Mechanical Engineering Department MEC1405
Mixing of Gases Lab

Object:
To investigate the mixing of two gases and apply partial pressure methodology.

Apparatus:
Two gas cylinders with different gases, eg. Argon and Nitrogen
Pressure tank into which to fill mixture
Vacuum pump
Electronic scales
Pressure Gauge
Barometer and Room Temperature

Theory:
The understanding and computations involving mixtures can be tackled by either partial pressure or partial volume analysis. The partial pressure of a gas in a mixture of gases is the pressure that the gas would exert in a volume if it where occupying that same volume alone. The addition of the partial pressures of the species of gases in the mixture adds up to the total pressure of the mixture.

Procedure:
1. take note of the barometric pressure and room temperature

2. Place the pressure container on the electronic scale. Vent it to atmosphere. Note the weight of the pressure container when vented. Due note has to be taken of fittings and/or flexible pipes attached to the tank because these could alter or mask the small effect on weight of the gases.

3. Connect the pressure tank to the vacuum pump and pull a good vacuum say around to -0.7 or -0.65 bar gauge. Close the tank valve and disconnect the piping. Note the weight of the evacuated tank. The difference in weight between that of Step 1 and this Step is the weight of the gases that were still in the tank even though it was vented. NB the gases in the tank will not be air because we try not to put air into the tank so that we avoid the possibility of moisture coming into the tank. Most probably the mixture would have been that of a previous run of this same experiment.

4. Fill the tank to 2.0 bar gauge with Nitrogen gas from the Nitrogen bottle. Allow the temperature and pressure to settle. You may need to fill a bit more to regain the 2.0 bar gauge due to temperature settling back to room temperature.

5. Measure the added weight, *i.e.* the weight of Nitrogen that was added. The exact weight measurement is obtained with cylinder disconnected from any piping but a rough measurement can be obtained during the actual filling allowing the pipe to make the least possible force interaction with the scales.

6. Vent the nitrogen and evacuate the cylinder with the vacuum pump. Weight the evacuated cylinder and compare to the previous evacuated measurement. Fill the cylinder to 2.0 bar gauge with Argon gas and note the change in mass due to argon filling. Make sure to allow the pressure to settle due to temperature and add pressure if necessary before taking weight measurement

7. Reconnect the nitrogen and increase the pressure to 4.7 bar with nitrogen. Measure the new weight of the tank and deduce the added weight of Nitrogen.

Analysis:

What is the cylinder volume as calculated from the Nitrogen filling and as calculated from the Argon filling?

How do the weights of gasses required to fill the cylinder from evacuated condition to 2 bar gauge compare with each other? Comment on the values.

What is the partial pressure of the nitrogen in the second filling of nitrogen. How does it compare to the first filling of nitrogen. What is the weight of nitrogen required for the top up from 2 bar gauge to 4.7 bar gauge and how does it compare to the weight required for the first nitrogen fill from evacuated condition to 2 bar gauge?

Conclusion:

Comment on the use of partial pressure to resolve mixture problems.