Carbon Monoxide and Density

8/28/2004

name Michael K.
status educator
age 40s

Question - Does carbon monoxide rise or sink if produced inside a house? Why? Does natural gas rise or sink?
(I am trying to figure out where to position gas detectors).

Although the molecular weights of these gases differ, convection and not density differences dominate the distribution of CO, methane etc. The release of gases associated with combustion tend to rise because they are hotter than ambient. For this reason smoke detectors and CO detectors are usually placed high on the walls of hallways etc.

Vince Calder

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Michael,

High or low in a room; It makes no difference where you put the detector -- but not because carbon monoxide and air have approximately the same density. Both are gases and as a result, diffusion alone and the entropy

effect will take care of mixing them. Any convection currents and/or forced-air turbulence present will also enable the gases to mix and affect the detector.

It is popularly misconceived that light (low-density) gases will somehow float atop heavy (higher density) gases. Indeed, if the higher density gas was admitted low in the room, and done so in a manner that would not cause much mixing, it would take a while for the gases to become thoroughly mixed by the mechanisms mentioned above. Even so, they would eventually mix.

That said, since time to detection may be of the essence, and in circumstances where the contaminant gas (such as radon -- a gas of very high density) gets into the room through entry points more or less at floor level, where one puts the detector can become important.

Regards,
ProfHoff 909
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Air is 1/4 oxygen O2, (weight 16) and mainly nitrogen N2 (weight 14).

CO is weight 12+8 = 20, so heavier than "air"
Methane (natural gas) is CH4 = 12 + 4(1) = 16, so mixes with air fairly well, hard to say.

I would put the CO and methane detectors near the furnace.

Steve Ross
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Neither, for the most part.
Carbon monoxide has nearly the same density as air.
You'll notice that the manufacturer's instructions that come with the detector don't say high or low either.

The density of a gas is proportional to the weight of a single molecule of that gas.

So you figure relative buoyancy for yourself if you start learning a few atomic weights:
H=1, He=4, C=12, N=14, O=16.

Add them up for the molecular weights of pure gasses:

H2 = (1+1)	= 2,	very light
He = (4)	= 4,	very light
N2 = (14+14)	= 28,	about neutral
O2 = (16+16)	= 32,	slightly heavy
CO2= (12+16+16)	= 44,	heavy
CO = (12+16)	= 28,	about neutral
CH4= (12+4*1)	= 18,	light (majority part of natural gas)
H2O= (2*1+16)	= 18,	light (steam)
C2H6=(2*12+6*1)	= 30,	about neutral (minority part of natural gas)
C3H8=(8 + 3*12)	= 42,	heavy (propane)
C4H10=(10+4*12)	= 58,	(butane)
C5H12=(12+5*12)	= 70,	pentane, lightest part of gasoline

For mixed gasses just take a proportionate average:
Air is 80% N2 + 20% O2 .
air = 0.8(28) + 0.2(32) = 29 (exactly neutral, by definition)

So pure carbon monoxide is actually about 3% lighter than air.
But usually it is made in modest concentrations, mixed in with the normal combustion products: CO2, H2O.
Which are always mixed with the 80% Nitrogen that never participates in burning.
Then that mixes with room air, making an even smaller concentration...

And there are uncertainties...
Some fuels make light exhaust (more H2O), some make heavy (more CO2).
Then when the exhaust cools the light part, H20 (steam), may condense and drop out.
Not to mention that the exhaust gas was expanded when hot, and it contracts as it cools.
No rule can predict which way it is going to go in most circumstances.

Because it travels in whatever directions your air normally circulates, which varies,
it is difficult in most homes to find an advantageous position where CO will enter or concentrate.
So we settle for any convenient position, or one associated with that which we wish to protect,
namely us, breathing in air at medium heights.

My CO detector is at about waist-level in a hallway, partly because there was a convenient power socket there.
Also the only air-intake to the house heater is there, so virtually all the air in the house will pass that position regularly.

Doing a really good job needs more than one detector, but they are not cheap enough for that yet.
One for each potential source of monoxide, plus one for each protectee. Maybe someday.
Meanwhile, if I had a wall heater, I wouldd definitely place my one detector near there, probably high up.

Jim Swenson

PS- natural gas rises.
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Up-date 2/4/2005
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Just read your reply to Michael K. on "Carbon Monoxide and Density" The furnace room location may be okay if you have more than one alarm. However of more prime concern is that the occupants be able to hear the alarm while asleep. National Fire Protection Association has a code , number 720, 2-1.1.2* 1998 states that " A carbon monoxide alarm or detector should be centrally located outside of each separated sleeping area in the immediate vicinity of the bedrooms. Where bedrooms are separated and the audibility of the alarm or detector to occupants within the bedroom area could be seriously impaired, more than one unit could be needed. Each alarm or detector should be located on the wall, ceiling, or other location as specified in the installation instructions that accompany the unit." . In addition more than CO will be emitted with furnace failure or with the use of an unvented heaters. Carbon dioxide a heavier gas will collect on the floor building up and possibly preventing carbon monoxide from ever reaching the alarm if located at a floor outlet. That is why it

is recommended that CO alarms be placed high around eye level where the higher concentrations would be concentrated. You are correct that natural gas rises, however Michael K. did not state if his question on the gas detector if it was about natural gas or propane gas. If his residence is using propane then he would need to place the gas detector on the floor next to the furnace and gas water heater. It is my hope that you ammend your answers to Michael K.

Gary R.
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