

SENIOR DESIGN PROJECT: LOW COST FILTRATION 2 ABSTRACT

The purpose of this group project was to build an air filtration system that is both highly effective and less costly than most commercially available options. An air filtration system is a device essential to cleanse the air of contaminants and other particulates. There are two primary categories of air filtration systems, portable air purifiers and HVAC filters. Portable air cleaners have the flexibility of being positioned at any desired location within a single room, and commonly use fibrous media to remove particulates. The efficiency of the removal of fibrous media efficiency is indicated by the Minimum Efficiency Reporting Values (MERV) rating, which is a standard set forth by ASHRAE. This rating specifically refers to the removal of viruses, bacteria, pollen, and water particles down to the size of 1 micron. Water particles 1 micron or larger can allow viruses to attach to the particles, which is why these particles need to be filtered from the air to help minimize the risk of airborne illnesses.

Financially, a household may not be able to afford a high-quality, portable air purifier. This research was performed in order to design and choose an air filtration system that filters particulates down to the size of 1 micron, but that the average consumer can purchase at under \$100, as well as to build suggested system and prove through physically and analytically testing it to be efficient and effective in the average American home. This do-it-yourself and portable air purifier on a budget includes two filters, a box fan, and duct tape, all of which could be purchased at an average hardware store. Physical performance testing was conducted on prototypes in order to ensure proof of concept and pressure drop is not significant enough to harm the motor in the fan. In addition, analytical models were performed in ANSYS to verify and compare between designs and placement, the frequency of air changes, size and number of dead spaces in typical room sizes, and suggested placement inside the room to maximize results. The final system designed and verified for its results is comprised of two different filters: a prefilter with a low MERV rating and a higher performance MERV 1- rated filter which filters 1-micron sized particles. The apparatus includes the MERV 13 filter to be attached directly to the back of the fan with the lower rated filter applied to the back of the MERV 13 filter by using duct tape. The lower rated filter allows the MERV 13 filter to be used for a longer time period and act as a prefilter to the system that separates hair, dirt, and larger particulates. This testing concluded that the ideal placement of the portable air filtration system is on a table where both the system and table are rotated 45 degrees from the corner of the room. This orientation allows air flow about the middle of the room to be maximized about standing and sitting heights with a reduction of dead spots within the room.