3.11.2: Environment- Determining Safe Mercury Concentrations in Drinking Water

For a review of determining concentration of solutions, click the following link and select CoreChem: Solution Concentrations

Mercury is a liquid metal which is found naturally in ores, typically combined with other elements. It is commonly used in electrical products, including fluorescent light bulbs, dry cell batteries, switches, and various control equipment. Mercury in drinking water is a possible health concern. Those who drink water with high levels of mercury over several years are at risk of experiencing kidney damage. The Environmental Protection Agency (EPA) in the USA has established particular guidelines regarding contaminants such as mercury in the drinking water: maximum contaminant level goals (MCLG) and the maximum contaminant level (MCL). The MCLG is the highest level of protection based on the best available data in order to prevent potential health issues. The MCL is the enforceable standard set by EPA; it is often the same as the MCLG, but sometimes it is a little less stringent due to cost restriants or limits of public water systems to detect, treat, or remove contaminants. For mercury, both the MCLG and the MCL are 0.002 mg/L. **Example 1** *Determine the safe molar concentration for mercury in drinking water, given that the MCL for mercury is 0.002 mg/L.*

Remember that molarity, or molar concentration, can be expressed in a variety of ways, including moles per liter. Expressed in this way, and using the conversion 1 g = 1000 mg and the molar mass of mercury, allows us to solve this problem:

(0.002 mg / L) x (1 g / 1000 mg) x (1 mol Hg / 200.59 g)= 9.97 x 10^{-9} mol / L

Example 2 *A water drinking source with a total volume of 2.35 x 10^{8} m^{3} is contaminated with 51.70 grams of mercury. Is this concentration more or less than the maximum contaminant level set by the EPA?*

In example one above, the units for the final answer were expressed in moles per liter. Using the above information, grams can be converted into moles and cubic meters can be converted into liters:

51.70 g Hg x (1 mol Hg / 200.59 g Hg) = 2.58 x 10^{-1} mol Hg

2.35 x 10^{8} m^{3} x (1000 L / 1 m^{3}) = 2.35 x 10^{11} L The concentration in moles per liter can be found by dividing results of the two calculations above:

Molarity = moles / liters = 2.58 x 10^{-1} mol Hg / 2.35 x 10^{11} L = 1.10 x 10^{-12} M

This concentration is an acceptable level for mercury because it is less than the maximum contaminant level of 9.97 x 10^{-9} mol / L set by the EPA.

PRACTICE PROBLEMS

1. 92.56 grams of mercury have contaminated a drinking water source with a volume of 7.5 x 10^{5} m^{3}. Does this mercury concentration fall below the EPA's maximum contaminant level?

2. Suppose the EPA revises its maximum contaminant level goal to 0.0015 mg/L. What would this concentration be expressed in moles per liter?

Solutions to Practice Problems

1. 7.5 x 10^{5} m^{3} x (1000 L / 1 m^{3}) = 7.5 x 10^{8} L

92.56 g Hg x (1 mol Hg / 200.59 g Hg)= 4.61 x 10^{-1} mol Hg

Concentration = moles / liters = 4.61 x 10^{-1} mol Hg / 7.5 x 10^{8} L = 6.15 x 10^{-10} M

Yes, this concentration falls below the EPA's maximum contaminant level.

2. 0.0015 mg / L x (1 g / 1000 mg) x (1 mol / 200.59 g)= 7.48 x 10^{-9} mol/L Reference

Drinking Water Regulations [water.epa.gov]