Answer on Question #58199 – Chemistry – Other

Task:

The concentrations of arsenic (As) and selenium (Se) in a drinking water well were 2.0 and 3.8 ppb. (a) Convert arsenic concentration into ppm and mg/L, (b) Convert selenium concentration into molarity (M) and micro-molarity (mM), (c) Have the concentrations exceeded the maximum contaminant level (MCL) of 50 mg/L for both elements? The atomic weight of Se is 79.

Solution:

$$C(As,\, ppb) = 2.0\, ppb;$$
$$C(Se,\, ppb) = 3.8\, ppb.$$

(a) Convert arsenic concentration into ppm and mg/L:

ppm and ppb are defined as:

$$1ppm \;=\; 1/10^{6} \;=\; 10^{-6};$$
$$1ppb \;=\; 1/10^{9} \;=\; 10^{-9}.$$

So

$$1ppm = 1000\, ppb$$
$$x_{ppm} = x_{ppb}\,/1000.$$

Then, the concentrations of arsenic (As) and selenium (Se) into ppm:

$$C(As,\, ppm) = C(As,\, ppb)\,/1000 = 2.0\, ppb\,/1000 = 0.0020\, ppm;$$
$$C(Se,\, ppm) = C(Se,\, ppb)\,/1000 = 3.8\, ppb\,/1000 = 0.0038\, ppm.$$

ppb and mg/l are defined as:

$$1000g(H_2O) = 1000ml(H_2O) = 1l(H_2O), \text{because the } \rho(H_2O) = 1g\,/\,ml;$$
$$1g = 10^{-3}mg;$$
$$1ppb \;=\; 1/10^{9} \;=\; 10^{-9} = \frac{10^{-6}g}{1000g} = \frac{10^{-6}g}{1000ml} = \frac{10^{-3}mg}{1l} = 1\times10^{-3}\, {mg}/{l}\,.$$

So

$$1\, {mg}/{l} \;= 1000\times1ppb.$$
$$x_{mg/l} = x_{ppb}\times10^{-3}.$$

Then, the concentrations of arsenic (As) and selenium (Se) into mg/l:

$$C(As, mg/l) = C(As, ppb) \times 10^{-3} = 2.0\, ppb \times 10^{-3} = 0.0020 mg/l;$$
$$C(Se, mg/l) = C(Se, ppb) \times 10^{-3} = 3.8\, ppb \times 10^{-3} = 0.0038 mg/l.$$

Answer:

$$C(As) = 2.0\, ppb = 0.0020\, ppm = 0.0020 mg/l;$$

b) Convert selenium concentration into molarity (M) and micro-molarity (mM):
The atomic weight of Se is 79.

$$M(Se) = 79\, {}^{g}\!/_{mol} = 79 \times 10^{3}\, {}^{mg}\!/_{l}\,.$$

The molarity of a solution is calculated by taking the moles of solute and dividing by the liters of solution:

$$Molarity = \frac{moles\ of\ solute}{liters\ of\ solution}.$$

Then,

$$Molarity(Se) = \frac{n(Se)}{V} = \frac{m(Se)}{M(Se) \times V} = \frac{C(Se, mg/l)}{M(Se)}.$$
$$Molarity(Se) = \frac{0.0038\, {}^{mg}\!/_{l}}{79 \times 10^{3}\, {}^{mg}\!/_{mol}} = 4.8 \times 10^{-8}\, {}^{mol}\!/_{l}\,.$$

$$Micro-molarity(Se) = Molarity(Se) \times 10^{6} = 4.8 \times 10^{-8} M \times 10^{6} = 0.048 mM.$$

Answer:

$$Molarity(Se) = 4.8 \times 10^{-8}\, {}^{mol}\!/_{l} = 4.8 \times 10^{-8} M;$$
$$Micro-molarity(Se) = 0.048 mM.$$

(c) Have the concentrations exceeded the maximum contaminant level (MCL) of 50 mg/L for both elements?

$$C(Se, mg/l) = 0.0038\, mg/l < the\ maximum\ contaminant\ level\ (MCL) = 50\, mg/l.$$
$$C(As, mg/l) = 0.0020\, mg/l < the\ maximum\ contaminant\ level\ (MCL) = 50\, mg/l.$$

$$\sum C(As) + C(Se) = 0.0020\,mg/l + 0.0038\,mg/l = 0.0058\,mg/l.$$

$$\sum C(As) + C(Se) = 0.0058\,mg/l \quad < \quad MCL = 50\,mg/l.$$

Since the amount concentrations of selenium and arsenic do not exceed the maximum permissible concentration of arsenic (MCL) of 50 mg/l, it can be said that the level content of both the metal in the water corresponds to the norm.

Answer:

The content of selenium and arsenic do not exceed the maximum permissible concentration of arsenic (MCL) of 50 mg/l.