Comments on the Humidity device in VAL4-309 laboratory of the Eco-campus (BUAP)

6 Feb 2024

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Section 3.1

I have no drawing of this device as it dates back to the 1960s.

The central tube (dia. 10mm ?) goes to the bottom of the reservoir leaving a few millimetres so it does not touch the bottom plate. The 2 level marks at the bottom and at the top indicate the full range of operation. I would not fill more than ½ the height to avoid liquid being pushed/splashed into the exhaust tube.

During operation the bubbling inside the bubbler can be heard.

I do not understand the heat transfer argument. The evaporation that is going on to produce the humid gas will reduce the temperature of the reservoir but I doubt, at these flow rates, the effect is measurable.

Section 3.2

The parameters to control are temperature and flow rate. Do contaminants affect this device ?

Before talking about gas velocity think about bubble size, surface area and volume. Diffusion is a function of the area of the bubble and the exposure time to the liquid. Assume the aim is to produce a saturated vapour (100%RH) and then find a means of adjusting this to value between 20 and 80% RH. Does the velocity (equivalent to flow rate) change the duration of exposure of the bubble to the liquid ? No but why ? Find somebody who keeps fish in a glass tank. Look at the device that injects air (oxygen) into the water you will see millions (?) of very small bubbles.

Do all tests with a cheap gas or clean compressed air.

The use of RH is not obvious as it depends upon the ambient temperature. Absolute humidity is a better reference for the measurement in either ppm or Dew point. Look for tables of these three values. What happens at 10deg C ?

How to adjust the saturated vapour ? 2 methods.

1. Temperature influences the humidity. I assume on a cold day the cloths you hang out on the washing line will dry very quickly as the air is very dry. What will happen if the bubbler is held at ~10degC and the gas comes out into a room that is at 20-25degC ?
2. Or make saturated gas and then mix it with a dry gas direct from the bottle.

In fig 4 I suspect you are looking at the hydrostatic pressure of the gas.

Section 4

Verification of the reservoir/bubbler to deal with 3l/hr.

Sorry I do not understand how you conclude that the device is not suitable. I assume you understand that the flow into and out of the device is continuous. It must not be restricted in any way. It is NOT a pressure vessel. DO NOT pressurise the reservoir it will be dangerous. Always leave the exhaust un-restricted finally going to the atmosphere after the chamber if there is one in the line.

It is a pity you have not seen the gas rack that this device was taken from as you could see that 6 flow meters could flow gas into the bubbler at perhaps 100l/hr.

Section 5

Perfect ! This is the hydrostatic pressure created by the 5cm height of the water in the bubbler.

The Po is the atmospheric pressure and since we are surrounded by this it affects everything. All (almost) pressure gauges are relative pressure wrt atmosphere pressure.

This is therefore the pressure that the gas has to overcome to ensure flow through the bubbler.

So this is the absolute minimum that the regulator on the bottle can be adjusted to. I would suggest using 100-200mBar to ensure a sufficient flow of 1-10litres/hr.

Hydrostatic pressure of R134a

CMS is split into 2 (or 3) different gas levels to try and reduce the impact of different pressures in chambers that affects the efficiency.

You could take off a supply at the bottle on the ground floor and through a flow meter up to the roof of the building that I guess is at approx. >10m.

A water column will be sufficient to measure the pressure caused by the weight of the Freon as it is pushed up the pipe to the top. I would like to know what you measure. I will try and do the same here with the students.

Do not connect the bubbler to a chamber before you are fully in control of the humidity process.

You need an instrument to check what is going on. If you put saturated gas directly from the bubbler it will condense in the chamber and ruin the gaps. Ask P5 about RE2 when it was on the surface !

I am not able to explain the level gauge on the side that appears to be stuck. Try cleaning it with water.

And when you have not been lucky with your bubbler go and find a Guinness to look at and then drink. The bubbles go down, not up. My Irish ancestors had a special knowledge. See;

https://www.youtube.com/watch?v=qNBTygWcy0s

Cheers Ian

Reservoir = bubbler = vessel.

Look for informative articles in “Physics Education” and “American Journal of Physics”