

## About Units of Measure

All the different concentration units can be confusing; different units of measure are used for PCE in soil, in groundwater, and in soil gas and air.

**Soil:** Concentrations of PCE in soil are typically reported as milligrams per kilogram (mg/kg), which is equal to parts per million (ppm), or as micrograms per kilogram ( $\mu\text{g}/\text{kg}$ ), which is equal to parts per billion (ppb). One ppb is comparable to one dollar out of one billion dollars.

**Groundwater:** Concentrations of PCE in groundwater are typically reported as milligrams per liter (mg/L), which is equal to ppm, or, more commonly, as micrograms per liter ( $\mu\text{g}/\text{L}$ ), which is equal to ppb.

**Soil Gas and Air:** Concentrations of PCE in air are typically reported as micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ). However, because gases expand with changes in temperature and pressure, the value of  $\mu\text{g}/\text{m}^3$  requires a calculation to be converted to parts per billion per volume (ppbv).

The molecular weight of PCE is 165.83 grams per mole (g/mol). Under conditions of standard temperature and pressure\*, one mole of an ideal gas has a volume of 24.04 liters per mole (L/mol), commonly rounded to 24 L. Therefore for each mole of PCE:

$$\text{ppbv} \times ((165.83 \text{ g}) / (24 \text{ L})) \times (1000 \text{ mg} / 1 \text{ g}) \times (1000 \mu\text{g} / 1 \text{ mg}) \times (1000 \text{ L} / \text{m}^3) = \mu\text{g}/\text{m}^3$$
which works out to 1 ppbv  $\sim$  6.9  $\mu\text{g}/\text{m}^3$  under standard conditions

\* Standard pressure is 1 atmosphere  
Standard temperature taken here as 20°C (68°F)

**What is a Part Per Billion** — Concentrations of chemicals are reported by the laboratory in metric units. Scientists generally speak of these concentrations as "parts per billion" (ppb) or "parts per million" (ppm) or even "parts per trillion" (ppt). However, laboratories actually report data in different metric units depending on whether the sample was a solid (like soil), or a liquid (like groundwater), or a gas (like soil vapor).

The concept of a "part per million" (or billion or trillion) can be difficult to put into perspective. So, just how much is a part per billion? One part per billion is:

- 1 sec in 31.7 years
- 1 inch in 15,738 miles
- 1 foot in 189,400 miles
- 1 square inch in 120 football fields
- 1 drop of water in a swimming pool
- 1 grain of sand in 730 pounds of sand

Six people in the world population  
One cent in \$10 million dollars  
One dollar in one billion dollars  
One penny in a stack of pennies 932 miles high  
1 kernel of corn in enough corn to fill a 45-foot-silo, 16 feet in diameter  
A pinch of salt in ten tons of potato chips  
1 square foot in 36 square miles  
1 bad apple in 2,000,000 barrels  
1 bogey in 3,500,000 golf tournaments  
1 second in the lifetime of a 32-year-old person