Ionization Reducing PM 2.5 in a Swine Barn
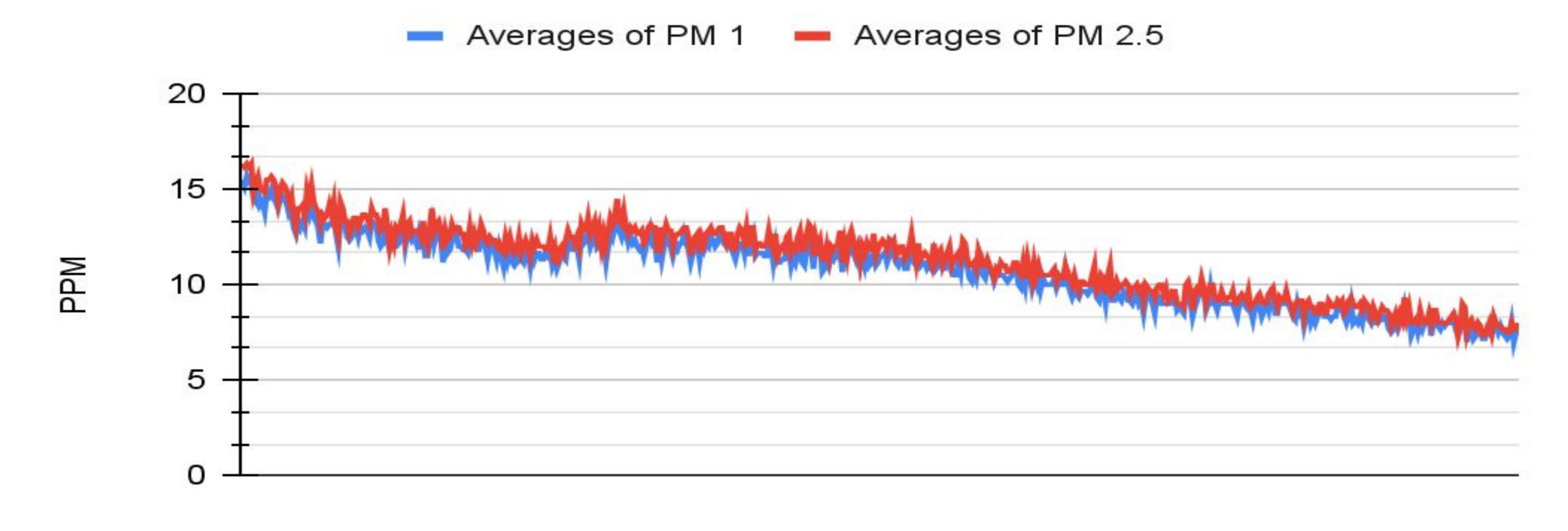
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Question

Can you leverage ionization to drive down PM 2.5 in an indoor swine barn?

Background Information

Particulate Matter 2.5 μm in size (PM2.5) can be various types of solid or liquid matter in the air. PM2.5 exposure can be harmful because the particles are small enough to enter your body and could cause various issues, the most common being respiratory and cardiovascular system related issues. Exposure to PM 2.5 at or under 12 μg/m3 is considered healthy, anything above 35μg/m3 is considered unhealthy.[1]

Ionization is the process of an atom becoming an ion, to do this the atom needs to either gain or lose an electron. A positively charged ion is called a cation, a negatively charged ion is called an anion. Ionization is commonly used in smoke detectors and to reduce PM in a process called agglomeration. During agglomeration, the ions bind to the PM in the air to make it larger. Once the particles are larger they get caught into air filters or possibly fall out of the air. Think of a snowball rolling down a hill, as it rolls down the snow sticks to it and it gets larger. [2]

Hypothesis

My hypothesis is that the ionizer will overall reduce the PM 2.5 in the swine barn.

Method

The two main reasons I chose the swine barn are, swine barns are notoriously dirty and the tools I needed were already installed, I just needed them active so that I could start compiling data. The three tools being used are, positive and negative ion generators, and a Sen44 sensor to take my readings. The generators create Hydrogen ions that bind to the PM and the sensor takes a reading of the PM 1 and PM 2.5 in the air every ten seconds. The sensor (Figure 3) along with and both ionizers (Figure 2) are placed inside of the indoor swine barn. The positive and negative ion generators are placed around the facility in a way that leverages the ventilation system that is already installed. The main controls I have in place is the ventilation, the amount of ions being produced and the positive and negative ion ratio, which is set to 16,000 anions/cc and 8,000 cations/cc. The independent variable is the ions being produced, whereas the dependent variables are humidity and PM in the air.

Averages of PM 1 and PM 2.5

Figure 1

Results & Conclusions

Over the course of 9 hours, I saw about a 50% reduction in PM 2.5 and PM 1, this shows a correlation between the generators and reducing PM 2.5. This information supports my hypothesis, however there are a few factors that could have affected the result. For example, feeding times and activities of the swine could cause spikes and drops in the data. There could also be electrical interference from nearby devices into the sensor, but due to the placement of the sensor that is unlikely. For future experiments, I would most likely run a longer trial of the swine barn and include data from other environments as well.

References

[1] Fine Particles (PM 2.5) Questions and Answers - https://www.health.ny.gov/environmental/indoors/air/pmq_a.htm#:~:text=What%20is%20Particulate%20Matter%202.5,unit%20of%20measurement%20for%20distance.
- Revised: February 2018
- Accessed: 3/31/23
[2] Information on Ionization https://www.iaq-cpr.com/

Figure 2

Figure 3