



How to determine dosage for batch chlorination (Modified Horrocks' Method)

Use this guide to determine the correct dosage for batch chlorination of drinking water, using the Modified Horrocks' Method.

Before batch chlorination you should determine:

- the temperature, pH and turbidity of the water to be treated, as it will affect the contact time
- The volume of water to be treated

Materials:

- At least 4 non-metallic buckets with lids (ideally 10 L or 20 L)
- Graduated syringe or disposable pipette
- Non-metallic stir stick
- 1% chlorine solution
- Pool test kit to measure free residual chlorine (FRC)

Calculating the reference dose for the water to be treated

Step 1

Identify each container with a label (e.g. #1, #2, #3, #4)

Fill each container with 20 L of the water to be treated.

Step 2

Add to each bucket a progressively increasing dose of 1% chlorine solution using a graduated syringe or disposable pipette.

For example:

Container 1: 1.0 ml

Container 2: 1.5 ml

Container 3: 2.0 ml

Container 4: 2.5 ml

The increments are not important. We used 0.5 ml increments for illustration purposes.

Make sure you record what dosage was added to each bucket!

Step 3

Put the lids on and wait for the chlorine to react during the minimum required contact time:

- pH less than 8: contact time 30 minutes

- pH 8 - 8.5: contact time 60 minutes
- pH more than 8.5: contact time 90 minutes

Step 4:

Measure the Free Residual Chlorine (FRC) concentration in each container.

Step 5:

Select the solution dosage that yielded the target FRC:

- pH less than 8: FRC 0.5 mg/L
- pH 8 - 8.5: FRC 0.7 mg/L
- pH more than 8.5: FRC 1.0 mg/L

Step 6:

If none of the FRC measurements are in the target range you will need to repeat the test with different doses.

- If FRC was too high -> start with lower doses in the test buckets
- If FRC was too low -> start with higher doses in the test buckets

Repeat the process until you measure the FRC in a test bucket within the target range. The amount of 1% solution that you added to your successful test bucket is your reference dose.

Calculate the correct batch chlorination dose

Once you have your reference dose you need to calculate the volume of 1% chlorine solution needed to treat your batch of water.

Step 1:

Calculate the concentration of the solution in the test bucket

$\text{Volume of water in your test bucket} / \text{Reference Dose} = \text{Chlorine concentration}$

For example: $20 \text{ L} / 2 \text{ ml} = 0.1 \text{ ml/L}$

We need a concentration of chlorine solution equal to 0.1 ml/L for effective chlorination

Step 2:

Multiply the volume to be treated by the concentration.

To calculate how much of your 1% solution to add to the volume of water to be treated:

$\text{Volume of water to be treated} \times \text{Concentration} = \text{Required dose}$

For example: $2,000 \text{ L} \times 0.1 \text{ ml/L} = 200 \text{ ml}$

In this example we would need to add 200 mL of the 1% chlorine solution to 2,000 L volume of water to achieve effective chlorination.

The calculation described above can be represented using the following formula:

$$V(1\% \text{ bat}) = \left(\frac{V(\text{water bat})}{V(\text{water test})} \right) \times V(1\% \text{ test})$$

Where:

- **V (1% bat):** the volume of 1% chlorine solution required to achieve the correct FRC in the batch of raw water (in ml)
- **V (water bat):** the volume of the batch of water to be treated (in litres)
- **V (water test):** the volume of water used in the Horrocks' test (in litres)
- **V (1% test):** the volume of 1% chlorine solution required to achieve the correct FRC in the Horrocks' test (in ml)

In our example:

- **V (1% bat):** this is what we want to know
- **V (water bat):** 2,000 L
- **V (water test):** 20 L
- **V (1% test):** 2 ml

$$V(1\% \text{ bat}) = \left(\frac{2,000}{20} \right) \times 2$$

$$V(1\% \text{ bat}) = 200\text{ml}$$

The volume of 1% chlorine solution required to achieve the correct FRC in the 2,000 L batch of raw water is 200 ml.

