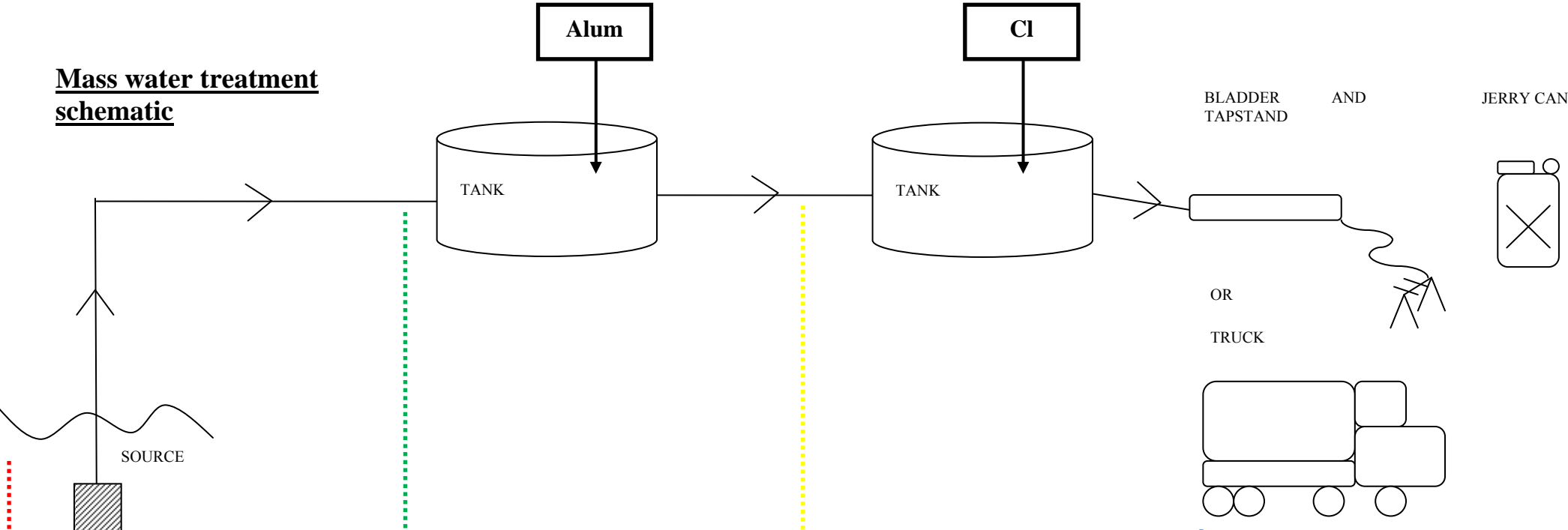


Mass water treatment schematic



1

Test source water for:

- a. **pH**
 - between 6 to 9 → OK
- b. **conductivity**
 - less than 2500 $\mu\text{S}/\text{cm}$ → OK
- c. **turbidity**
 - IF more than 5NTU → need to add flocculant; go to step 2
 - IF less than or equal to 5NTU → no need to add flocculant; go to step 3

2

1. Do a Jar Test

2. Add required amount of alum, mix and let settle for 30 minutes.

Then test water for:

- a. **turbidity**
 - IF less than 5NTU → OK, go to step 3
 - IF more than 5NTU → repeat jar test, add more alum

3

1. Do a Bucket Test

2. Add required amount of chlorine and mix.

4

After 30 minutes contact time, test water at tap for free residual chlorine:

- IF 0.2 – 0.5 mg/L → OK
- IF less than 0.2 mg/L → repeat bucket test [step 3], add more chlorine
- IF more than 0.5 mg/L → wait for chlorine to evaporate ~ 1 – 2 hours, test again before distribution

Jar Test

Purpose:

To find out how much **aluminium sulphate (Alum)** we need to add to the turbid raw source water for effective flocculation.

Method:

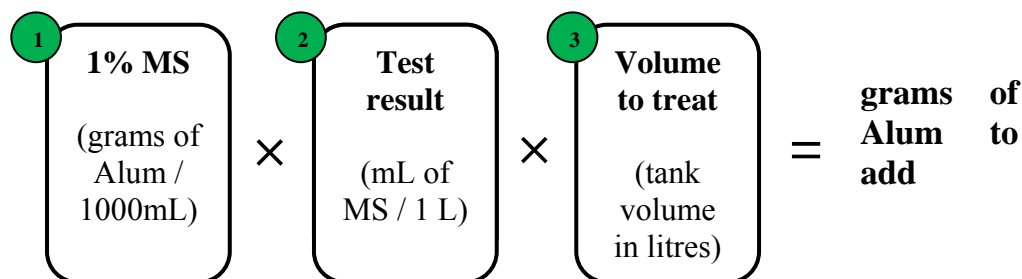
1. Make 1 Litre of mother solution (MS) at 1% concentration:

$$100\% \times 10 \text{ grams} = \text{Conc. of Alum}(\%) \times ? \text{ grams}$$

$$\frac{100\% \times 10 \text{ grams}}{\text{Conc. of Alum}(\%)} = \frac{1000}{\text{Conc. of Alum}(\%)} = \text{grams of Alum per 1 Litre MS}$$

2. Add MS (2mL, 4mL, 6mL, 8mL, 10mL, 12mL) into the raw water jars of 1 Litre size; and stir vigorously for 5 minutes.
3. Leave to settle for 30 minutes.
4. Measure the turbidity of each jar. Out of the jars that have less than 5 NTU, the jar with the least amount of MS is the correct dosage.

General formula:



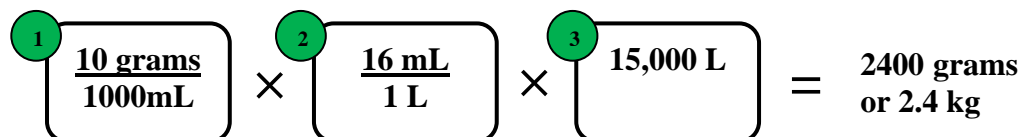
The diagram shows a flow from left to right. It starts with a box labeled '1' containing '1% MS (grams of Alum / 1000mL)'. This is multiplied by a box labeled '2' containing 'Test result (mL of MS / 1 L)'. This result is then multiplied by a box labeled '3' containing 'Volume to treat (tank volume in litres)'. The final result is 'grams of Alum add to'.

$$\begin{array}{|c|} \hline 1 \\ \hline \end{array} \begin{array}{|c|} \hline 1\% \text{ MS} \\ \hline \end{array} \begin{array}{|c|} \hline \text{(grams of Alum / 1000mL)} \\ \hline \end{array} \times \begin{array}{|c|} \hline 2 \\ \hline \end{array} \begin{array}{|c|} \hline \text{Test result} \\ \hline \end{array} \begin{array}{|c|} \hline \text{(mL of MS / 1 L)} \\ \hline \end{array} \times \begin{array}{|c|} \hline 3 \\ \hline \end{array} \begin{array}{|c|} \hline \text{Volume to treat} \\ \hline \end{array} \begin{array}{|c|} \hline \text{(tank volume in litres)} \\ \hline \end{array} = \text{grams of Alum add to}$$

Example calculation:

Your jar test result shows that 16mL of 1% mother solution (MS) is the optimum dosage. You used 100% Alum to make your MS. How much Alum do we need for a tank of 15,000 Litres?

[1000/100% = 10 grams of Alum per 1 Litre of MS]



The diagram shows a flow from left to right. It starts with a box labeled '1' containing '10 grams / 1000mL'. This is multiplied by a box labeled '2' containing '16 mL / 1 L'. This result is then multiplied by a box labeled '3' containing '15,000 L'. The final result is '2400 grams or 2.4 kg'.

$$\begin{array}{|c|} \hline 1 \\ \hline \end{array} \begin{array}{|c|} \hline \frac{10 \text{ grams}}{1000\text{mL}} \\ \hline \end{array} \times \begin{array}{|c|} \hline 2 \\ \hline \end{array} \begin{array}{|c|} \hline \frac{16 \text{ mL}}{1 \text{ L}} \\ \hline \end{array} \times \begin{array}{|c|} \hline 3 \\ \hline \end{array} \begin{array}{|c|} \hline 15,000 \text{ L} \\ \hline \end{array} = 2400 \text{ grams or 2.4 kg}$$

Bucket Test

Purpose:

To find out how much **chlorine (Cl)** we need to add to clear water so that there is 0.5 mg/L of free residual chlorine (after 30 minutes contact time).

Method:

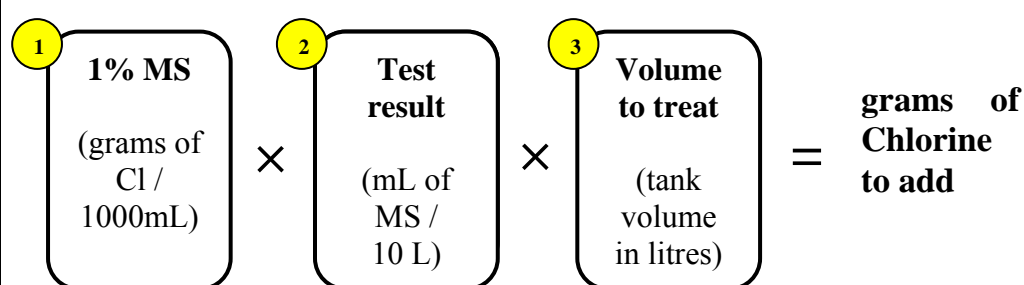
1. Make 1 Litre of mother solution (MS) at 1% concentration:

$$100\% \times 10 \text{ grams} = \text{Conc. of Chlorine}(\%) \times ? \text{ grams}$$

$$\frac{100\% \times 10 \text{ grams}}{\text{Conc. of Cl}(\%)} = \frac{1000}{\text{Conc. of Cl}(\%)} = \text{grams of Chlorine per 1 Litre MS}$$

2. Add MS (0.5mL, 1mL, 2mL, 3mL, 4mL, 5mL) into 10 L buckets with water; and stir for 5 minutes.
3. Leave for 30 minutes to give time for the chlorine to react.
4. Measure the chlorine concentration in each bucket. The bucket with the chlorine level closest to 0.5 mg/L is the one with the correct dosage.

General formula:



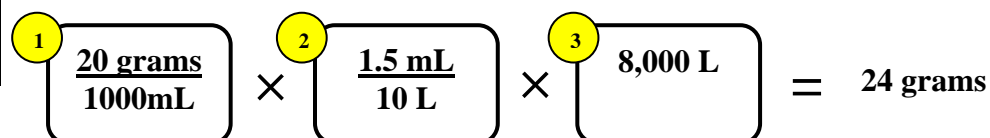
The diagram shows a flow from left to right. It starts with a box labeled '1' containing '1% MS (grams of Cl / 1000mL)'. This is multiplied by a box labeled '2' containing 'Test result (mL of MS / 10 L)'. This result is then multiplied by a box labeled '3' containing 'Volume to treat (tank volume in litres)'. The final result is 'grams of Chlorine to add'.

$$\begin{array}{|c|} \hline 1 \\ \hline \end{array} \begin{array}{|c|} \hline 1\% \text{ MS} \\ \hline \end{array} \begin{array}{|c|} \hline \text{(grams of Cl / 1000mL)} \\ \hline \end{array} \times \begin{array}{|c|} \hline 2 \\ \hline \end{array} \begin{array}{|c|} \hline \text{Test result} \\ \hline \end{array} \begin{array}{|c|} \hline \text{(mL of MS / 10 L)} \\ \hline \end{array} \times \begin{array}{|c|} \hline 3 \\ \hline \end{array} \begin{array}{|c|} \hline \text{Volume to treat} \\ \hline \end{array} \begin{array}{|c|} \hline \text{(tank volume in litres)} \\ \hline \end{array} = \text{grams of Chlorine to add}$$

Example calculation:

You have just done a bucket test with 50% concentration (HTH) chlorine. The result shows that 1.5 mL of 1% mother solution is the optimum dosage for disinfection. How many grams of chlorine will you need for dosing a tank of 8,000 Litres?

[1000/50% = 20 grams of chlorine per 1 Litre of MS]



The diagram shows a flow from left to right. It starts with a box labeled '1' containing '20 grams / 1000mL'. This is multiplied by a box labeled '2' containing '1.5 mL / 10 L'. This result is then multiplied by a box labeled '3' containing '8,000 L'. The final result is '24 grams'.

$$\begin{array}{|c|} \hline 1 \\ \hline \end{array} \begin{array}{|c|} \hline \frac{20 \text{ grams}}{1000\text{mL}} \\ \hline \end{array} \times \begin{array}{|c|} \hline 2 \\ \hline \end{array} \begin{array}{|c|} \hline \frac{1.5 \text{ mL}}{10 \text{ L}} \\ \hline \end{array} \times \begin{array}{|c|} \hline 3 \\ \hline \end{array} \begin{array}{|c|} \hline 8,000 \text{ L} \\ \hline \end{array} = 24 \text{ grams}$$