



SOUTHWEST
ENVIRONMENTAL
FINANCE CENTER

US Territories Water Operator Training Series

Session 11: Disinfection 4 Chlorine Disinfection Math

11/13/25

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Specialist

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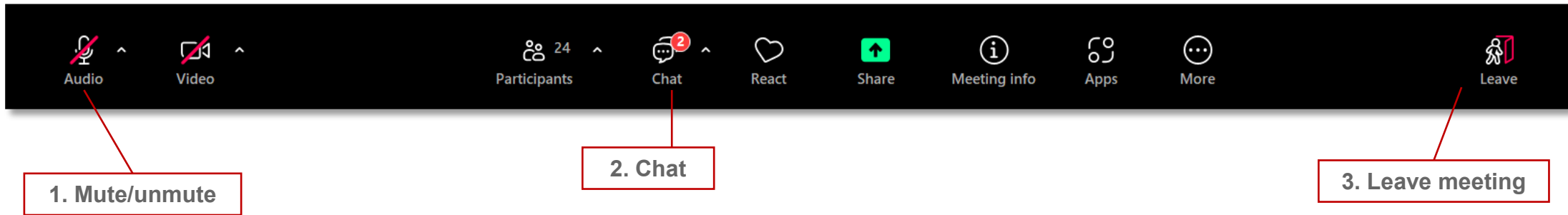


SCHOOL OF
ENGINEERING



This training series is funded by the US EPA

Attendee Meeting Controls



1. Mute/unmute

- Click the microphone icon to unmute yourself to speak (if you are not speaking, don't unmute)

2. Chat

- Click the chat icon and then use the dropdown next to send text instant messages to:
 - Everyone publicly: messages will be visible to all participants
 - Host only: messages will be sent only to the meeting host – Don't send a chat to only me; I won't have time to see it while presenting.
 - Any attendee directly: message will be sent to the selected meeting participant only

3. Leave meeting

- Click on the leave icon to exit the ZOOM Meeting

Schedule for 2025:

Date	Topic
6/26/25	Program Overview, Test Format, Study & Test Tips
7/10/25	Drinking Water System Overview - (Source, Treatment, & Distribution)
7/24/25	Basic Operator Math (+, -, /, x, Exponents and basic algebra)
8/7/25	Applied Operator Math (Areas, Volume, Pressure)
8/21/25	Drinking Water Regulations
9/4/25	Source Water Characteristics
9/18/25	Surface Water Intake Components, Well Components, and O&M
10/2/25	Disinfection 1: Chloramines, UV, Chlorine Dioxide, Chlorine
10/16/25	Disinfection 2: Chlorine Disinfection Application for Sodium Hypochlorite and Gas Chlorine (including storage and safety)
10/30/25	Disinfection 3: Distribution System Application, Residual Measurement, Evaluation & Adjustment,
11/13/25	Disinfection 4: Chlorine Disinfection Math
12/4/25	Surface Water Treatment 1: Coagulation, Flocculation, Sedimentation (including chemistry, process controls, operations)
12/18/25	Surface Water Treatment 2: Filtration

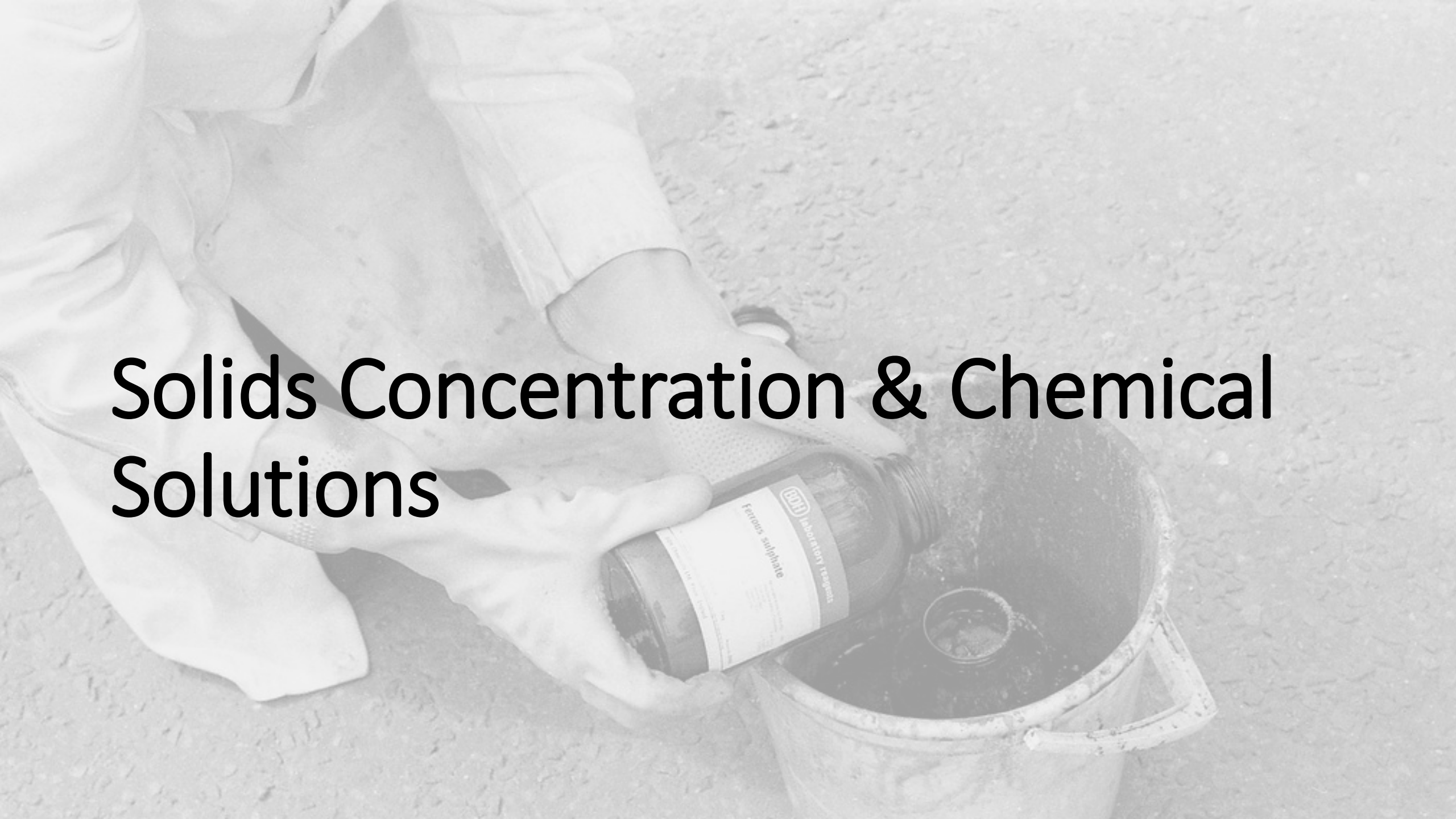
Links to recordings and material are available on our website at <https://swefc.unm.edu/home/op-cert-trainings/>

Disinfection 4:

Chlorine Disinfection Math

- Solid Concentrations and Chemical Solutions
- Specific Gravity
- Feed Rate

Solids Concentration & Chemical Solutions

A grayscale photograph showing a person wearing a white lab coat and white gloves. They are holding a dark plastic bottle labeled 'Ferrous sulphate' and pouring its contents into a metal bucket. The bucket is partially filled with a dark liquid. The background is a textured, light-colored surface.

Chemical Solutions: A homogenous mixture of at least two substances.



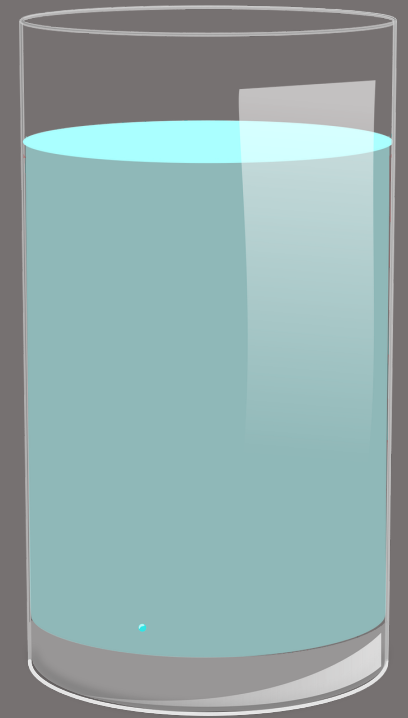
Chemical Solution
(Hypochlorite Solution)

=



Solute
(Hypochlorite Salt)

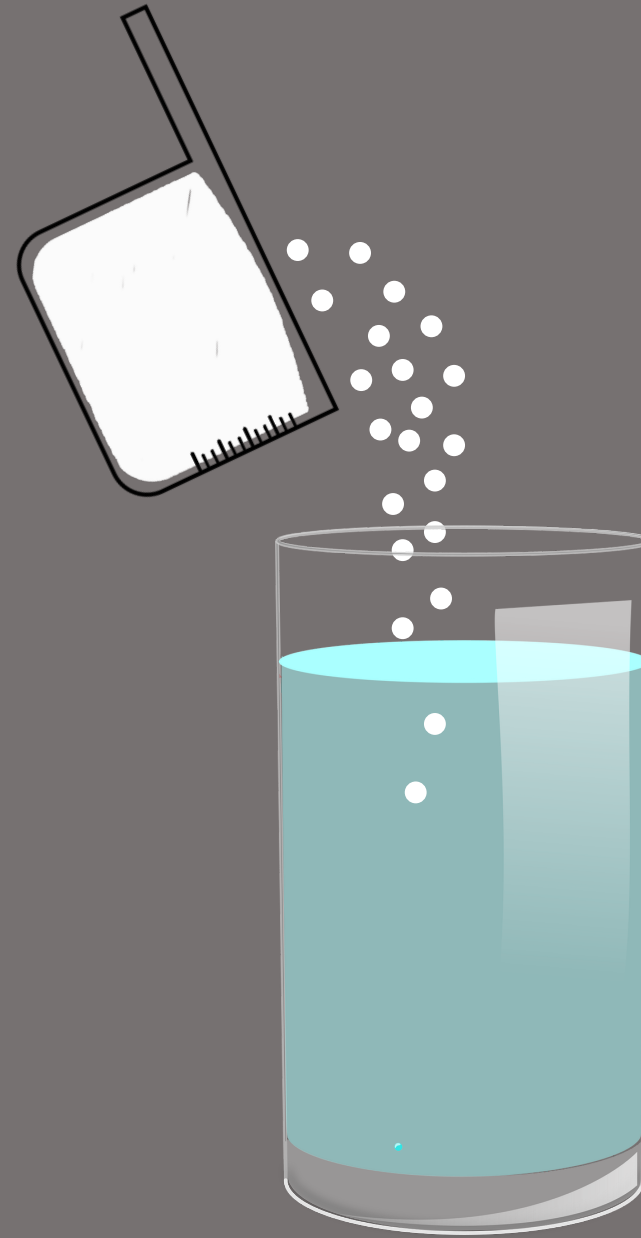
+



Solvent
(Water)

Chemical Solutions

Add hypochlorite salt to the water.

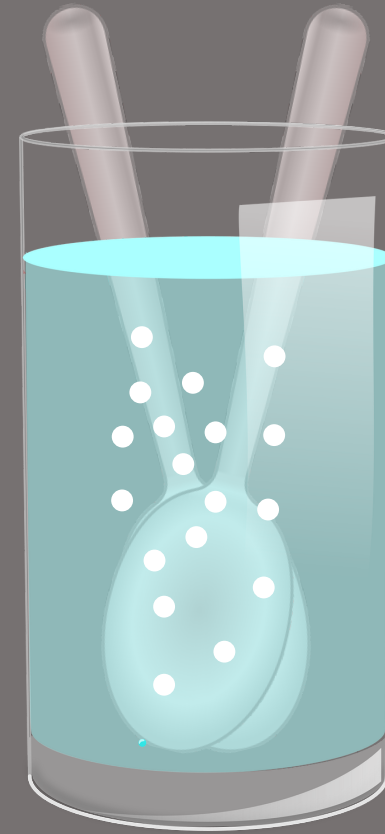


Chemical Solutions

Mix until solute is completely dissolved.

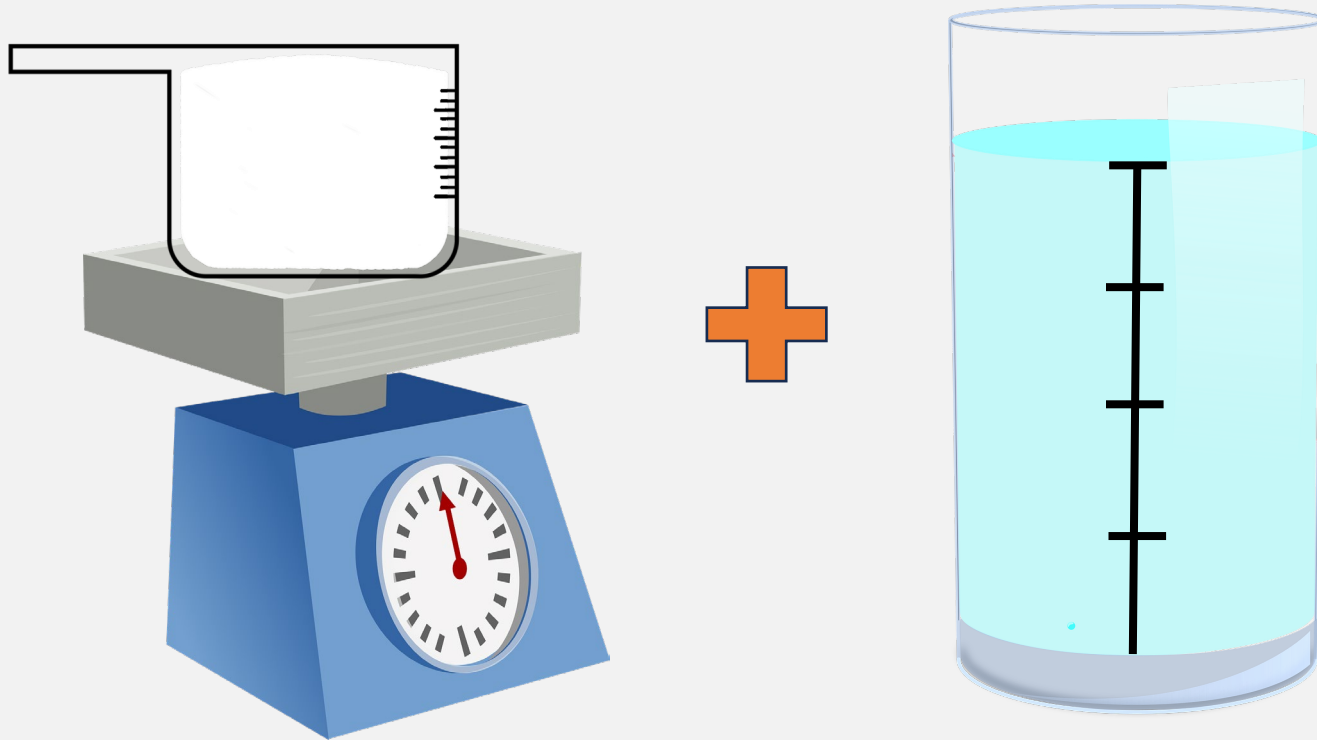
Now we have our hypochlorite solution.

Chemical
Solution



Solids Concentration & Chemical Solutions

Solids concentration is the amount of dry chemical by **weight (milligrams)** mixed with an amount of water by **volume (Liters)** to make a chemical solution.



Solids Concentration & Chemical Solutions

Solids concentration is the amount of dry chemical by **weight (milligrams)** mixed with an amount of water by **volume (Liters)** to make a chemical solution.

$$\text{Solids Concentration, mg/L} = \frac{\text{Weight, mg}}{\text{Volume, L}}$$

Solids Concentration & Chemical Solutions

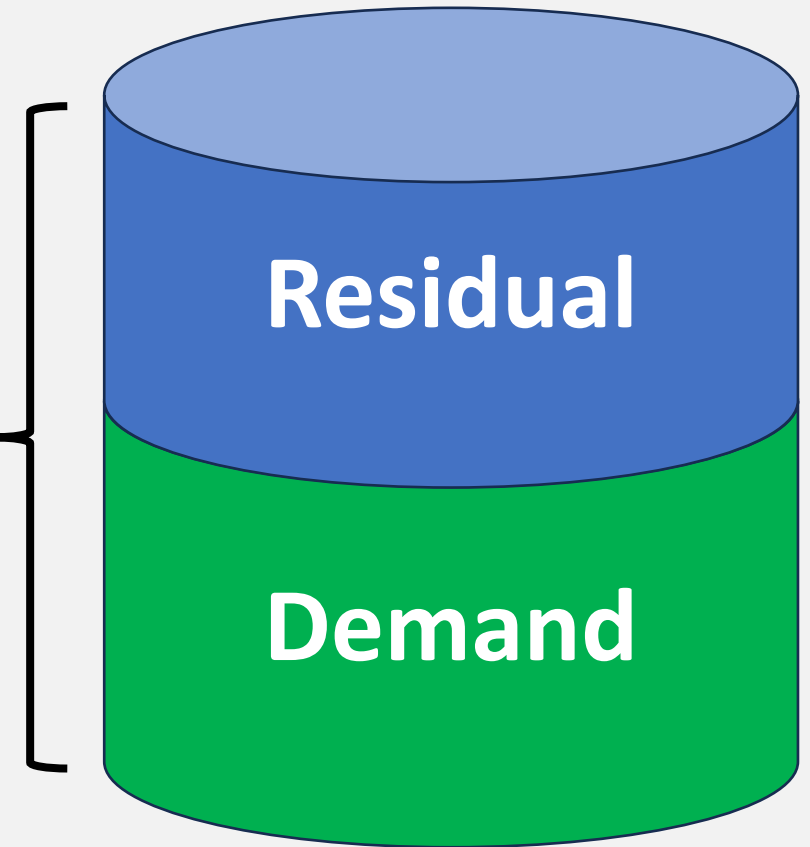
What ways are concentration expressed?

- mg/L
 - Weight of Solids (mg)/Volume of Liquid (L)
- Parts per million (ppm)
 - ppm = mg/L
 - 10 ppm = 10 mg/L
- Purity (%)
 - $(\text{Mass}_{\text{chemical}})/(\text{Mass}_{\text{sample}}) \times 100\%$
 - 1% = 10,000 mg/L = 10,000 ppm
 - 10% NaClO solution = 100,000 mg/L = 100,000 ppm

Chlorine Dosage

- A concentration represented as a weight/volume
- Expressed as mg/L or ppm
- Most operators record pounds/day or gallons/day.
This is the FEED RATE, not the dosage.

Dosage



$$\text{DOSAGE} = \text{DEMAND} + \text{RESIDUAL}$$

Chlorine Demand

- The amount of chlorine consumed or bound up by material in the water (expressed as mg/L)
- This chlorine is **NOT** available as residual (free or total)

$$\text{DOSAGE} = \text{DEMAND} + \text{RESIDUAL}$$

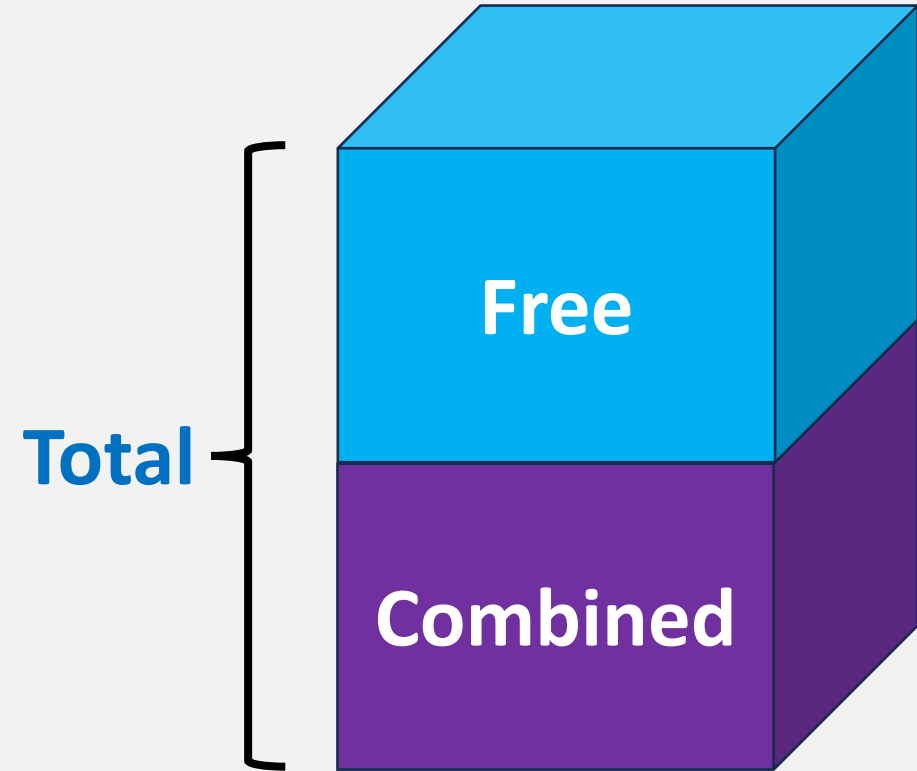
Chlorine Residual

- The amount of chlorine remaining after the chlorine demand is satisfied (expressed as mg/L)
- This chlorine **IS** available for further disinfection

$$\text{DOSAGE} = \text{DEMAND} + \text{RESIDUAL}$$

Chlorine Residual

- Three types of residuals
 - Free
 - Combined
 - Total



$$\text{TOTAL} = \text{COMBINED} + \text{FREE}$$

$$\text{DOSAGE} = \text{DEMAND} + \text{RESIDUAL}$$

$$\text{DEMAND} = \text{DOSAGE} - \text{RESIDUAL}$$

$$\text{RESIDUAL} = \text{DOSAGE} - \text{DEMAND}$$



Calculate chlorine dosage if the demand is 0.35 mg/L and the residual is 0.82 mg/L.

$$\text{Dosage}_{(\text{mg/L})} = \text{Demand}_{(\text{mg/L})} + \text{Residual}_{(\text{mg/L})}$$

- (A) -0.47 mg/L
- (B) 0.47 mg/L
- (C) 1.17 mg/L
- (D) 2.34 mg/L



Calculate chlorine dosage if the demand is 0.35 mg/L and the residual is 0.82 mg/L.

▪ Demand = 0.35 mg/L ✓ ▪ Residual = 0.82 mg/L ✓

$$\text{Dosage}_{(\text{mg/L})} = \text{Demand}_{(\text{mg/L})} + \text{Residual}_{(\text{mg/L})}$$

(A) -0.47 mg/L

(B) 0.47 mg/L

(C) 1.17 mg/L

(D) 2.34 mg/L

Step 1: Set up the equation to solve for the unknown, Dosage. ✓

Step 2: Make sure units match.

Step 3: Plug in the known values for Demand and Residual.

$$\text{Dosage} = 0.35 \text{ mg/L} + 0.82 \text{ mg/L}$$

Step 4: Solve.

$$\text{Dosage} = 0.35 \text{ mg/L} + 0.82 \text{ mg/L} = 1.17 \text{ mg/L}$$



Calculate chlorine dosage if the demand is 0.35 mg/L and the residual is 0.82 mg/L.

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(C) 1.17 mg/L

(D) 2.34 mg/L

Step 1: Set up the equation to solve for the unknown, Dosage.

Step 2: Make sure units match.

Step 3: Plug in the known values for demand and residual.

$$\text{Dosage} = 0.35 \text{ mg/L} + 0.82 \text{ mg/L}$$

Step 4: Solve.

$$\text{Dosage} = 0.35 \text{ mg/L} + 0.82 \text{ mg/L} = 1.17 \text{ mg/L}$$

Chlorine Dosage = 1.17 mg/L



Calculate Chlorine Residual

Calculate the residual chlorine if the demand is 2.0 mg/L and the dosage is 2.8 mg/L.

▪ Demand = 2.0 mg/L ▪ Dosage = 2.8 mg/L

$$\text{Dosage}_{(\text{mg/L})} = \text{Demand}_{(\text{mg/L})} + \text{Residual}_{(\text{mg/L})}$$



Calculate Chlorine Residual

Calculate the residual chlorine if the demand is 2.0 mg/L and the dosage is 2.8 mg/L.

▪ Demand = 2.0 mg/L ✓ ▪ Dosage = 2.8 mg/L ✓

$$\text{Dosage}_{(\text{mg/L})} = \text{Demand}_{(\text{mg/L})} + \text{Residual}_{(\text{mg/L})}$$

Step 1: Set up the equation to solve for the unknown, Residual.

$$\begin{array}{l} \text{Dosage} = \text{Demand} + \text{Residual} \\ -\text{Demand} \quad -\cancel{\text{Demand}} \\ \hline \text{Residual} = \text{Dosage} - \text{Demand} \end{array}$$

Step 2: Make sure units match.



Calculate Chlorine Residual

Calculate the residual chlorine if the demand is 2.0 mg/L and the dosage is 2.8 mg/L.

▪ Demand = 2.0 mg/L ▪ Dosage = 2.8 mg/L

$$\text{Dosage}_{(\text{mg/L})} = \text{Demand}_{(\text{mg/L})} + \text{Residual}_{(\text{mg/L})}$$

Step 3: Plug in values for Dosage and Demand.

$$\text{Residual} = 2.8 \text{ mg/L} - 2.0 \text{ mg/L}$$

Step 4: Solve.

$$\text{Residual} = 2.8 \text{ mg/L} - 2.0 \text{ mg/L} = 0.8 \text{ mg/L}$$



Calculate Chlorine Residual

Calculate the residual chlorine if the demand is 2.0 mg/L and the dosage is 2.8 mg/L.

$$\text{Dosage}_{(\text{mg/L})} = \text{Demand}_{(\text{mg/L})} + \text{Residual}_{(\text{mg/L})}$$

Step 3: Plug in values for Dosage and Demand.

$$\text{Residual} = 2.8 \text{ mg/L} - 2.0 \text{ mg/L}$$

Step 4: Solve.

$$\text{Residual} = 2.8 \text{ mg/L} - 2.0 \text{ mg/L} = 0.8 \text{ mg/L}$$

$$\text{Residual chlorine} = \mathbf{0.8 \text{ mg/L}}$$

A circular, textured object, possibly a piece of wood or stone, is centered on a light-colored surface. Four small, shiny, metallic-looking spheres are arranged around it: one at the top, one at the bottom, one to the left, and one to the right. The text "Specific Gravity" is overlaid on the left side of the image.

Specific Gravity

Specific Gravity

- Ratio: $\frac{\text{Density}_{\text{substance}}}{\text{Density}_{\text{standard}}} = \text{Unitless Number}$
- Standard is usually:
 - **Water** for a liquid or solid
 - **Air** for a gas
- $\frac{\text{Density}_{\text{water}}}{\text{Density}_{\text{water}}} = 1$

Specific Gravity

- Some liquids are:
 - Lighter than water
 - Heavier than water
- Chlorine solutions are heavier than water



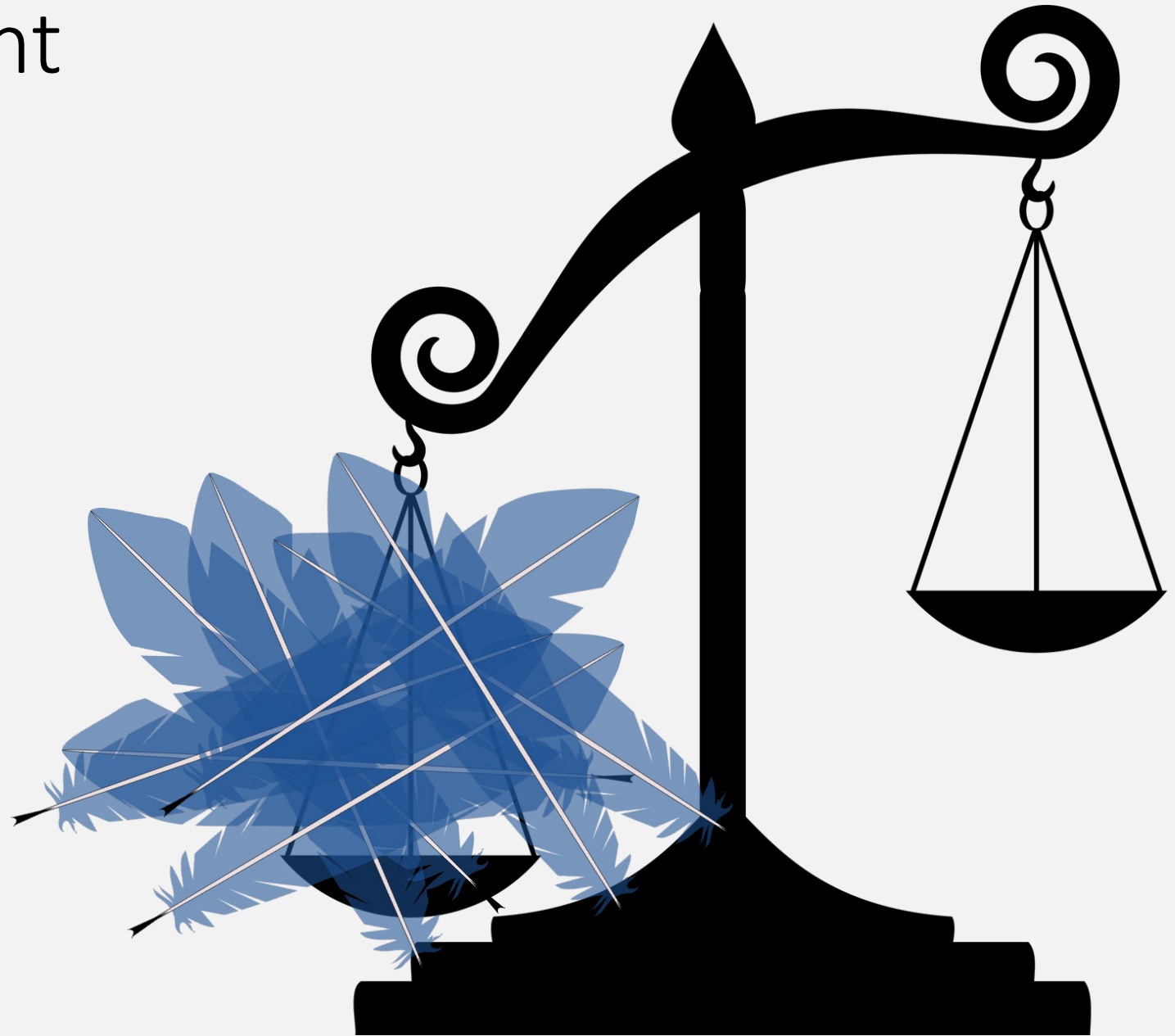
Specific Gravity

- Specific gravity can be **measured** with a hydrometer
- Specific gravity can also be **calculated**

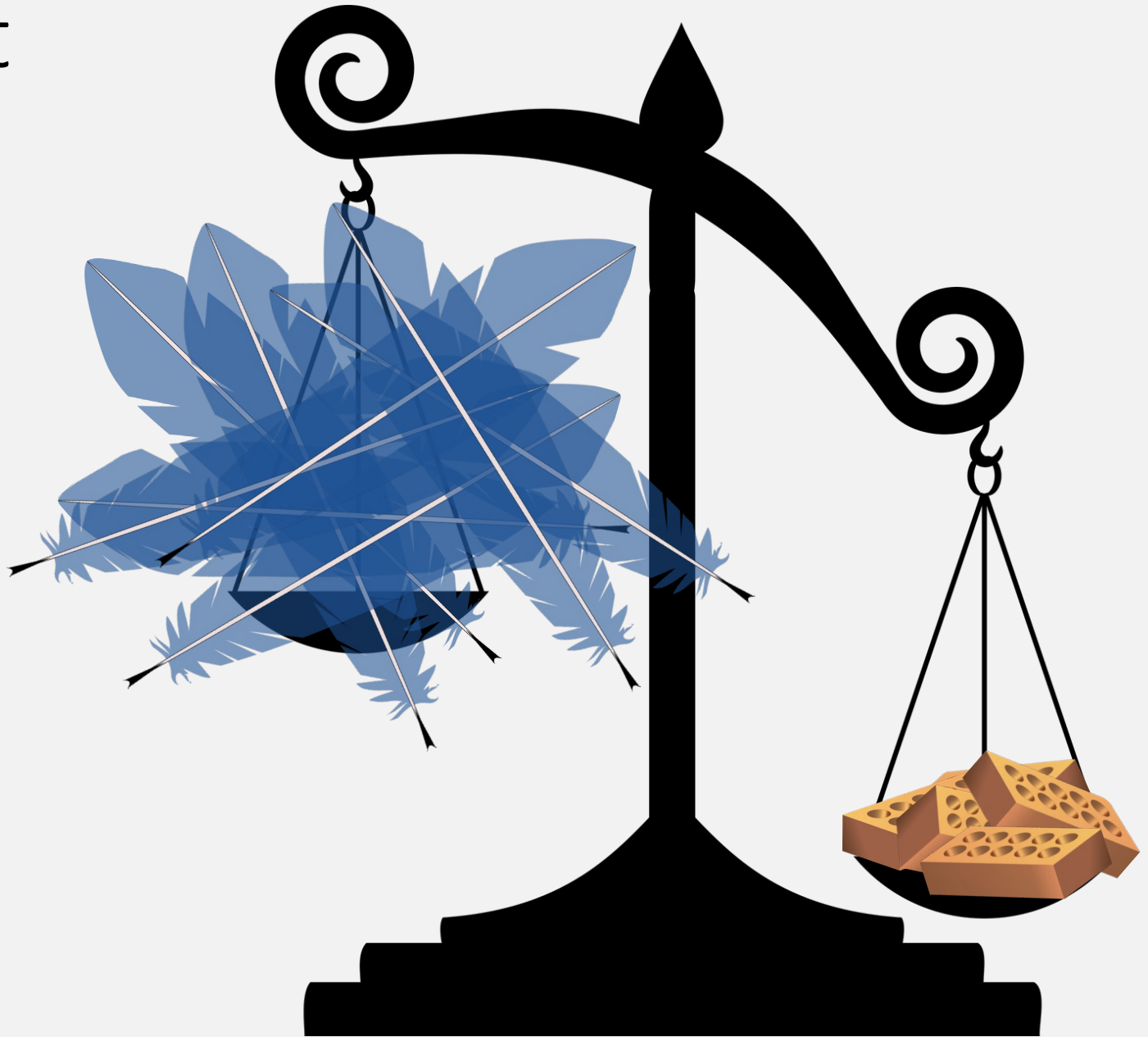
$$\text{Specific Gravity} = \frac{\text{Specific Weight of Substance, lb/gal}}{8.34 \text{ lb/gal}}$$



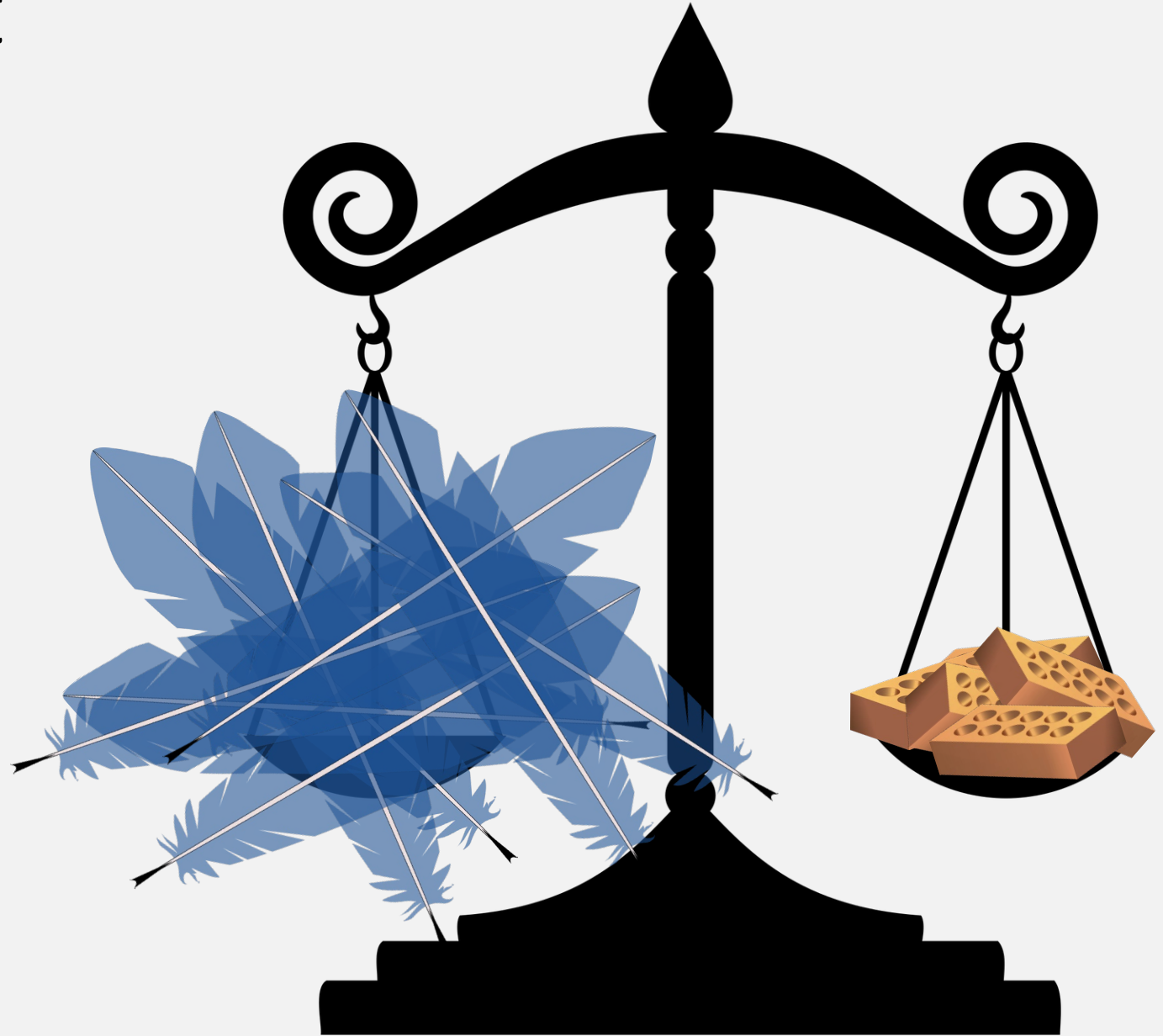
Specific Weight

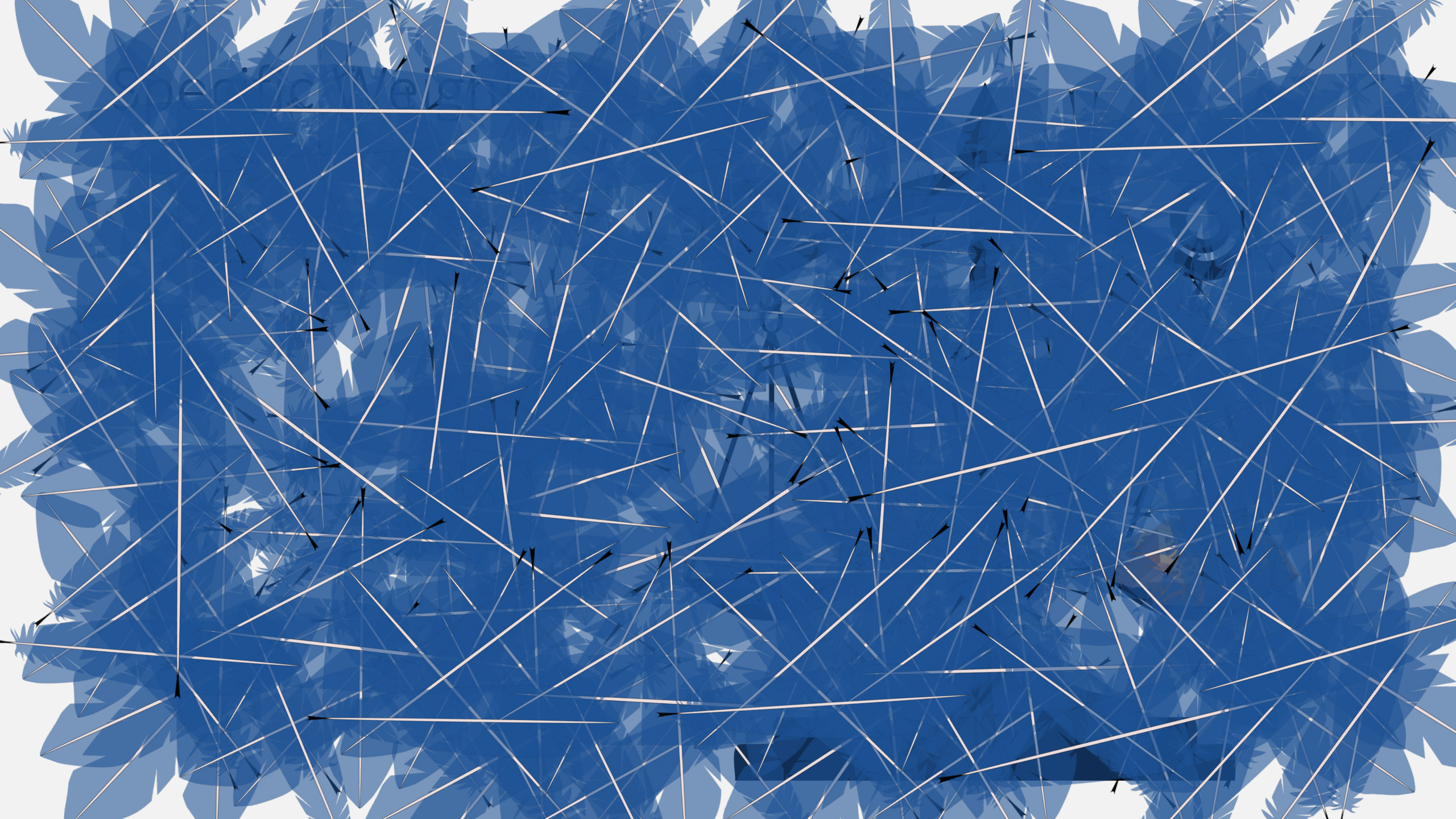


Specific Weight



Specific Weight





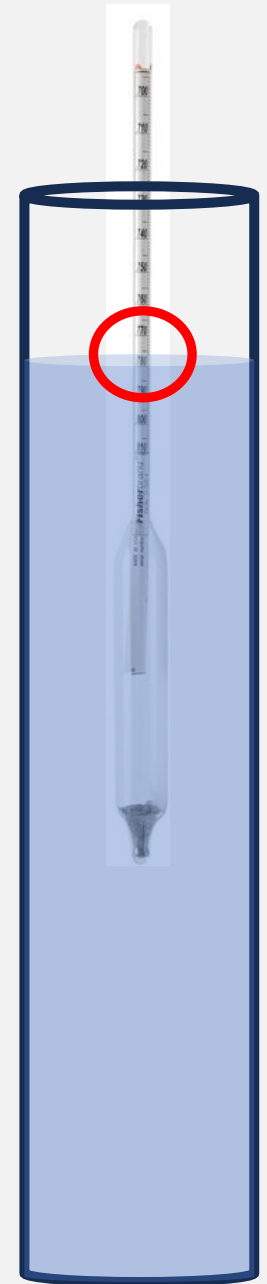
Specific Weight



Specific Gravity

- Specific gravity can be **measured** with a hydrometer
- Specific gravity can also be **calculated**

$$\text{Specific Gravity} = \frac{\text{Specific Weight of Substance, lb/gal}}{8.34 \text{ lb/gal}}$$





What is the **specific gravity** for a solution that weighs 10.27 lb/gal? ■ **Specific Weight = 10.27 lb/gal** ✓

$$\text{Specific Gravity} \checkmark = \frac{\text{Specific Weight of Substance, lb/gal} \checkmark}{8.34 \text{ lb/gal}}$$

(A) 0.81

(B) 1.23

(C) 1.93

(D) 18.61

Step 1: Set up the equation to solve for the unknown, Specific Gravity. ✓

Step 2: Make sure units match.

Step 3: Plug in the value for Specific Weight and solve.

$$\text{Specific Gravity} = \frac{10.27 \cancel{\text{ lb/gal}}}{8.34 \cancel{\text{ lb/gal}}} = 1.23$$



What is the specific gravity for a solution that weighs 10.27 lb/gal?

$$\text{Specific Gravity} = \frac{\text{Specific Weight of Substance, lb/gal}}{8.34 \text{ lb/gal}}$$

(A) 0.81

(B) 1.23

(C) 1.93

(D) 18.61

Step 1: Set up the equation to solve for the unknown, Specific Gravity.

Step 2: Make sure units match.

Step 3: Plug in the value for Specific Weight of a Substance and solve.

$$\text{Specific Gravity} = \frac{10.27 \cancel{\text{ lb/gal}}}{8.34 \cancel{\text{ lb/gal}}} = 1.23$$

1.23 is the specific gravity of a solution that weighs 10.27 lb/gal.



A 12.5% chlorine solution has a specific gravity of 1.20. How many pounds would 55 gallons of this solution weigh?

$$\text{Specific Gravity} = \frac{\text{Specific Weight of Substance, lb/gal}}{8.34 \text{ lb/gal}}$$



A 12.5% chlorine solution has a specific gravity of 1.20. How many pounds would 55 gallons of this solution weigh? ■ **Specific Gravity = 1.20** ■ **Volume = 55 gal**

$$\text{Specific Gravity} = \frac{\text{Specific Weight of Substance, lb/gal}}{8.34 \text{ lb/gal}}$$

Step 1: Set up the equation to solve for the unknown, Specific Weight.

Multiply both sides by 8.34 lb/gal.

$$\text{Specific Gravity} = \frac{\text{Specific Weight}}{\cancel{8.34 \text{ lb/gal}}} \times \cancel{8.34 \text{ lb/gal}}$$

$$\text{Specific Weight} = \text{Specific Gravity} \times 8.34 \text{ lb/gal}$$



A 12.5% chlorine solution has a specific gravity of 1.20. **How many pounds** would 55 gallons of this solution weigh? ■ **Specific Gravity = 1.20** ✓ ■ **Volume = 55 gal**

$$\text{Specific Gravity} \checkmark = \frac{\text{Specific Weight of Substance, lb/gal}}{8.34 \text{ lb/gal}}$$

Step 2: Make sure units match.

$$\text{Specific Weight} = \text{Specific Gravity} \times 8.34 \text{ lb/gal}$$

Step 3: Plug in the value for Specific Gravity and solve.

$$\text{Specific Weight} = 1.20 \times 8.34 \text{ lb/gal} = 10.0 \text{ lb/gal}$$



A 12.5% chlorine solution has a specific gravity of 1.20. How many pounds would 55 gallons of this solution weigh? ■ **Specific Gravity = 1.20** ■ **Volume = 55 gal**

$$\text{Specific Gravity} = \frac{\text{Specific Weight of Substance, lb/gal}}{8.34 \text{ lb/gal}}$$

Step 4: Calculate the weight of 55 gals of the solution by multiplying the specific weight of the solution by the volume of the solution.

$$\text{Specific Weight} = 1.20 \times 8.34 \text{ lb/gal} = 10.0 \text{ lb/gal}$$

$$\text{Weight of 55 gal} = \frac{10.0 \text{ lb}}{\cancel{\text{gal}}} \times \frac{55 \cancel{\text{gal}}}{1} = 550 \text{ lb}$$



A 12.5% chlorine solution has a specific gravity of 1.20. How many pounds would 55 gallons of this solution weigh?

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$$\text{Specific Weight} = 1.20 \times 8.34 \text{ lb/gal} = 10.0 \text{ lb/gal}$$

$$\text{Weight of 55 gal} = \frac{10.0 \text{ lb}}{\cancel{\text{gal}}} \times \frac{55 \cancel{\text{gal}}}{1} = 550 \text{ lb}$$

550 lb is the weight of 55 gallons of 12.5% chlorine solution.



The 50% sodium hydroxide solution you use to increase pH has a specific gravity of 1.50 at 20°C. How many pounds would 20 gallons of this solution weigh?

- **Specific Gravity = 1.50**
- **Volume = 20 gal**

$$\text{Specific Gravity} = \frac{\text{Specific Weight of Substance, lb/gal}}{8.34 \text{ lb/gal}}$$

(A) 3.6 lbs

(B) 197 lbs

(C) 250 lbs

(D) 550 lbs

Step 1: Set up the equation to solve for the unknown, Specific Weight.
Multiply both sides by 8.34 lb/gal.

$$\text{Specific Weight, lb/gal} = \text{Specific Gravity} \times 8.34 \text{ lb/gal}$$

Step 2: Make sure units match.

Step 3: Plug in the value for Specific Gravity and solve for Specific Weight.

$$\text{Specific Weight, lb/gal} = 1.50 \times 8.34 \text{ lb/gal} = 12.5 \text{ lb/gal}$$



The 50% sodium hydroxide solution you use to increase pH has a specific gravity of 1.50 at 20°C. How many pounds would 20 gallons of this solution weigh?

▪ **Specific Gravity = 1.50**

▪ **Volume = 20 gal**

$$\text{Specific Gravity} = \frac{\text{Specific Weight of Substance, lb/gal}}{8.34 \text{ lb/gal}}$$

Step 4: Calculate the weight of 20 gals of the solution by multiplying the specific weight of the solution by the volume of the solution.

$$\text{Specific Weight, lb/gal} = 1.50 \times 8.34 \text{ lb/gal} = 12.5 \text{ lb/gal}$$

$$\text{Weight of 20 gal NaOH} = \frac{12.5 \text{ lb}}{\cancel{\text{gal}}} \times (20 \cancel{\text{ gal}}) = 250 \text{ lb}$$

(A) 3.6 lbs

(B) 197 lbs

(C) 250 lbs

(D) 550 lbs



The 50% sodium hydroxide solution you use to increase pH has a specific gravity of 1.50 at 20°C. How many pounds would 20 gallons of this solution weigh?

$$\text{Specific Gravity} = \frac{\text{Specific Weight of Substance, lb/gal}}{8.34 \text{ lb/gal}}$$

Step 4: Calculate the weight of 20 gals of the solution by multiplying the specific weight of the solution by the volume of the solution.

(A) 3.6 lbs

(B) 197 lbs

(C) 250 lbs

(D) 550 lbs

$$\text{Specific Weight, lb/gal} = 1.50 \times 8.34 \text{ lb/gal} = 12.5 \text{ lb/gal}$$

$$\text{Weight of 20 gal NaOH} = \frac{12.5 \text{ lb}}{\cancel{\text{gal}}} \times (20 \cancel{\text{ gal}}) = 250 \text{ lb}$$

250 lb is the weight of 20 gallons of 50% sodium hydroxide solution.



The NaOCl in your day tank is getting a bit old and you want to determine its percent concentration. You weigh a gallon of it and your scale reads 9.08 lbs. What is your percent concentration?

▪ **Specific Weight = 9.08 lb/gal** ✓

$$\text{Specific Gravity} = \frac{\text{Specific Weight of Substance, lb/gal}}{8.34 \text{ lb/gal}}$$
 ✓

Step 1: Set up the equation to solve for the unknown, Specific Gravity. ✓

Step 2: Make sure units match.

Step 3: Plug in the value for Specific Weight and solve.

$$\text{Specific Gravity} = \frac{9.08 \text{ lb/gal}}{8.34 \text{ lb/gal}} = 1.09$$

% Concentration	Specific Gravity
1.0	1.020
2.0	1.034
3.0	1.048
4.0	1.062
5.0	1.076
6.0	1.089
7.0	1.103
8.0	1.116
9.0	1.129
10.0	1.142
11.0	1.155
12.0	1.168
13.0	1.181
14.0	1.193
15.0	1.206

Source: USA Bluebook Operator's Companion
*values vary with temperature



The NaOCl in your day tank is getting a bit old and you want to determine its percent concentration. You weigh a gallon of it and your scale reads 9.08 lbs. What is your percent concentration?

▪ **Specific Weight = 9.08 lb/gal**

$$\text{Specific Gravity} = \frac{\text{Specific Weight of Substance, lb/gal}}{8.34 \text{ lb/gal}}$$

Step 4: Read the chart to get the Percent Concentration value.

$$\text{Specific Gravity} = \frac{9.08 \cancel{\text{ lb/gal}}}{8.34 \cancel{\text{ lb/gal}}} = 1.09$$

% Concentration	Specific Gravity
1.0	1.020
2.0	1.034
3.0	1.048
4.0	1.062
5.0	1.076
6.0	1.089
7.0	1.103
8.0	1.116
9.0	1.129
10.0	1.142
11.0	1.155
12.0	1.168
13.0	1.181
14.0	1.193
15.0	1.206

Source: USA Bluebook Operator's Companion

*values vary with temperature



The NaOCl in your day tank is getting a bit old and you want to determine its percent concentration. You weigh a gallon of it and your scale reads 9.08 lbs. What is your percent concentration?

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Step 4: Read the chart to get the Percent Concentration value.

$$\text{Specific Gravity} = \frac{9.08 \text{ lb/gal}}{8.34 \text{ lb/gal}} = 1.09$$

Percent concentration of NaOCl $\approx$ **6.0%**

% Concentration	Specific Gravity
1.0	1.020
2.0	1.034
3.0	1.048
4.0	1.062
5.0	1.076
6.0	1.089
7.0	1.103
8.0	1.116
9.0	1.129
10.0	1.142
11.0	1.155
12.0	1.168
13.0	1.181
14.0	1.193
15.0	1.206



Source: USA Bluebook Operator's Companion fishersci.com

*values vary with temperature

Feed Rate Chlorine

SPEED



PUMP WILL CONTINUE TO
STROKE UNTIL UNPLUGGED



STROKE
TURN WHILE
UNIT IS
RUNNING

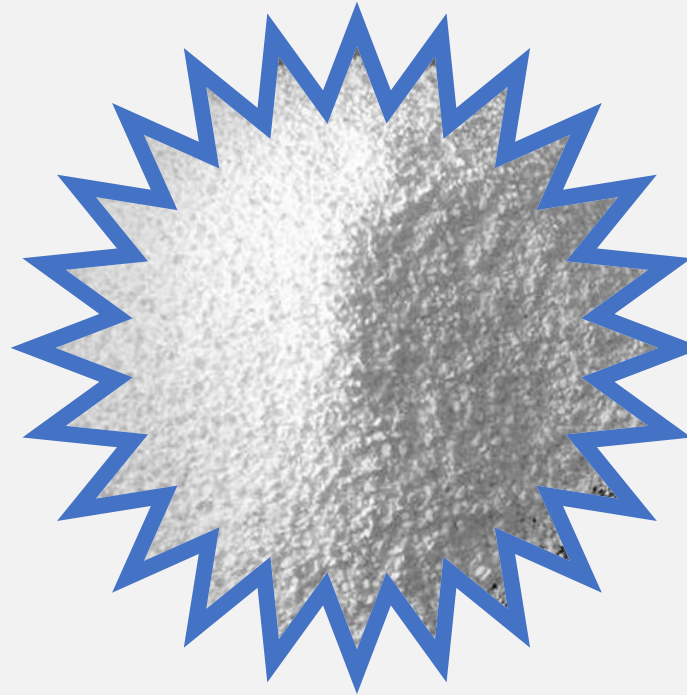
www.lmipumps.com

DISCONNECT

Chlorine/Chemical Purity



Gas Chlorine
100% Purity



Solid Chlorine
Calcium Hypochlorite
60-65% Purity



Liquid Chlorine
Sodium Hypochlorite
10-12% Purity

1% = 10,000 mg/L = 10,000 ppm

In what situations at a water system does the feed rate formula come in handy for using chlorine?



Disinfecting Drinking Water



Shocking Wells



Batch Chlorinating Stored Water



Shocking Distribution Repairs/New Construction

Feed Rate

The amount of chemical in pounds **or** gallons that you feed into a volume of water over a period of time.

Pounds/Day or Gallons/Day

$$\text{Feed Rate, lb/day}^* = \frac{(\text{Dosage, mg/L})(\text{Flow, MGD})(8.34 \text{ lb/gal})}{\text{Purity, \% expressed as a decimal}}$$

Feed Rate Equation Parts

$$\text{Feed Rate, lb/day}^* = \frac{(\text{Dosage, mg/L})(\text{Flow, MGD})(8.34 \text{ lb/gal})}{\text{Purity, \% expressed as a decimal}}$$

- Dosage, (mg/L) = The total amount of chemical solution fed into a volume of water.
- Flow (MGD) = The volume of water in Million Gallons per Day that you are feeding the chemical into.
- 8.34 lb/gal = The weight of water. This is what converts gallons to pounds.
- Purity, % expressed as a decimal = Purity of the chemical that you are feeding into the water expressed as a decimal.

Feed Rate in Gallons per Day

$$\text{Feed Rate} \frac{\text{gallons}}{\text{day}} = \frac{(\text{Dosage, mg/L})(\text{Flow, MGD})(8.34 \text{ lb/gal})}{\text{Purity, \% expressed as a decimal}}$$

$$\text{Feed Rate, gallons/day} = \frac{(\text{Dosage, mg/L})(\text{Flow, MGD})}{\text{Purity, \% expressed as a decimal}}$$

Feed (Not Feed Rate) in Pounds

$$\text{Feed Rate, lb/day} = \frac{(\text{Dosage, mg/L}) (\text{Flow, MGD}) (8.34 \text{ lb/gal})}{\text{Purity, \% expressed as a decimal}}$$

Volume, MG

$$\text{Flow, MGD} = \frac{\text{Volume, MG}}{\text{Time, day}}$$

$$\text{Feed, lb} = \frac{(\text{Dosage, mg/L}) (\text{Volume, MG}) (8.34 \text{ lb/gal})}{\text{Purity, \% expressed as a decimal}}$$

Feed (Not Feed Rate) in Gallons

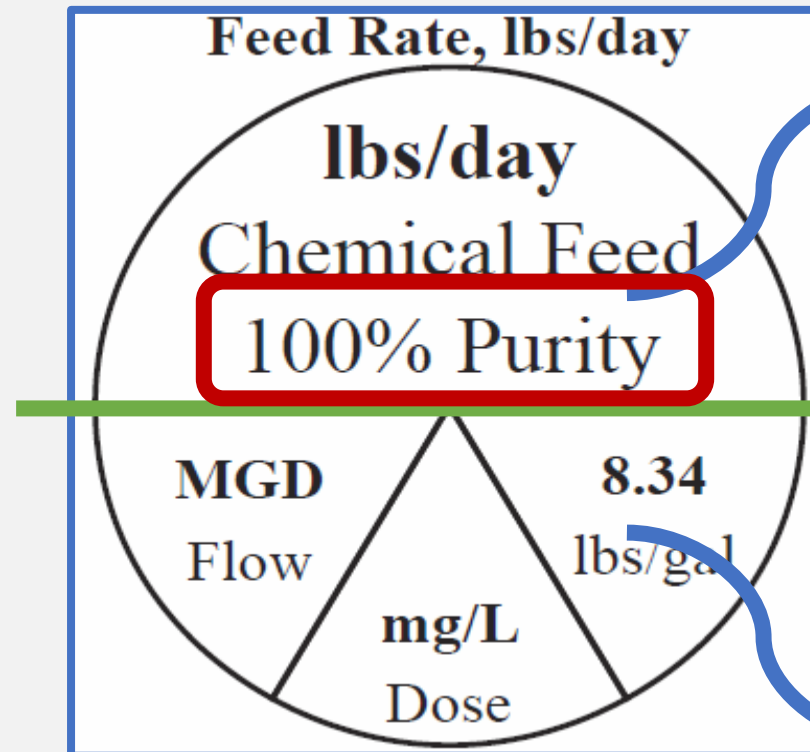
$$\text{Feed Rate, } \frac{\text{gallons}}{\text{lb/day}} = \frac{(\text{Dosage, mg/L}) (\text{Flow, MGD}) (8.34 \text{ lb/gal})}{\text{Purity, \% expressed as a decimal}}$$

$$\text{Feed, gallons} = \frac{(\text{Dosage, mg/L})(\text{Volume, MG})}{\text{Purity, \% expressed as a decimal}}$$

Pie Wheel Formulas

$$\text{Feed Rate, lb/day}^* = \frac{(\text{Dosage, mg/L})(\text{Flow, MGD})(8.34 \text{ lb/gal})}{\text{Purity, \% expressed as a decimal}}$$

****Your units must match the units in the pie wheel!!****



Top half: One side of the equation

Balance the top of the wheel, to the bottom of the wheel

Bottom half: Opposite side of the equation



How many pounds of 60% calcium hypochlorite is needed to add to a system each day that has a flow rate of 1.5 MGD to achieve a dosage of 1.1 mg/L?

$$\text{Feed Rate, lb/day}^* = \frac{(\text{Dosage, mg/L})(\text{Flow, MGD})(8.34 \text{ lb/gal})}{\text{Purity, \% expressed as a decimal}}$$

- Purity = $\frac{60\%}{100\%} = 0.60$
- Flow Rate = 1.5 MGD
- Dosage = 1.1 mg/L

Step 1: Set up the equation to isolate the unknown, Feed Rate.

Step 2: Make sure units match.

Step 3: Plug in values for Dosage, Flow, and Purity and solve for Feed Rate.

$$\text{Feed Rate, lb/day} = \frac{(1.1 \text{ mg/L})(1.5 \text{ MGD})(8.34 \text{ lb/gal})}{0.60} = 22.9 \text{ lb/day}$$



How many pounds of 60% calcium hypochlorite is needed to add to a system each day that has a flow rate of 1.5 MGD to achieve a dosage of 1.1 mg/L?

$$\text{Feed Rate, lb/day}^* = \frac{(\text{Dosage, mg/L})(\text{Flow, MGD})(8.34 \text{ lb/gal})}{\text{Purity, \% expressed as a decimal}}$$

Step 1: Set up the equation to isolate the unknown, Feed Rate.

Step 2: Make sure units match.

Step 3: Plug in values for dosage, flow, and purity and solve for feed rate.

$$\text{Feed Rate, lb/day} = \frac{(1.1 \text{ mg/L})(1.5 \text{ MGD})(8.34 \text{ lb/gal})}{0.60} = 22.9 \text{ lb/day}$$

22.9 lb of calcium hypochlorite must be added to the system each day to achieve a dosage of 1.1 mg/L.

$$\text{Feed Rate, lb/day}^* = \frac{(\text{Dosage, mg/L})(\text{Flow, MGD})(8.34 \text{ lb/gal})}{\text{Purity, \% expressed as a decimal}}$$

$$\text{Feed Rate, lb/day} = \frac{(1.1 \text{ mg/L})(1.5 \text{ MGD})(8.34 \text{ lb/gal})}{0.60} = 22.9 \text{ lb/day}$$

$$\text{Feed Rate, lb/day} = \frac{1.1 \cancel{\text{mg}}}{\cancel{\text{L}}} \times \frac{1.5 \text{ MG}}{\text{day}} \times \frac{8.34 \text{ lb}}{\text{gal}} \times \frac{1}{0.60}$$

million

mg/L = parts
per million

$$\text{Feed Rate, lb/day} = \frac{1.1}{\cancel{\text{million}}} \times \frac{1.5 \cancel{\text{million gal}}}{\text{day}} \times \frac{8.34 \text{ lb}}{\cancel{\text{gal}}} \times \frac{1}{0.60} = 22.9 \text{ lb/day}$$

or

$$\text{Feed Rate, lb/day} = \frac{1.1}{\cancel{1,000,000}} \times \frac{1.5 \times 1,000,000 \cancel{\text{gal}}}{\text{day}} \times \frac{8.34 \text{ lb}}{\cancel{\text{gal}}} \times \frac{1}{0.60} = 22.9 \text{ lb/day}$$



A 500,000 gpd system has switched from gas disinfection to disinfection with a 10% sodium hypochlorite solution. How many gallons per day of 10% sodium hypochlorite are required to treat the water to a dosage of 2.8 mg/L?

$$\text{Feed Rate, lb/day}^* = \frac{(\text{Dosage, mg/L})(\text{Flow, MGD})(8.34 \text{ lb/gal})}{\text{Purity, \% expressed as a decimal}}$$

- Flow = 500,000 gpd
- Purity = 10%
- Dosage = 2.8 mg/L



A 500,000 gpd system has switched from gas disinfection to disinfection with a 10% sodium hypochlorite solution. How many gallons per day of 10% sodium hypochlorite are required to treat the water to a dosage of 2.8 mg/L?

$$\text{Feed Rate, } \frac{\text{gallons}}{\text{day}}^* = \frac{(\text{Dosage, mg/L})(\text{Flow, MGD})(\cancel{8.34 \text{ lb/gal}})}{\text{Purity, \% expressed as a decimal}}$$

- Flow = 500,000 gpd
- Purity = 10% = 0.10
- Dosage = 2.8 mg/L

Step 1: Rewrite the equation to solve for Feed in gallons/day. ✓

$$\text{Feed Rate, gallons/day}^{\checkmark} = \frac{(\text{Dosage, mg/L})(\text{Flow, MGD})}{\text{Purity, \% expressed as a decimal}}$$



A 500,000 gpd system has switched from gas disinfection to disinfection with a 10% sodium hypochlorite solution. How many gallons per day of 10% sodium hypochlorite are required to treat the water to a dosage of 2.8 mg/L?

$$\text{Feed Rate, gallons/day} = \frac{(\text{Dosage, mg/L})(\text{Flow MGD})}{\text{Purity, \% expressed as a decimal}}$$

▪ Flow = $\frac{500,000 \text{ gpd}}{1,000,000} = 0.5 \text{ MGD}$

▪ Purity = $\frac{10\%}{100\%} = 0.10$

▪ Dosage = 2.8 mg/L

Step 2: Make sure units match.



A 500,000 gpd system has switched from gas disinfection to disinfection with a 10% sodium hypochlorite solution. How many gallons per day of 10% sodium hypochlorite are required to treat the water to a dosage of 2.8 mg/L?

$$\text{Feed Rate, gallons/day} = \frac{(\text{Dosage, mg/L})(\text{Flow, MGD})}{\text{Purity, \% expressed as a decimal}}$$

- Flow = 500,000 gpd = 0.5 MGD
- Purity = 10% = 0.10
- Dosage = 2.8 mg/L

Step 1: Set up the equation to isolate the unknown, Feed Rate.

Step 2: Make sure units match.

Step 3: Plug in values for Dosage, Flow, and Purity and solve for Feed Rate.

$$\text{Feed Rate, gallons/day} = \frac{(2.8 \text{ mg/L})(0.5 \text{ MGD})}{0.10} = 14.00 \text{ gal/day}$$



A 500,000 gpd system has switched from gas disinfection to disinfection with a 10% sodium hypochlorite solution. How many gallons per day of 10% sodium hypochlorite are required to treat the water to a dosage of 2.8 mg/L?

$$\text{Feed Rate, gallons/day} = \frac{(2.8 \text{ mg/L})(0.5 \text{ MGD})}{0.10} = 14.00 \text{ gal/day}$$

14.00 gal/day of 10% sodium hypochlorite are required to treat 500,000 gallons of water per day to a chlorine dosage of 2.8 mg/L



How many gallons of 10% sodium hypochlorite are required to disinfect the water in a 20 ft diameter tank with 30 ft of water to a dosage of 5.0 mg/L?

$$\text{Feed Rate, } \cancel{\text{lb/day}}^{\text{gallons}} = \frac{(\text{Dosage, mg/L})(\text{Volume, MGD})(\cancel{8.34 \text{ lb/gal}})}{\text{Purity, \% expressed as a decimal}}$$

Step 1: Rewrite the equation to solve for Feed in gallons.

$$\text{Feed, gal} = \frac{(\text{Dosage, mg/L})(\text{Volume, MG})}{\text{Purity, \% expressed as a decimal}}$$



How many gallons of 10% sodium hypochlorite are required to disinfect the water in a 20 ft diameter tank with 30 ft of water to a dosage of 5.0 mg/L?

$$\text{Feed, gal} = \frac{(\text{Dosage, mg/L})(\text{Volume, MG})}{\text{Purity, \% expressed as a decimal}}$$

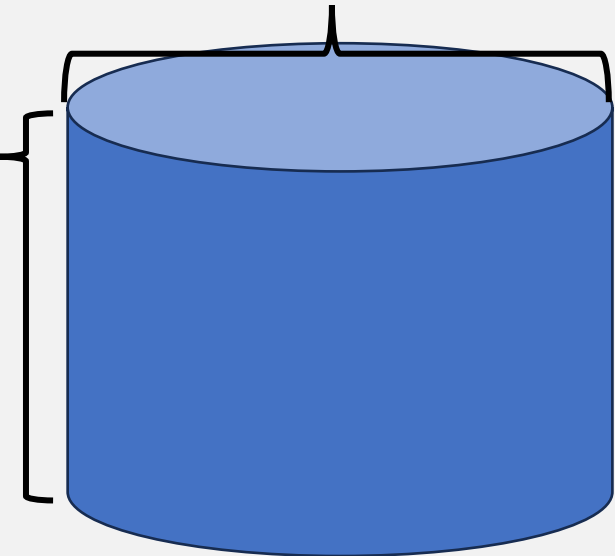
▪ Purity = 10%

▪ Dosage = 5.0 mg/L

▪ Volume of Water = ?

Tank Diameter = 20'

Water Height = 30'



Step 2: Find the volume of our water in MG.

Volume of a Cylinder



How many gallons of 10% sodium hypochlorite are required to disinfect the water in a 20 ft diameter tank with 30 ft of water to a dosage of 5.0 mg/L?

Step 2: Find the volume of our water in MG.

$$\text{Volume of a Cylinder} = \pi r^2 \times \text{Height}$$

$$\text{Volume of a Cylinder} = (0.785)(\text{Diameter})^2(\text{Height})$$



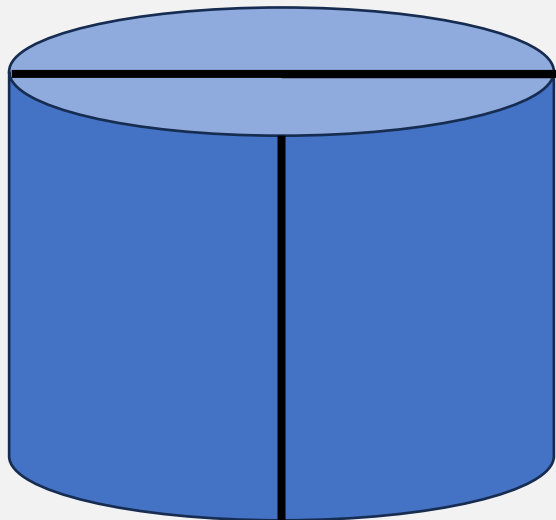
How many gallons of 10% sodium hypochlorite are required to disinfect the water in a 20 ft diameter tank with 30 ft of water to a dosage of 5.0 mg/L?

Step 2: Find the volume of our water in MG.

Tank Diameter = $\frac{20'}{2}$

Tank Radius = 10'

Water Height = 30'



$$\text{Volume of a Cylinder} = \pi r^2 \times \text{Height}$$

units must be compatible

Step 3: Set up the equation to solve for the unknown, Volume of a Cylinder.

Step 4: Make sure units match.



How many gallons of 10% sodium hypochlorite are required to disinfect the water in a 20 ft diameter tank with 30 ft of water to a dosage of 5.0 mg/L?

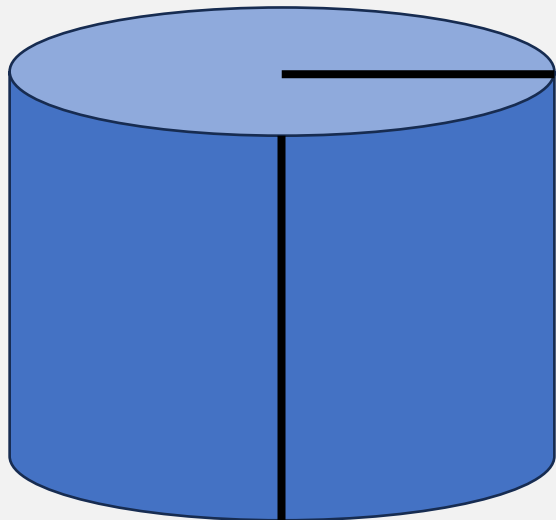
Step 2: Find the volume of our water in MG.

$$\text{Volume of a Cylinder} = \pi r^2 \times \text{Height}$$

units must be compatible

Tank Radius = 10'

Water Height = 30'



Step 5: Plug in values for Radius and Height and solve for Volume of Water.

$$\text{Vol of Water} = \pi(10 \text{ ft})^2 \times 30 \text{ ft} = 9,425 \text{ ft}^3$$

Step 6: Convert ft^3 to gallons.

$$\text{Vol of Water, gal} = 9,425 \cancel{\text{ft}^3} \times \frac{7.48 \text{ gal}}{1 \cancel{\text{ft}^3}} = 70,500 \text{ gals}$$

Step 7: Convert gallons to MG.

$$\text{Vol of Well, MG} = \frac{70,500 \cancel{\text{gals}}}{1} \times \frac{1 \text{ MG}}{1,000,000 \cancel{\text{gals}}} = \mathbf{0.075 \text{ MG}}$$



How many gallons of 10% sodium hypochlorite are required to disinfect the water in a 20 ft diameter tank with 30 ft of water to a dosage of 5.0 mg/L?

$$\text{Feed, gal} = \frac{(\text{Dosage, mg/L})(\text{Volume, MG})}{\text{Purity, \% expressed as a decimal}}$$

▪ Purity = 10% = 0.10 ▪ Dosage = 5.0 mg/L ▪ Volume of Water = 0.075 MG

Step 8: Make sure units match.

Step 9: Plug values for Dosage, Volume, and Purity into the equation and solve for Feed in gallons.

$$\text{Feed, gal} = \frac{(5.0 \text{ mg/L})(0.075 \text{ MG})}{0.10} = 3.75 \text{ gallons}$$



How many gallons of 10% sodium hypochlorite are required to disinfect the water in a 20 ft diameter tank with 30 ft of water to a dosage of 5.0 mg/L?

$$\text{Feed, gal} = \frac{(\text{Dosage, mg/L})(\text{Volume, MG})}{\text{Purity, \% expressed as a decimal}}$$

Step 8: Make sure units match.

Step 9: Plug values for Dosage, Volume, and Purity into the equation and solve for Feed in gallons.

$$\text{Feed, gal} = \frac{(5.0 \text{ mg/L})(0.075 \text{ MG})}{0.10} = 3.75 \text{ gallons}$$

3.75 gallons of 10% sodium hypochlorite are required to disinfect the tank to a chlorine dosage of 5.0 mg/L

CONTACT INFORMATION



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