- 1 litre of water (abbr. to 1 l) contains 1000 ml, and weighs 1000 g (or 1 kg).
- 1000 litres is 1 cubic metre (abbr. to 1 m^3) in volume, and weighs 1 000 000 g (1000 kg, or 1 metric tonne).
- Hence, for practical purposes: **1 gram of solid (for example powdered medication) dissolved in 1000 litres (1 m^3 or 1 000 000 ml) of water = 1 ppm *by weight***. (Strictly speaking, this would actually be 1 part per 1 million and 1, by weight, but such a high degree of accuracy is unnecessary for the purpose of medicating fish.)

  So, for medicating purposes: **1 gram in 1000 litres is regarded as 1 ppm**. Similarly, 1 millilitre in 1000 litres is also used for 1 ppm, 25 ml in 1000 l would be 25 ppm, and so on.
- Similarly, **1 gram (or millilitre) per litre** will be approximately 1 ppth (one part per thousand). This degree of accuracy is also acceptable for medicating purposes.
- On a scale 1000 times smaller, 1 mg is 1 000 000th (one millionth) of the weight of 1 kg and 1 kg is the weight of 1 litre of water. Hence, for the purpose of medicating: **1 mg of solid added to 1 litre of water (1 mg/L) = 1 part per million (abbr. to 1 ppm)**. (Again, strictly speaking, it would actually be 1 part per 1 million and 1, but this degree of accuracy is unnecessary.)
- Similarly: **1 ml per litre (1 ml/L) = 1 part per thousand (1 ppth) *by volume*, while 1 ml per 1000 litres = 1 ppm *by volume***.
- The same applies when using all dry weights: **1 gram per 1000 kg (1 tonne) = 1 ppm *by weight*** and **1 gram per kilogram = 1 ppth**. This would be used for administering dry medications in dry diets.

Measuring dry weights by volume

Grams are normally used for **dry** medications which are weighed, while **millilitres** are used for medications in **liquid** form, which are usually measured by volume. However, very usefully, when working with large volumes of dry chemicals, where there is a comfortable margin of safety (that is, when working with chemicals of low toxicity) it can be quicker to work out the weight of a given volume of chemical initially, and then use multiples or fractions of this volume to give an approximate weight, rather than having to weigh out the chemical each time.

Calculating dosages

To avoid error in the calculations given below, because fractions sometimes arise, instead of writing just the numeral '1' alone, a decimal point (1.0) is used to denote 'one'. Care must of course be taken not to read this as 10.

Medications administered into the water are most commonly measured in ppm, or as mg/L, which as shown above, amounts to the same thing, that is, the number of grams or millilitres of medication per 1000 litres of water.

Therefore to treat 1000 litres at 10 ppm would require 10 grams or 10 ml of medication, *provided the medication is pure* – see 'Active ingredient' below. Similarly, treating 100 litres at 10 ppm would require 1.0 gram or 1.0 ml and treating 10 litres at 10 ppm would require 0.1 gram or 0.1 ml.

To arrive at a dosage for any volume at a given dose rate in ppm, the following formula can be used. NOTE: Some explanations are given for how the formulae are arrived at, but these do not have to be understood. If preferred, just use the formulae.

Formula 1

This formula gives the *dose in grams or millilitres* of medication to be administered to a known volume of culture water to attain a required concentration in ppm of medication for treatment.

The required dose rate in ppm (grams/1000 litres) is divided by 1000 litres and multiplied by the volume in litres of the culture facility to be treated, to give the dose in grams or millilitres. (The 1000 litres is the volume in which any given ppm dose rate would give the correct strength in ppm if added in grams. If the volume of the system to be treated is greater than 1000 litres, the formula automatically increases this amount proportionately; if smaller, it decreases it.)