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How Much Is A Part Per Million?

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Because the chemical residues found in animal feed, food, food products, plants or soil are commonly found in very small amounts, concentrations of these chemicals are expressed in parts per million (ppm), parts per billion (ppb) or parts per trillion (ppt). How much is one in a million, billion or trillion?

Remember ppm, ppb and ppt are expressions of concentration, not absolute amounts. In other words, they indicate how much of something is in a larger amount of something else. One part per million (1 ppm) means that for every million parts of a solution or mixture, there is one part of the substance being measured. For example, a teaspoonful of instant coffee dissolved in a mug of hot water has a concentration of approximately 32,000 ppm coffee. (Put another way, the coffee represents approximately 3.2% of the total mixture: 32,000/1,000,000 = 4/125 = 3.2%).

The following may help in visualizing ppm, ppb, and ppt concentrations:

PARTS PER MILLION (ppm)

1 ppm = 1 milligram (mg) in a kilogram (kg), or
1 inch in 16 miles, or
1 minute in 2 years, or
1 ounce in 32 tons, or
1 fluid ounce in 7,812.5 gallons of an aqueous mixture

10,000 ppm = 1%

PARTS PER BILLION (ppb)

1 ppb = 1 microgram in a kilogram, or
1 inch in 16,000 miles, or
1 second in 32 years, or
1 drop in a 10,000 gallon tank

PARTS PER TRILLION (ppt)

1 ppt = 1 microgram in 1,000 kilograms, or
1 inch in 16,000,000 miles, or
1 second in 320 centuries (32,000 years), or
1 grain of sugar in an Olympic-size swimming pool

In order to understand expressions of ppm, ppb or ppt, it may be helpful to first understand the metric system. The metric system has long been used by scientists and is now gaining acceptance by the public. The metric system is actually much easier to work with than the standard English system--all increasing units are simply multiples of ten, and decreasing units are tenths. These units are expressed by prefixes. Using the gram (g) as an example: (See box, bottom of page).

1 milligram (mg) = 1,000 micrograms
1 gram (g) = 1,000 milligrams
1 kilogram (kg) = 1,000 grams

1 kg = 1,000 g = 1,000,000 mg = 1,000,000,000 micrograms
1 microgram = 0.001 milligram (mg)
1 milligram (mg) = 0.001 gram (g)
1 gram (g) = 0.001 kilogram (kg)

1 microgram = 0.001 mg = 0.000001 g = 0.00000001 kg
1 milliliter (ml) is approximately 20 drops
1 liter (L) = 1,000 milliliters (ml)
1 milliliter (ml) = 0.001 liter (L)

However, because most of us have grown up with the standard English system, the relationship of the metric system to the units we are familiar with may still be difficult to understand.

micro-	milli-	centi-	deci-	g	deca-	hecta-	kilo-
1/1,000,000th	1/1,000th	1/100th	1/10th	1	10	100	1,000

There are 28.35 grams in one ounce.
There are 454 grams in one pound.
1 g = 0.035 ounces
1 kg = 2.2 pounds

For liquid measures,

1 teaspoon = 5 milliliters (ml)
1 Tablespoon = 15 ml
1 cup = 236 ml
1 pint = 2 cups = 472 ml
1 quart = 2 pints = 946 ml
One liter (L) = 0.26 gallons = 1.06 quarts
= 2.11 pints = 4.2 cups

Table 1 shows how to convert various measures between the English and metric systems. The metric system is convenient to use with expressions of ppm, ppb, and ppt. For dry matter mixtures, such as herbicide mixed with soil, ppm is equal to the number of micrograms of chemical present in each gram of soil mixture.

ppm = 1 microgram in a gram
= 1 milligram in a kilogram

Parts per million in an aqueous solution is equal to the number of milligrams of chemical present in each liter of solution.

ppm = mg chemical in liter of solution
= microgram of chemical in milliliter of solution.

Regardless of what is being measured and how that measurement is being expressed, ppm, ppb and ppt are always expressions of concentration--what amount of something is in a million, billion or trillion of something else.

Table 1. Approximate conversions — metric and English systems.

You can find —	*If you multiply —*	*by—*
Length		
millimeters	inches	25.4
centimeters	feet	30.48
meters	yards	0.914
kilometers	miles	1.609
inches	millimeters	0.03937
inches	centimeters	0.3937
yards	meters	1.094
miles	kilometers	0.6214
feet	meters	3.28
Area		
square centimeters	square inches	6.452
square meters	square feet	0.093
square meters	square yards	0.836
square kilometers	square miles	2.589
square hectometers (hectares)	acres	0.404
square inches	square centimeters	0.1550
square yards	square meters	1.196
square miles	square kilometers	0.347
acres	square hectometers (hectares)	2.471
(1 short ton = 2,000 pounds; 1 metric ton = 2,204.622 pounds)		

You can find —	*If you multiply —*	*by —*
Mass		
grams	ounces	28.35
kilograms	pounds	0.4536
megagrams (metric tons)	short tons	0.9072
ounces	grams	0.0353
pounds	kilograms	2.2046
short tons	megagrams (metric tons)	1.102
Liquid Volume		
milliliters	ounces	29.573
liters	pints	0.473
liters	quarts	0.946
liters	gallons (U.S.)	3.785
ounces	milliliters	0.0338
pints	liters	2.11
quarts	liters	1.057
gallons (U.S.)	liters	0.2642
U.S. liquid measure	Imperial liquid measure	0.8327
Temperature		
degrees Celsius (centigrade)	degrees Fahrenheit	5/9 (after subtracting 32)
degrees Fahrenheit	degrees Celsius (centigrade)	9/5 (then add 32)

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