Executive Summary:
The aim of the UCI AirCore Team is to design and create a payload that is able to sample air at different altitudes between sea level and 10,000 feet above sea level. The main objective of the AirCore system is to compare CH₄ concentrations of the air samples from varying altitudes. This is accomplished by using a CubeSat design with a sectioned coil storage system. The data collected will provide valuable information into the carbon profile and exchanges within the atmosphere.

Objectives:
- A CubeSat-structure that houses all components of the system while protecting it from the forces experienced during flight and other environmental factors.
- An avionics subsystem aimed to collect flight data and control the valve conditions to fill air appropriately.
- A CH₄ analyzing mechanism that is able to easily connect the AirCore tube and inject the sampled air to the commercial analyzer and yield a valid CH₄ concentration readings

Major Requirements:
- The AirCore must be at least 4 Kg
- The AirCore must be a CubeSat Shape
- The AirCore must at least be 3Us
- The AirCore must contain 4 different samples
- The AirCore must store 0.4 L of Air
- The AirCore must test CH4 ppm
- The AirCore must handle -4C to 47C

Shortcomings:
- Was able to only measure CH4 levels in the atmosphere
- Left out the other planned atmospheric measurements of CO2 and CO

Future Improvements:
- Develop real-time monitoring of air samples
- Provide a continuous vertical profile of atmospheric concentrations

Analysis:
Flow Rate based on Altitude:
Bernoulli’s Equation: \( Q = \frac{A \sqrt{(P_1 - P_2)}}{\gamma} \)
The Orifice Equation: \( P_2 = \frac{V^2}{2g} + P_1 \)
- Inlet Velocity: 0.0397 m/s
- Inlet Flow Rate: 0.09 L/s
- Time to fill one sample: 1.11 s

Air Sample Calculations:
Volume Equation: \( V = \frac{m}{\rho} \)
- \( V = 35.325 \text{ cm}^3 \), 0.579 L

Key Features:
- Valve System
- Storage System
- Microcontroller
- Power System
- Data Storage System
- Sensor System

Reference:

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