# Using Correction Factors and a Photoionization Detector (PID) to Investigate Amines' Vapor Concentrations

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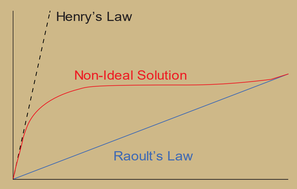
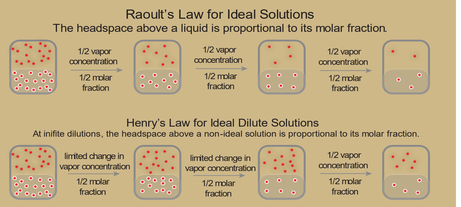
## Introduction

Henry's and Rault's Law

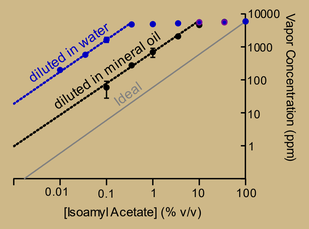


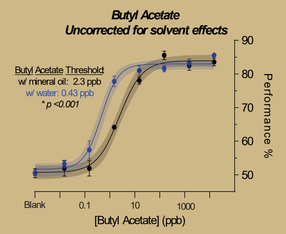

*Depiction of odorants in solution not following the gas laws




*Visual depiction of Henry's and Rault's Law

## Vapor Concentrations Vary




*Odor concentrations depend on what solvent they are dissolved in

## Goal

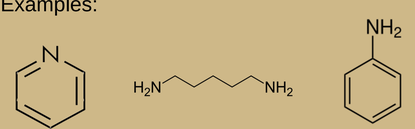
The goal of this research is to find the fitted curve for each odorant in my class of molecules. This curve is different for every molecule, and it is essential for the other research in our lab, as well as research in many other similar labs. It allows us to output a specific concentration of vapor-phase odorant based on the odorant's liquid concentration. This information is very valuable, especially when delivering smells to mice in order to measure their reactions or run other tests.

## Focus- Amines

Amines:

-Consist of a nitrogen atom with a lone pair of electrons
-Have a rather fishy smell

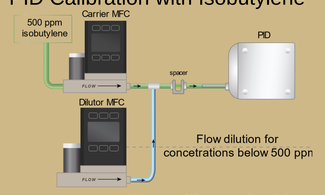
Examples:




Pyridine Cadaverine Aniline

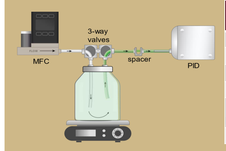
## Methods

PID Calibration with Isobutylene




*PID must be calibrated with isobutylene beforehand

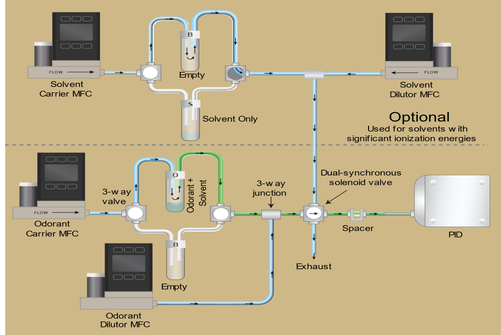
Measuring for Correction Factors




| Odor | Correction Factor |
|---|---|
| Butylamine | 0.94 |
| Amylamine | 0.76 |
| Isopentylamine | 0.7 |
| Hexylamine | 0.72 |
| 2-Ethylhexylamine | 0.78 |
| Heptylamine | 0.61 |

*Correction factors are needed to properly scale the graphs to the right

Flow Dilution Pathway to the PID

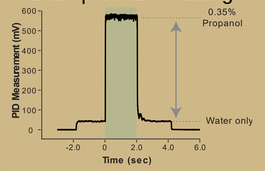



*Blue tubing contains clean air; green tubing contains odorant

Special Instructions

-Check for contamination
-Ensure pressure is constant throughout system
-Cleaning the bulb with ethanol is necessary before and after each odor
-Single concentration is measured 5 times then averaged

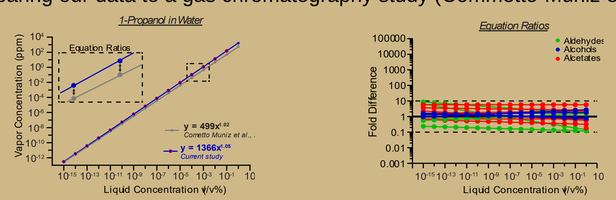
Example PID Reading




*PID measurements as shown on an oscilloscope

## Verifying the Method

Comparing our data to a gas chromatography study (Commetto-Muniz et al., 2003)

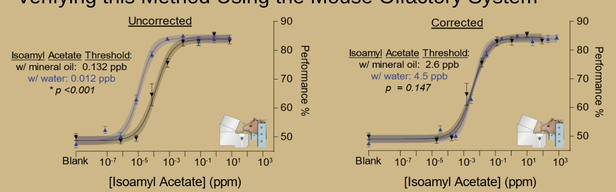






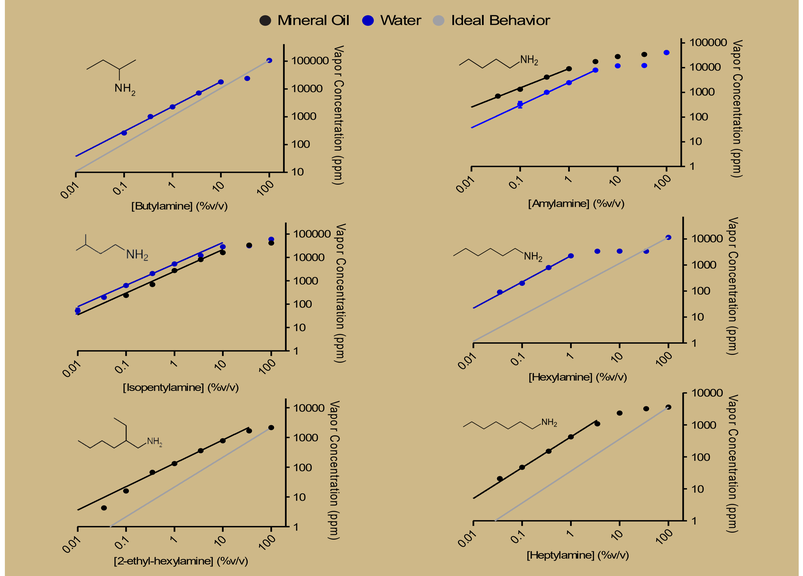
*Not a large difference between our data (less costly) and theirs (more costly)

Verifying this Method Using the Mouse Olfactory System




*Our liquid-/vapor-phase equilibrium equations successfully corrected for behavioral sensitivity differences observed in animals tested with the same odorant.

## Results




| Odor | Ideal | Mineral Oil | Water |
|---|---|---|---|
| Butylamine | $y=1073x^{1}$ | N/A | $y=2328x^{.90}$ |
| Amylamine | $y=409.2x^{1}$ | $y=9108x^{.78}$ | $y=2519x^{.92}$ |
| Isopentylamine | $y=599.2x^{1}$ | $y=2545x^{.93}$ | $y=5259x^{.91}$ |
| Hexylamine | $y=116.1x^{1}$ | N/A | $y=2267x^{1.01}$ |
| 2-Ethylhexylamine | $y=21.58x^{1}$ | $y=135.3x^{.78}$ | N/A |
| Heptylamine | $y=36.05x^{1}$ | $y=424.2x^{.96}$ | N/A |

## Summary & Future Implications

This research has added to the Dewan Lab's running list of odorants and their corresponding liquid-vapor concentration relations graphs. These are data points, and the end goal is to have a huge list of most all common odorants and their liquid-vapor concentrations in multiple different solvents. This research will be continued in the Dewan Laboratory to help achieve this.

## References


- Cometto-Muñiz, J.E., Cain, W.S., and Abraham, M.H. 2003. Quantification of chemical vapors in chemosensory research. Chem Senses. 28:467–477.
- Jennings, L., Williams, E., Caton, S., Avlas, M., & Dewan, A. (2022, December 26). Estimating the relationship between liquid- and vapor-phase odorant concentrations using a photoionization detector (PID)-based approach. Oxford Academic. Retrieved March 21, 2023, from https://academic.oup.com/chemse/article/doi/10.1093/chemse/bjac038/6961025