Particle Air Pollution In Developing Countries

Author: Claire Qiao[1], Charles Hashem[2]
Palo Alto High School[1], Lockheed Martin[2]

INTRODUCTION

Air pollution is a global issue that affects widely differing areas and communities. While there are many forms of air pollution, one commonality that is seen between them is particulate pollution. Filtering this type of pollution presents researchers with tough challenges. These challenges are not only technical, but also economic in nature. Within this study a cutting edge air purification technology and methodology developed by Stanford will be investigated for use in a novel air filtration system. The system presented will be targeted for use in developing areas. Key requirements addressed will be modularity, affordability, ease of use, and performance. Our goal is an affordable multi-use system that will not completely mitigate air pollution, as that is not as economically feasible in developing areas. Instead the system will attempt to lower harmful particulate levels in localized areas down to a more manageable level.

BACKGROUND AND SIGNIFICANCE

- Numerous air pollution problems occur in low income countries that are not seen in wealthier nations. One such problem is an increase in mortality rates that can be directly correlated to air quality. Within these populations the result of long term, consistent exposure creates a much higher risk of respiratory diseases that can occur at any time of one's life. Our research aims to create something that can help mitigate indoor air pollution in homes leading to a cleaner environment for those living in these developing areas.
- Research on filtration techniques is extensive, but engineering solutions implementing the laboratory findings are not. It is well known that air pollution is a problem, but little has been done to implement localized, affordable, indoor solutions on a widespread scale. Air purifiers exist, however the cost is prohibitive in low income areas.
- Currently, there are simple indoor air purifiers that are made to combat allergies, large particulates (50-70 microns), but not purifiers that can filter out particulate pollution at <10 microns. Technology has existed for some time that can do so, but not at a low price point (i.e.: prohibitive to widespread use, even in developed nations).
- The research at Stanford is quite exciting, as it opens up doors for an affordable sub 10 micron indoor filtration system. Furthermore, this research provides valuable insight into problems that occur behind behind the scenes. Forward thinking in this regard is incredibly important because everyday we consume energy that releases toxic gasses into the atmosphere which as a result, leads to sickness and increased mortality rates. The goal is to help create something practical, affordable, and simple that can help mitigate indoor air pollution threats for people in areas that traditionally could not afford such luxuries.

DATA ANALYSIS AND DESIGN

STANFORD FILTER

- Polymer nanofiber filter technology
  - High filtering efficiency and 90% + optical transparency
  - Low resistance to airflow and low weight
- Production
  - Utilizes common metal screening and a simple electrospinning process

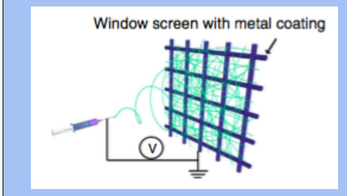


Figure 1: Electroscreening process

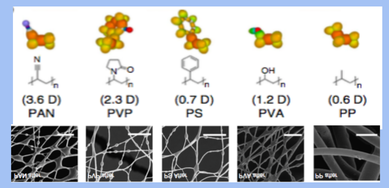


Figure 2: Polymer material selection and results

- Cost scaling potential via polymer material selection
- Various polymer results at 2.5 and 10 micron levels

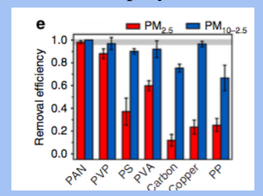
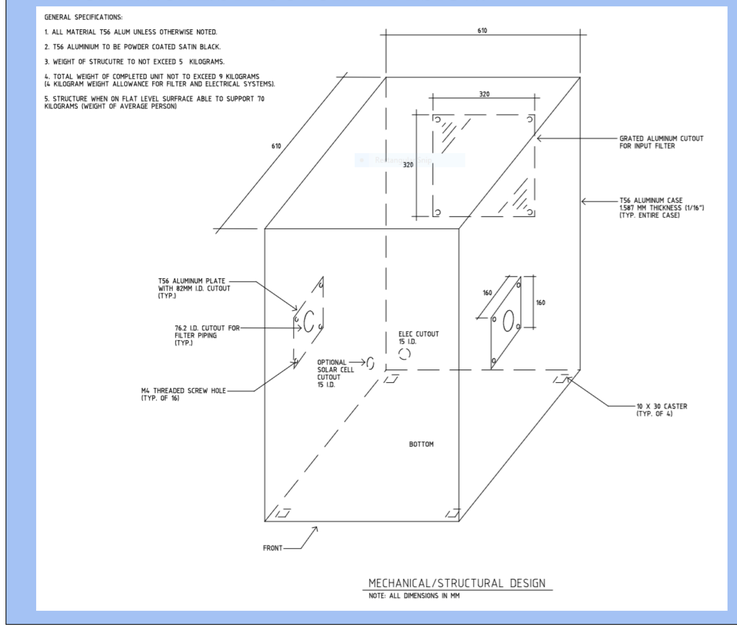


Figure 3: Polymer filtration efficiencies at 2.5 and 10 micron

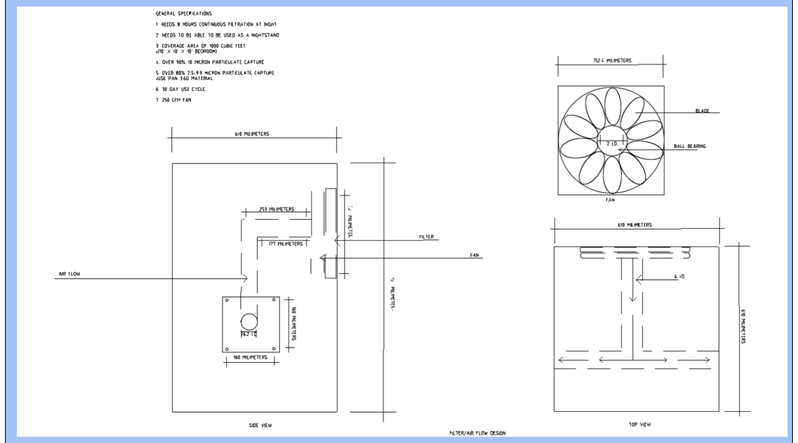
Figure 4: Stanford Laboratory Set-up

MECHANICAL/STRUCTURAL DESIGN:

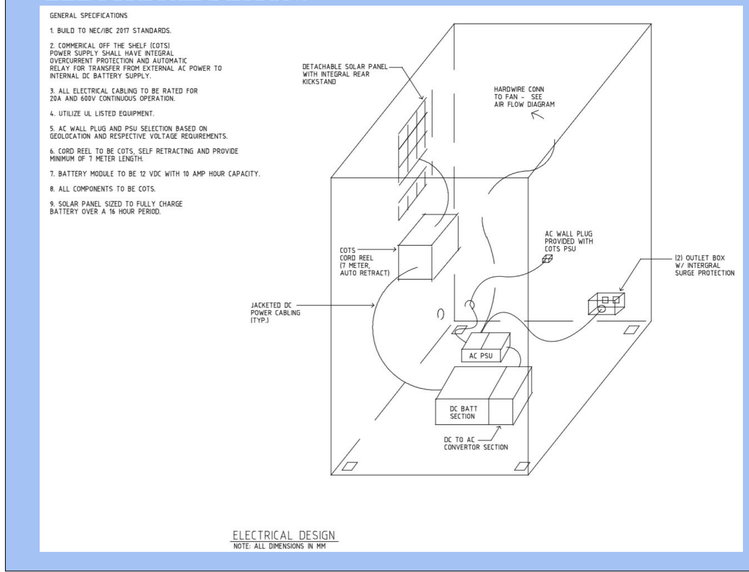


DESIGN CONTINUED

OPERATIONAL/AIR FILTER DESIGN:



ELECTRICAL DESIGN:



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