

Solution to Pollution: Neutralization and Filtration of Ambient Air Pollution

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Introduction/Background

Environmental concerns have widely developed, especially as a concern in the 21st century, due to the constant dependency on fossil fuels and factory systems that govern the manufacturing of technological innovations. In today's world, pollution ranks in the top 5 of the world's biggest problems. In order to tackle this issue, the Environmental Protection Agency (EPA) (www.epa.gov) have developed the Clean Air Act in order to regulate airborne contaminants that prove hazardous to both humans and the environment. In the Clean Air Act, there are six distinguished pollutants which are most commonly found in the air; these include: Ozone, Particulate Matter, Carbon Monoxide, Nitrogen Oxides, Sulfur Dioxides, and Lead. In El Paso, Texas, the air quality remains moderate, but this research project is aimed at not only benefiting El Paso, but to go on and contribute to improved air quality worldwide. In the Clean Air Act, that are part of the environment of the border population and the Asarco factory that once was instrumental in the area, has shed much pollution that contributes to that of the city. Through research and investigations studied in respects to environmental pollution, a resource we considered when approaching the solution at a local level was Dr. Roosegaarde, a Dutch innovator and artist who uses his talents to create a greener world. While in Beijing, China, Dr. Roosegaarde was inspired to create a product that could clear the air of the dark haze that masked the city, this creation became known as the Smog Vacuum. The vacuum works by using high-voltage, low-amp electricity to create an electrostatic field which gives particles a positive charge and then draws them to a grounded electrode. Inspired by Roosegaarde's Smog Vacuum, an approach has been sequenced to develop a product that could clear the air of the dark haze that are found in the pollutants, or that can filter out the detrimental elements. The design and construction of the product is to be determined after analyzing the composition of air samples that include the major pollutants found in the El Paso air and forming a solution to obliterating or minimizing the pollution. This solution is predicted to be either a substance that can neutralize through the correcting of ions, compounds, and molecules or an apparatus capable of filtering out the undesired elements.

Objective/Significance

The objective of this experiment is to further research the composition of ambient air pollution, and to provide a potential solution to decrease it. Understanding that air pollution is dramatically increasing over the past years, it is harming not only us humans, but the environment itself. Threatening emissions from factories and fuel-producing vehicles continue to destroy the environment all while posing health risks. The task at hand is to hopefully create a product that can filter and neutralize the elements of outdoor air pollution, possibly preventing further deterioration of the environment due to pollution. Air pollution is shown to be extremely harmful to both our respiratory system and cardiovascular systems as various pollutants can attack the lungs which in turn lead to inflammation that spills over to blood vessels. Removing air pollution dramatically increases human health and creates a better atmosphere which is incredibly significant to every living being on Earth; for safer, more breathable air. Achieving this contribution proves significant as cleaner air is not only favorable toward health, but also in preventing acidification, eutrophication, and ground-level ozone which involve the formation of acid rain, infiltration of soil, and the damage to vegetation. If outdoor air pollution can be managed, then both humans and the environment would reap numerous benefits.

Hypothesis

In recent observation of the increasing levels of PM and ground ozone in El Paso, Texas, the development of a chemical substance by distribution through an air filtration system leads as a prospect to solving air pollution, by which we will be able to neutralize ambient air pollution to minimize or resolve it entirely. The product is expected to work by having the solution to interact with pollutants found in the air substances, neutralize it through a chemical reaction among compounds, and having a machine that ultimately filters the air. If the product proves attainable, then effects of pollution (such as smog and health hazards) will decrease.

Thesis

The goal of this research is to understand the properties of criteria pollutants and to create a product that can filter or neutralize ambient air pollution.

Specific Student Responsibilities

Each student is responsible for the researching of air composition, the analyzing of air samples, and creating and designing of a final product under the guidance of my professor, Dr. Jacen Moore. Throughout experimentation, I am also responsible for ensuring consistent execution of procedures, careful organization of data, and original calculation in order to maintain reliable and valid data. Through this project, I will learn the elements behind environmental science and the process of engineering for the final project. We also gain first hand experience in conducting laboratory work, including analyzing air samples as well as developing and creating a final product.

Materials

Before creating a product, the main materials needed are charcoal, sand, and diatomaceous earth in creating the filter necessary to remove particulate matter and biological pollutants. In concrete part of the product, vacuum tanks, valves, and metal frames will be used as the main materials to be used as the respiratory device. In combination with water and an electric current. Plants will be used to observe the effects of the product in the process of photosynthesis.

Product Creation (Engineering Process)

- Draft
- Test
- Prototype:
- Test and Redesign

- Capability to consider the capacity of the filter by the pressure drop across the sample utilized in the trial.
- Calculations are done respectively to the bias and precision in terms of the concentration of gradient in each filter. By which they're categorized as measured concentrations that are unknown, but estimates are derived in a ratio of the size to concentration.

Methods

Project Timeline

The project period is 5 weeks. List of tasks per week:

- Week 1 (June 22- June 28):**
 - Collaborations with several professors and graduate students to develop self-sufficiency of the system
 - Reverse engineer air purifier
 - Develop the composition of the filters
 - Include photo remediation in the system
- Week 2 (June 29- July 3):**
 - Draft and begin prototype creations:
 - In having analyzed and reached a thorough understanding of the chemical composition of the air samples collected, we will begin the development of receiving the natural air of the environment while successfully adding the solvent with the air molecules and pollutants to cause a chemical reaction that will neutralize them, then expelling clean air that can no longer be categorized as detrimental to the environment and to humans. We will have to be able to fully comprehend the fundamental concepts and factors that contribute to ionic air purifiers, the application of an electrostatic field, and the vacuum tube components, learning the structures will enable us to construct the prototype utilizing the critical parts of each system to collect the pollutant compounds and molecules that become collected by ionizing them, and expelling those molecules onto the environment.
- Week 3 (July 6- July 10):**
 - Redesign with improvements
 - Design must successfully:
 - Take in air
 - Release the filtered air back into the environment
 - Test
 - Take an air sample from a specific location
 - Run the prototypes for 5 minute increments (5, 10, 15, 20, etc)
 - Retake samples at the end of every interval
 - Analyze samples for air element and particle composition
 - Repeat if necessary
 - Make necessary changes to achieve results
- Week 4 (July 13- July 17):**
 - Modifications
- Week 5 (July 20- July 24):**
 - Continue changes and redesigning with improvements
 - Make energy efficient if possible
 - Product should emit a relatively low amount of pollution or run only off of clean energy
 - Product should be made of reasonably priced materials

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