A. $60\ ft \times 30\ ft \times 10\ ft = 18{,}000\ ft^3 \times \frac{7.48\ gal}{1\ ft^3} = \mathbf{134{,}640\ gal}$

B. $134{,}640\ gal \times \frac{8.34\ lbs}{1\ gal} = \mathbf{1{,}122{,}897.6\ lbs}$

C. $134{,}640\ gal \times \frac{1\ sec}{5\ gal} = 26{,}928\ sec \times \frac{1\ min}{60\ sec} = \mathbf{448.8\ min}$

4. A Clearwell is 15 feet long by 13 feet 4 inches wide and measures 9 feet 6 inches deep.
   A. How many gallons of water can the Clearwell hold?
   B. How many tons would the contained water weigh?

L= 15 ft W= 13 ft 4 in= 13.33 ft D= 9 ft 6 in= 9.5 in

A. $15\ ft \times 13.33\ ft \times 9.5\ ft = 1{,}899.5\ ft^3 \times \frac{7.48\ gal}{1\ ft^3} = \mathbf{14{,}208\ gal}$

B. $14{,}208\ gal \times \frac{8.34\ lbs}{1\ gal} = 118{,}495\ lbs \div 2{,}000\ \frac{lbs}{ton} = \mathbf{59.25\ tons}$

5. A tank has a 10-foot radius. What is its circumference and area?

Radius= 10 ft Diameter= $10\ ft \times 2 = 20\ ft$

$Circumference = \pi \times diameter$: $3.14 \times 20\ ft = 62.8\ ft$

$A = \pi r^2$: $3.14 \times (10\ ft)^2 = 314\ ft^2$

6. How many gallons of water would it take to completely fill a total of 3,000 feet of 12-inch water main?

$Vol = \pi R^2 \times length$ Diameter= 12 in Length= 3,000 ft

Step 1: $3.14 \times (0.5\ ft)^2 \times 3{,}000\ ft = 2{,}355\ ft^3$

Step 2: $2{,}355\ ft^3 \times \frac{7.48\ gal}{1\ ft^3} = 17{,}615.4\ gal$

7. If three stabilization ponds cover 5 acres, 7 acres, and 10.5 acres, how many square feet is this? If all three ponds are 8 feet deep and completely full, how many gallons of water will they hold?

Total Acres: $5\ acres + 7\ acres + 10.5\ acres = 22.5\ acres$

Total Square Feet: $22.5\ acres \times \frac{43{,}560\ ft^2}{1\ acre} = 980{,}100\ ft^2$

Total Gallons: $980{,}100\ ft^2 \times 8\ ft = 7{,}840{,}000\ ft^3 \times \frac{7.48\ gal}{1\ ft^3} = 58{,}649{,}184\ gal$

8. A sewer line is 10 inches in diameter and 1,000 feet long. How many gallons does it hold?

$Vol = \pi R^2 \times length$ Diameter = 10 in Length = 1,000 ft

Step 1: $3.14 \times (0.417\ ft)^2 \times 1{,}000\ ft = 546\ ft^3$

Step 2: $546\ ft^3 \times \frac{7.48\ gal}{1\ ft^3} = 4{,}084\ gal$

9. A trench is to be excavated that is 7 feet wide, 30 feet long, and 36 inches deep. What is the volume in cubic yards of the trench?

L = 30 ft W = 7 ft Depth = 36 in

Step 1: $7\ ft \times 30\ ft \times 3\ ft = 630\ ft^3$

Step 2: $630\ ft^3 \times \frac{1\ yd^3}{27\ ft^3} = 23.33\ yd^3$

10. A pipe has a diameter of 2 feet and is full of water. If the velocity through the pipe is 60 feet per minute, what is the flow rate through the pipe in cubic feet per second?

$Q = V \times A \quad A = \pi r^2$ Diameter = 2 ft Velocity = 60 ft/min

Step 1: $A = 3.14 \times (1\ ft)^2 = 3.14\ ft^2$

Step 2: $Q = 60 \frac{ft}{min} \times 3.14\ ft^2 = 188.4\ ft^3/min$

Step 3: $\frac{188.4\ ft^3}{min} \times \frac{1\ min}{60\ sec} = 3.14\ \frac{ft^3}{sec}$

11. A water storage tank holds 500,000 gallons of water. How much chlorine (HTH) in pounds must be added to chlorinate the water to 50 mg/L? (Assume HTH is 65% chlorine).

$$Chemical\ fed = flow/water\ treated\ (MG) \times dosage\ \left(\frac{mg}{L}\right) \times weight\ of\ H_2O\ (8.34 \frac{lbs}{gal})$$

Step 1: $0.5\ MG \times 50 \frac{mg}{L}\ or\ ppm \times \frac{8.34 lbs}{gal} = 208.5\ lbs\ @\ 100\%\ chlorine$

Step 2: $208.5\ lbs \div 0.65 = 320.8\ lbs$

12. A water plant is treating 2,000,000 gallons per day. A test for free chlorine residual at the plant indicates a level of 0.2 mg/L. Based on experience, the operator knows they must bring the free chlorine level up to 1.7 mg/L at the plant in order to maintain a level of 1.0 mg/L free residual in the distribution system. If the rotameter on the chlorinator is set at 35, what must the new setting be?

$$Chemical\ fed = flow/water\ treated\ (MG) \times dosage\ \left(\frac{mg}{L}\right) \times weight\ of\ H_2O\ (8.34 \frac{lbs}{gal})$$

Step 1: $2 \frac{MG}{day} \times 1.5 \frac{mg}{L} \times 8.34 \frac{lbs}{gal} = 25.02 \frac{lbs}{day}$

Step 2: $25.02 \frac{lbs}{day} + 35 = 60.02 \frac{lbs}{day}\ or\ 60$

13. Water is flowing into a sedimentation basin at a rate of 500 gpm. Find the detention time for the basin if it is the shape of a cylinder with a diameter of 100 feet and 20 feet deep.

Flow Rate = 500 gpm Diameter = 100 ft Depth = 20 ft $Vol = \pi R^2 \times depth$

Step 1: $Vol = 3.14 \times (50\ ft)^2 \times 20\ ft = 157{,}000\ ft^3$

Step 2: $157{,}000\ ft^3 \times \frac{7.48\ gal}{1\ ft^3} = 1{,}174{,}360\ gal$

Step 3: $1{,}174{,}360\ gal \times \frac{1\ min}{500\ gal} = 2{,}348.72\ min$

Step 4: $2{,}348.72\ min \times \frac{1\ hr}{60\ min} = 39.1\ hrs$

14. A 12-inch sewer line is completely full and the velocity of the wastewater through it is 1.8 feet per second. What is the flow through the line in gpm?

$Q = V \times A \quad A = \pi r^2$ Diameter = 12 in. Velocity = 1.8 ft/sec

Area: $3.14 \times (0.5\ ft)^2 = 0.785\ ft^2$

Flow Rate: $1.8\frac{ft}{sec} \times 0.785\ ft^2 = 1.413\ ft^3/sec$

Conversion: $\frac{1.413\ ft^3}{sec} \times \frac{7.48\ gal}{1\ ft^3} \times \frac{60\ sec}{1\ min} = 634.2\ gpm$

15. A 6-inch water main has a discharge of 200 gallons per minute. Determine the velocity of the water in the main.

$Q = V \times A,\ so\ V = \frac{Q}{A} \quad A = \pi r^2$ Diameter = 6 in Flow Rate = 200 gpm

Area: $3.14 \times (0.25\ ft)^2 = 0.19625\ ft^2$

Convert Flow Rate to Ft^3: $\frac{200\ gal}{1\ min} \times \frac{1\ ft^3}{7.48\ gal} = 26.7\ ft^3/min$

Velocity: $\frac{26.7\ ft^3/min}{0.19625\ ft^2} = 136\ ft/min$

16. A stabilization pond is being loaded at the rate of 150 pounds of BOD_5 per day. A small industry contributes 35 pounds of BOD_5 per day to the total loading. If the average per capita of BOD_5 is 0.17 pounds per day, what is the approximate population of the city?

Total BOD_5= 150 lbs Industry BOD_5= 35 lbs Avg. BOD_5 per Capita= 0.17 lbs

BOD_5 from Population: $150\ lbs - 35\ lbs = 115\ from\ population$

Approx. Population: $\frac{115\ lbs}{day} \times \frac{1\ person}{0.17\ lbs/day} = 676\ people$

17. The reservoir for a water treatment plant has a capacity of 250,000 gallons. If the reservoir is only 10% full and the capacity of the plant is 500 gpm while the usage from the customers is a constant 300 gpm, how long will it take to fill the reservoir?

Total Capacity= 250,000 gal Current Capacity= $250{,}000\ gal \times 0.10 = 25{,}000\ gal$

Gallons needed to fill= $250{,}000\ gal - 25{,}000\ gal = 225{,}000\ gal$

Plant Capacity= 500 gpm Customer Usage= 300 gpm

Net inflow=$500\ gpm - 300\ gpm = 200\ gpm$

Time to fill: $225{,}000\ gal \times \frac{1\ min}{200\ gal} = 1{,}125\ min \times \frac{1\ hr}{60\ min} = 18.75\ hrs$

18. The wastewater entering a stabilization pond has a BOD_5 of 250 mg/L. The discharge from the pond in the fall has a BOD_5 of 25 mg/L. What is the efficiency of the pond?

Entering BOD_5= 250 mg/L Discharge BOD_5= 25 mg/L

Efficiency: $\frac{250\frac{mg}{L} - 25\ mg/L}{250\ mg/L} = \frac{225\ mg/L}{250\ mg/L} = 0.9 \times 100 = 90\%$