# Impact of Temperature on Odor Detection Strength with a Photo-Ionization Detector

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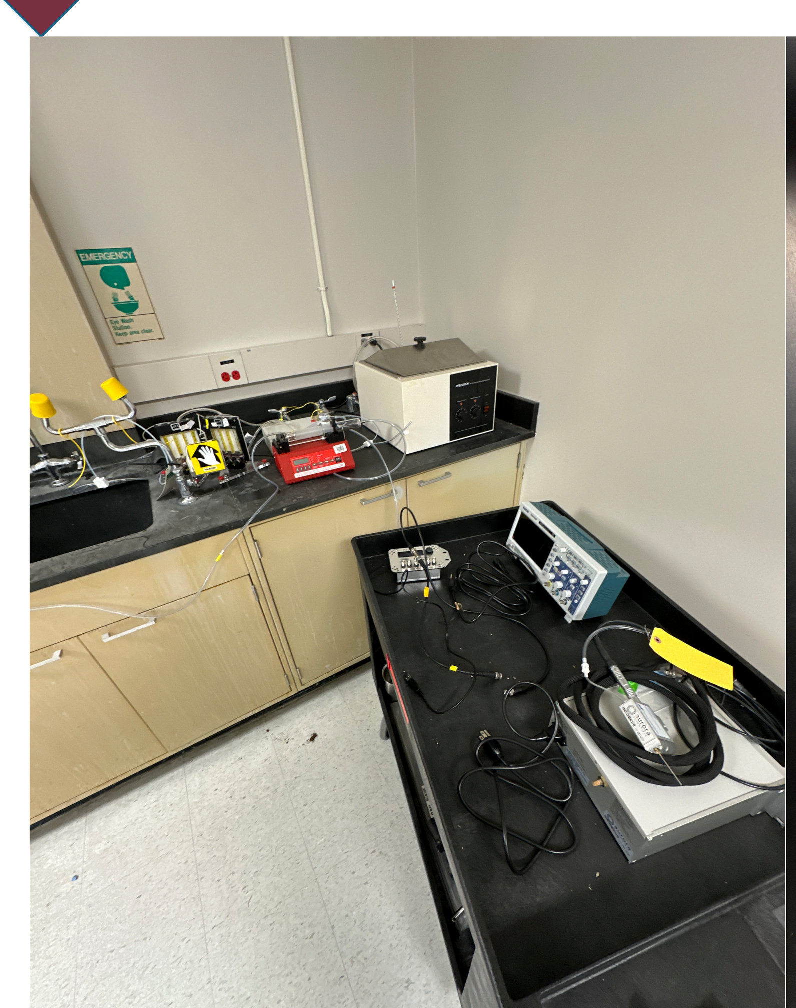
## Introduction:

Existing research provides limited insights into the impact of temperature on odor strength, leaving the nature of this relationship and its underlying mechanics open for further study. To investigate this, we created a variable-temperature olfactometer and took readings at various temperatures to potentially extrapolate a relationship. The main component of the setup was a sensor capable of quantifying the strength of an odor within the air known as a photo-ionization detector. The detector gives out an electrical signal that can be read and stored as an intensity vs time graph on an oscilloscope. The detector requires a constant airflow which is kept the same throughout the tests. What we changed between runs was the temperature of the water bath containing the vial of the odor solution. Different readings were taken at three temperatures: 0°C, 20°C, and 40°C and the results were compared to each other to see if it is possible to extrapolate a relationship between temperature of the odor solution and signal strength. My current hypothesis is that the higher the temperature is, the greater the signal strength will be as it will increase the reactivity of the odor molecules to interact with the detector more frequently.

**Air Supply**
- 500 mL/sec Air and 30 mL/sec Air are taken from a pump
- 30 mL/sec Air is pumped through the odor

**Odorization**
- 530 mL/sec air source is at output when solenoid is deactivated
- 500 mL/sec air + 30 mL/sec odorized air when solenoid is active

**Sensing**
- Non-odorized air is measured as a baseline
- Odorized air signal is compared at different temperatures



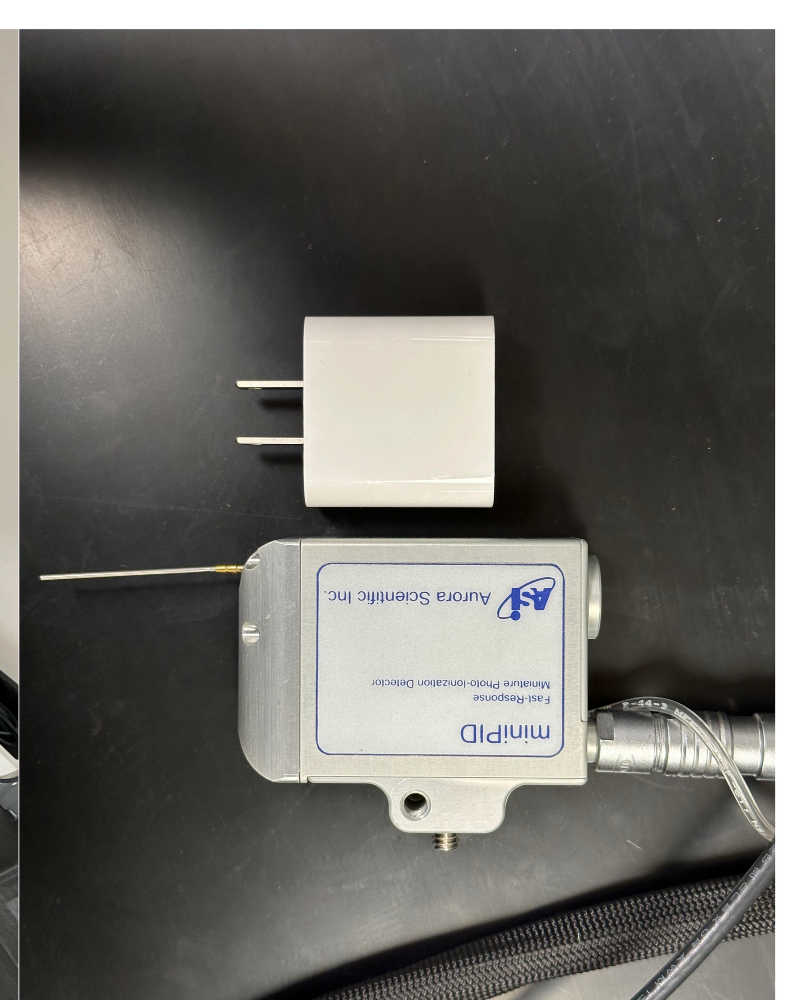


Figure 1.1 (Left) Olfactometer Setup    Figure 1.2 (Right) Photoionization Detector

## Methods:

- Readings are primarily taken from an apparatus consisting of an Olfactometer and a Photoionization Detector
- Experiments that quantify odor intensity require a setup with a constant flow of clean air mixed with a switchable source of either odorized or clean air
- The constant air flow is set at 500 mL/minute, combined with 30 mL/minute from the solenoid air source
- The switchable air source's flow is regulated by a user-operated 4-way electric solenoid valve to maintain a total flow of 530 mL/minute over the sensor as the sensor requires a constant rate of flow through it
- The sensor, a photo-ionization detector, quantifies odor molecule numbers in the air and converts this data into an electrical signal for oscilloscope reading and storage for later data interpretation
- Accurate temperature control of the odor source is vital for this experiment, achieved using a large thermal mass electric water bath to maintain consistent solution temperatures between readings.
- The test is performed multiple times at each temperature and the results were averaged

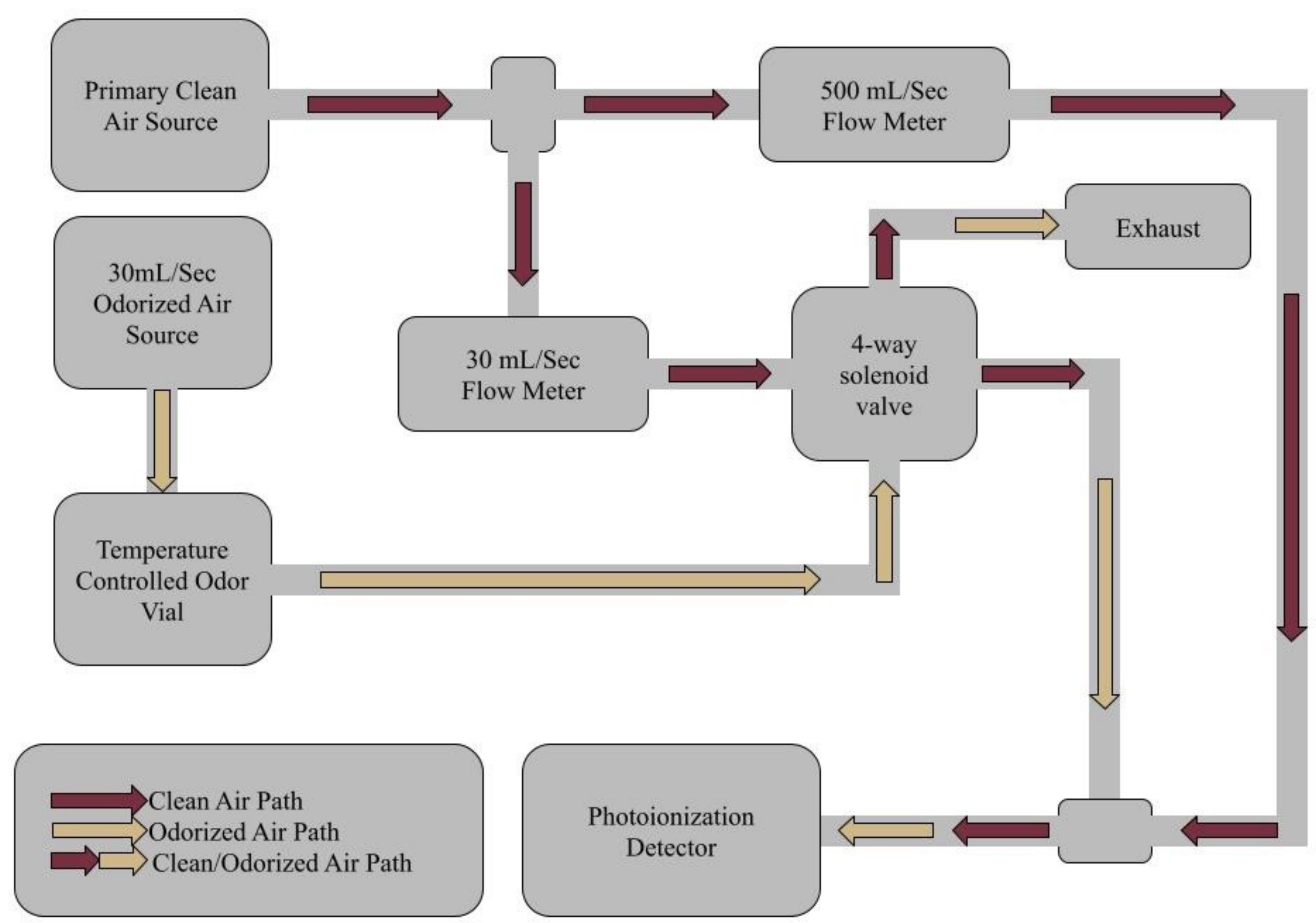



Figure 1.3 Olfactometer Airflow

## References:

## Results:

- The current data is preliminary and further study is in progress
- Data from the sensor provides mixed results supporting the original hypothesis
- A test was performed moving the odor vial from a warm water bath to an ice bath and observing changes in signal strength
- After being placed in the solution the signal strength dropped as predicted, however the signal slowly gained strength back to the initial value (top two photos)
- In another test involving opening and closing the valve and letting the solution sit in either the cold or warm bath a stronger signal could be observed in the warm bath (lower left warm and lower right cold)

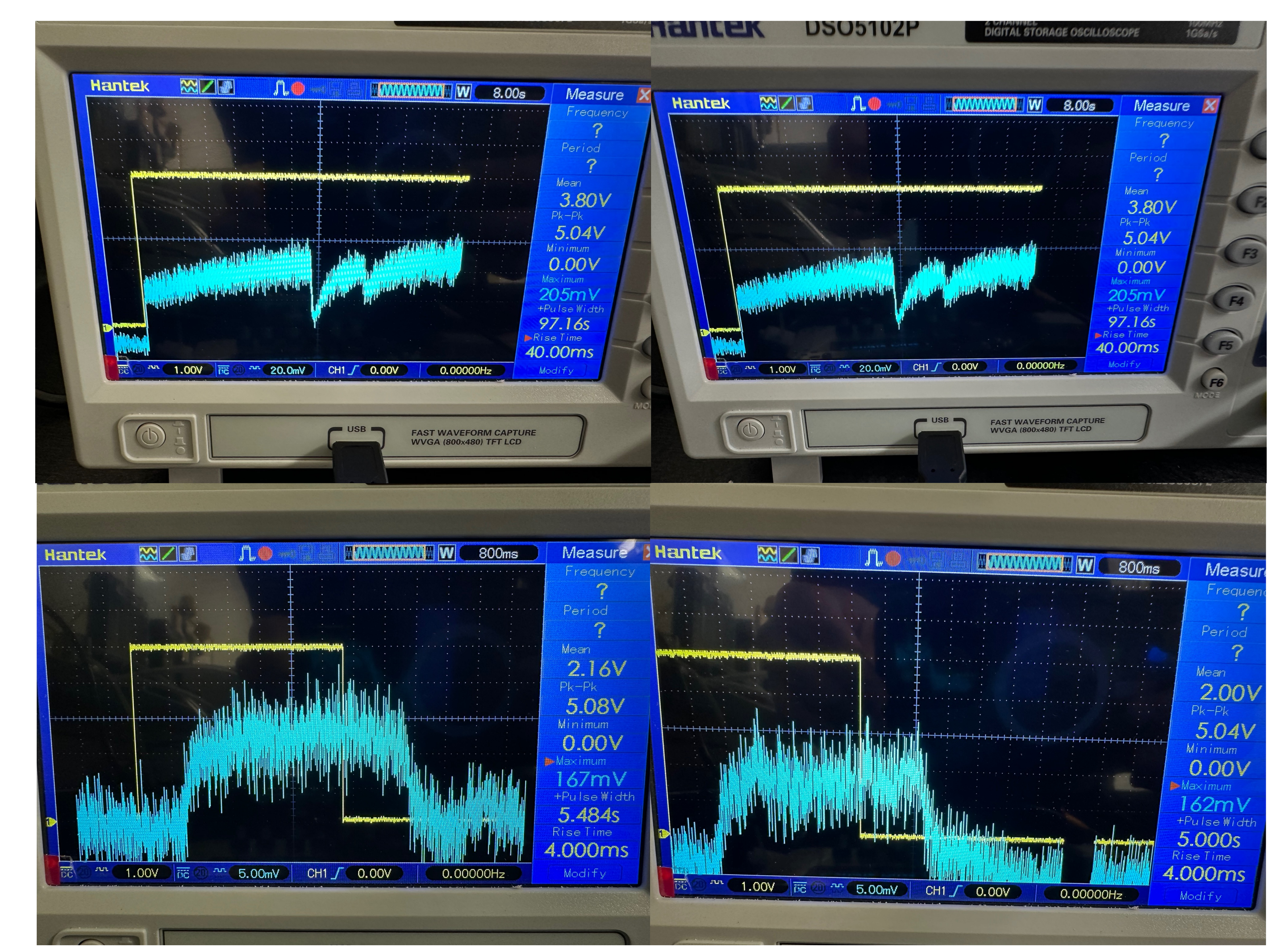


Figure 1.4 - 1.7 Oscilloscope Screen Captures from Photoionization Detector

## Conclusion:

- The current hypothesis explaining the decrease in signal is the temperature drop from the ice bath causes a significant decrease in air volume within the odor vial and tubing, temporarily reducing flow rate until the pump adjusts for the pressure loss.
- Further research is needed to confirm if the temperature change directly causes the volume decrease and to explore designs for an olfactometer that can compensate for such drops in flow rate and maintain accurate sensing.