

Chem 1025 Methane
14-Nov-2007

Homework / Pop Quiz Replacement
Due Monday, 19-Nov-2007

The hood in the lab has a small gas leak when the valve is turned off:

Holding a beaker of water up to the outlet, it is leaking approximately 1 gas bubble per second.

Using an approximation of 20 drops of water = 1 ml, you can assume 20 gas bubbles = 1 ml.

The gas is natural gas, alias Methane - CH₄. Methane has a minimum explosive mixture of 5% [5% volume of Methane in 95% volume of air].

The hood measures approximately 1 meter on a side - a cube measuring 1 meter x 1 meter x 1 meter.

Assuming all the methane that leaks out stays in the hood, how long will it take for the methane in the hood to build to an explosive mixture?

ANSWER:

Hood = 1 Meter on a side = 1 Meter³

From you Class Book, 1 Meter³ = 1,000 Liters

You need 5 % or 0.05 x the hood volume of Methane = 0.05 x 1,000 Liters of Methane = **50 Liters of Methane are needed.**

The rate the Methane is coming out is:

[Note the ratios are such that "Gas Bubbles" cancel out.]

$$\frac{\text{Second}}{1 \text{ Gas Bubble}} * \frac{20 \text{ Gas Bubble}}{1 \text{ ml}} = 20 \text{ Seconds} / 1 \text{ ml}$$

So, it takes 20 seconds for 1 ml of Methane to come out. How long will it take for 50 Liters?

50 Liters * 1000 ml / Liter * 20 Seconds / 1 ml = **1,000,000 Seconds**

Now, convert that large number of seconds to a reasonable number:

1,000,000 Seconds * 1 Minute / 60 Seconds * 1 Hour / 60 Minutes * 1 Day / 24 Hour = 11.5 Days - or rounded off to @ 12 days.

I've had a few questions on how to do the Explosive Mixture of Methane. So, here is some hints. The first hint is to ALWAYS put in your UNITS. Make sure the UNITS cancel out:

1. Hood = 1 Meter on a side = 1 Meter cubed

From you Class Book, 1 Meter cubed = ???? Liters

2. You need 5 % or 0.05 x the hood volume of Methane to form an explosive mixture = how many Liters of Methane do you need then?

3. What is the rate of Methane coming out in Seconds / ml of Methane?

4. So, now you have the rate that the Methane is coming out in Seconds / ml [3 above].

You also have the amount of Methane that you need - but it's in Liters [2 above], so how do you convert Liters to ml?

See how you do now!

GK