Concentrations

November 27, 2017 8:27 AM

Solution Concentrations

The concentration of a substance in solution is very important.

Concentration refers to amount of solute per quantity of solvent.

These quantities of solvent or solute can be measured in **mass** or **volume**.

Mass/Volume Percent
This calculation is usually used for a solid dissolved in a liquid.

$$P_{m/v} = \frac{m_{solute}}{V_{solution}}$$

This formula assumes that all of the solid solute is dissolved.

Ex. 20g of herbicide is dissolved in water and the resultant solution has a volume of 55ml. What is the mass/volume percent?

$$P_{m/v} = \frac{m_{solute}}{V_{solution}} = \frac{20\,g}{55\,mL} = 0.36\,\frac{g}{mL} = 36\%\ m/v$$

What is the concentration of the pesticide in g /100 ml?

$$P_{m/v} = \frac{m_{solute}}{V_{solution}} = \frac{20\,g}{100\,mL} = 0.2\,\frac{g}{mL} = 20\%\ m/v$$

How much herbicide would you need to add to make 1.5 L of solution?

$$P_{m/v} = \frac{m_{solute}}{V_{solution}}$$

$$\frac{20\,g}{100\,mL} = \frac{x\,g}{1500\,mL}$$

$$x\,g = 300\,g$$

Mass/Mass Percent
This calculation is usually used for solids with solids and solid with liquids.

$$P_{m/m} = \frac{m_{solute}}{m_{solution}}$$

Ex. The concentration of gold of is measured in Karats with 24 k being pure gold. Calculate karat value for a piece of gold that contains 2.86 g of gold and has a total mass of 4.9 g.

$$P_{m/m} = \frac{2.86\,g}{4.9\,g} = 0.58 = 58\%$$

You are interested in a gold ring that a jeweler says he made himself and claims it to be 18 K gold. He says he put 35 g of gold into it and the ring weighs 45 g. Is the jeweler telling the truth?

A gold chain weighs 57.5g and is 14 K gold. If gold sells for $ 22.00/g how much did the gold cost in the chain?

Volume/Volume Percent

This calculation is usually used for liquids with liquids.

To calculate the volume/volume percent use the following formula.

$$P_{v/v} = \frac{V_{solute}}{V_{solution}}$$

Ex. Rubbing alcohol is 70% by volume propanol. How much propanol would be in 500 ml of rubbing alcohol?

$P_{v/v} = \frac{V_{solute}}{V_{solution}} = 0.7 = \frac{V_{solute}}{500mL}$

$350mL = V_{solute}$

ppm and ppb

Very dilute solutions contain small quantities of solute for a given quantity of solution.

ppm = parts per million ppb = parts per billion

Both of these measurements relate the mass of solute to the mass of the solution.

These measurements do **not** deal with particles even though this is what their name implies.

$$ppm = \frac{m_{solute}}{m_{solution}} \times 10^6 \qquad ppb = \frac{m_{solute}}{m_{solution}} \times 10^9$$

$\frac{1g}{1,000,000g} = \frac{0.001g}{1000g} = \frac{1mg}{kg} = PPM = \frac{1mg}{L}$

$\frac{1g}{1,000,000,000g} = \frac{0.000001g}{1000g} = \frac{1\mu g}{kg} = PPb = \frac{1\mu g}{L}$

Ex. When the water of local beachs reaches 60 ppm E .coli bacteria health regulations say it must be closed. If a 5 liter water sample is found to contain 0.7 mg of E. coli bacteria does the beach need to be closed?

$PPM = \frac{0.7mg}{5L} = 0.14\frac{mg}{L} = 0.14PPM$

Ex. Mercury is present in soils but is considered safe bellow 90 ppb. What is the safe amount of mercury in a 400 g soil sample?

$PPb = \frac{\mu g}{kg}$ $\qquad 90ppb = \frac{90\mu g}{kg} = \frac{x\mu g}{0.4kg}$

$90PPb = \frac{\mu g}{0.4kg}$

$36\mu g = \mu g$

$36\mu g = 0.000036g$