Answer on Question #45946 – Chemistry – Inorganic Chemistry

Question:

If the LEL for hydrogen = 4% and the UEL = 74%, what mass of hydrogen was contained in the 500 ml tin when it exploded? (Conditions at the time of the experiment were 23^{o}C and 750 mm Hg).

Answer:

The ideal gas law will be used to calculate the mass of hydrogen which was in the tin.

The ideal gas law is the equation of state which describes the relation between the parameters of gas. The ideal gas law is often introduced in its common form:

$$\mathbf{PV} = \frac{\mathbf{m}}{\mathbf{M}}\mathbf{RT}$$

where **P** is the absolute pressure of the gas, **V** is the volume of the gas, **m** is the mass of the gas (measured in grams), **M** is the molecular mass of the gas (measured in g/mol), **R** is the universal gas constant, and **T** is the absolute temperature of the gas.

The minimum volume of the hydrogen needed for explosion in the tin is:

V_{min} = 500*0.04 = 20 ml = 2*10^{-5} m^3

The maximum volume of the hydrogen in the tin can be:

V_{max} = 500*0.74 = 370 ml = 3.7*10^{-4} m^3

The SI value for R is 8.314 J/(mol*K).

Pressure needs to be measured in pascals (Pa), so P = 750 mm Hg = 99992 Pa

Absolute temperature is equal to T = 23 + 273 = 296 K

The molecular mass of the hydrogen is M = 2 g/mol

Now we can calculate the minimum mass of the hydrogen in the tin.

$$\mathbf{m_{min}} = \frac{\mathbf{MPV}}{\mathbf{RT}} = \frac{\mathbf{2 * 99992 * 2 * 10^{-5}}}{\mathbf{8.314 * 296}} = \mathbf{0.00163\ g = 1.63\ mg}$$

Now we can calculate the maximum mass of the hydrogen in the tin.

$$\mathbf{m_{max}} = \frac{\mathbf{MPV}}{\mathbf{RT}} = \frac{\mathbf{2 * 99992 * 3.7 * 10^{-4}}}{\mathbf{8.314 * 296}} = \mathbf{0.03007\ g = 30.07\ mg}$$

Answer: the mass of hydrogen in the tin was **from 1.63 mg to 30.07 mg** when it exploded.