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Your Life Your Health
Pandemic V: Air Quality in Your Home – HEPA Filters
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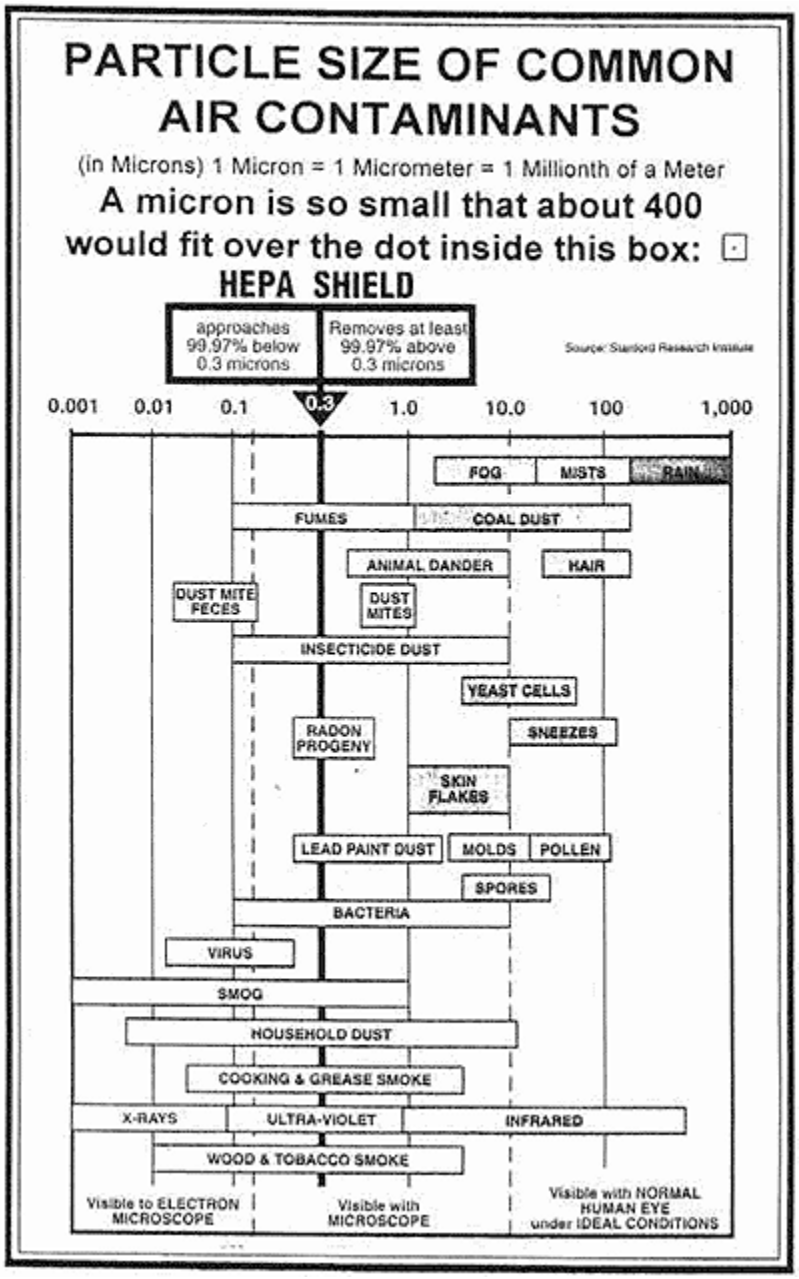
If a pandemic should take place, one of the best ways of protecting your family will be to avoid contact with anyone who is potentially infected. The problem is that a person is contagious for several days before they become symptomatic so it is not enough just to avoid those who are ill. Additionally, if you choose to isolate your family in your home, not allowing anyone to enter until the threat of the pandemic is past, the airborne nature of the virus makes it important to make sure that the air you breath is clear of virus as well. The only way to do that is with an effective air filtration system in your home.

The following table gives you an idea of the size of particles which are commonly circulating in the air you breath. It can give you a good idea of how important a good filter is especially in the face of a circulating particle which can result in your death, i.e., a highly contagious virus such bird flu which has mutated into a form which allows infection from one human to another. The Avian (Bird) Flu virus is 5 microns in size.



HEPA Filters

The only effective air filters for protection against a pandemic is a HEPA Filter. “HEPA” is an acronym which stands for “High Efficiency Particulate Air” or “High Efficiency Particulate Arrestance.” HEPA filters can remove at least 99.97% of airborne particles 0.3 micrometers (μm) in diameter. Particles of this size are the most difficult to filter and are thus considered the *most penetrating particle size* (MPPS). Particles that are larger *or smaller* are filtered with even higher efficiency.

HEPA filters are composed of a mat of randomly arranged fibers. Key metrics affecting function are fiber density and diameter, and filter thickness. The air space between HEPA

filter fibers is much greater than 0.3 μm. The common assumption that a HEPA filter acts like a sieve where particles smaller than the largest opening can pass through is incorrect. Just as for membrane filters, particles so large that they are as wide as the largest opening or distance between fibers cannot pass in between them at all. But HEPA filters are designed to target much smaller pollutants and particles are mainly trapped (they stick to a fiber) by one of the following three mechanisms:

1. *Interception*, where particles following a line of flow in the air stream come within one radius of a fiber and adhere to it.
2. *Impaction*, where larger particles are unable to avoid fibers by following the curving contours of the air stream and are forced to embed in one of them directly; this increases with diminishing fiber separation and higher air flow velocity.
3. *Diffusion*, an enhancing mechanism is a result of the collision with gas molecules by the smallest particles, especially those below 0.1 μm in diameter, which are thereby impeded and delayed in their path through the filter; this behavior is similar to Brownian motion and raises the probability that a particle will be stopped by either of the two mechanisms above; it becomes dominant at lower air flow velocities.

Diffusion predominates below the 0.1 μm diameter particle size. Impaction and interception predominate above 0.4 μm. In between, near the 0.3 μm MPPS, diffusion and interception predominate.

History

The original HEPA filter was designed in the 1940s and was used in the Manhattan Project to prevent the spread of airborne radioactive contaminants. It was commercialized in the 1950s, and the original term became a registered trademark and a generic term for highly efficient filters. Over the decades filters have evolved to satisfy the higher and higher demands for air quality in various high technology industries, such as aerospace, pharmaceutical processing, hospitals, health care, nuclear fuels, nuclear power, and electronic microcircuitry (computer chips).

Biomedical Application

HEPA filters are critical in the prevention of the spread of airborne bacterial and viral organisms and, therefore, infection. Typically, medical-use HEPA filtration systems also incorporate high-energy ultra-violet light units to kill off the live bacteria and viruses trapped by the filter media. Some of the best-rated HEPA units have an efficiency rating of 99.995%, which assures a very high level of protection against airborne disease transmission.

Vacuum Cleaners

Many vacuum cleaners also use HEPA filters as part of their filtration systems. This is beneficial for asthma and allergy sufferers, because the HEPA filter traps the fine particles (such as pollen and dust mite feces which trigger allergy and asthma symptoms. For a HEPA filter in a vacuum cleaner to be effective, the vacuum cleaner must be designed so that all the air drawn into the machine is expelled through the filter, with none of the air leaking past it. Also, because of the extra density of a HEPA filter, the vacuum cleaner requires a more powerful motor to provide adequate cleaning power.

Residential Indoor Air Quality Problems

Indoor air quality problems can be found in any building whether it is residential or commercial in design. For the most part, all occupied spaces use heating/cooling systems to control the environment. Some spaces have more people per square foot than others, but overall they all share similar issues when it comes to Indoor Air Quality problems.

Most indoor air quality problems are associated with four areas: moisture, ventilation (or lack thereof), construction and filtration. The amount of moisture in a home is controlled by a couple of factors. One, the general humidity levels in the area and two, the amount of cooling (air conditioning) that is done in the home. If the home is located in a high humidity area of the country, then more air conditioning is needed to condense the water out of the air and provide cooler, dryer air. If cooling is inadequate or if the construction of the home is such that condensation forms on the walls, the probability of having mold grow in the home is greater. Where there is moisture (water) there is mold.

Ventilation is comprised of both airflow through the home via the heating/cooling system as well as the introduction of outside air. Construction techniques for today's homes mean they are very, very tight, creating indoor air quality problems. In most cases they will have an air exchange rate of no more than .25 ACH (air changes per hour). The tighter the home the more the CO2 builds up and also more moisture is retained in the environment. The ability to introduce some fresh outside air and to exchange the air in the home at least 1.5 to 3 times per day is essential for proper ventilation and good air quality. Lack of proper ventilation leads to higher concentrations of airborne contaminants as well as increases in concentrations of gases from household chemicals and construction materials.

Construction of the home consists of both the actual building materials, the tightness of the home and the heating/cooling system or mechanical system for proper environmental control. If the heating/cooling system is not properly balanced, it is very possible for the home to be under negative pressure anytime the HVAC fan is running. This significantly impacts the indoor air quality as it allows for the entry of fine particles and gases from the outside to be pulled into the occupied environment. If there is any communication between the attic or the outside and the living space, contaminants will be present if the negative pressure issue is not resolved. Many building materials can be a source of chemical out-gassing and with little ventilation and the negative pressure problems the indoor air quality is severely compromised. Again, mold and bacteria growth are more common in these situations.

The lack of good filtration and ventilation can also add to significant challenges in providing a healthy indoor environment. The air filters that come with any heating/cooling system are primarily just a very light duty fiberglass media or washable sponge type media. In either case, these air filters are designed to ONLY keep the blower/motor assembly clean, resulting in indoor air quality problems. They were never intended filter out small or respirable sized particles, gases or odors for the occupied space. These OEM air filters don't remove any mold or bacteria or any of the fine airborne dust. These air filters are also not appropriate if you are going to introduce outside air through your return air duct.

Pure Air Systems – what is available and what will it cost

This is not a commercial for a particular manufacture but an illustration of what is available and what it will cost to improve the air quality in your home and to protect your family in the event of a pandemic. These air filters will cost about $1500 per unit plus the cost of installing them. You will need one HEPA filer for each air conditioning unit you have in your home. These systems have three different filters which need to be changed at a frequency of three months for one of the filters, twelve months for another filer and three years for the HEPA filter.

There are three main HEPA indoor air purifier model families sold by Pure Air Systems: the HEPA Model 600HS, the HEPA Model 1200HS, and the HEPA Model 2000HS. All of the models come in the “L” configuration for vertical applications, such as when sitting in a utility closet and the “S” configuration for horizontal applications, such as when an attic installation is required. All three systems give the same TRUE HEPA filtration and are different only by their size and the amount of air they will filter.

The system that is right for you depends on the size of the area you are filtering. Generally, the 600HS is for areas up to 3000 square feet, the 1200HS for areas 3000 – 4000 square feet and the 2000HS for areas greater than 4000 square feet.

- HEPA 600 Series (600 CFM) The FIRST Whole-House HEPA Filtration System. . . And The LAST System You'll Ever Need. The series includes the 600 HEPA Shield, the first whole-house TRUE HEPA filtration system. By utilizing the efficiency of the HEPA indoor air purifiers, the HEPA 600HS has adopted the same filtration effectiveness as required in hospital surgery rooms, clean rooms and other applications where the removal of harmful respirable particles (less than 1 micron in size) are necessary.

- HEPA 1200 Series (1200 CFM) has a BIGGER capacity for BIGGER applications. In 1999 Pure Air Systems introduced the versatile HEPA Model 1200HS indoor air filtration series. Like all of our systems, the 1200 comes in two ducting configurations. In the original 1200HS-S the unit is horizontal; the air enters from the left side and exits out the right. In the 1200HS-L model, the unit sits upright and the air follows the traditional L-pattern in which it enters from the one end, makes a 90 degree turn, and exits from the side. The HEPA indoor air purifiers system can also be configured for purposes of gas and odor adsorption in the 1200HS-OA models.

- HEPA 2000 Series (2000 CFM) has our LARGEST capacity for the TOUGHEST applications. Since its introduction the HEPA 2000HS series is rapidly becoming the system contractors are using for their most essential applications. In addition to the original and OA models, the HEPA 2000 system is available in either the single piece, horizontal S-design or the two piece L-design configurations.
- Pure Air Systems introduces a new commercial quality, portable air filtration system with true HEPA filtration. Pure Air Systems' new portable system is ideal for apartments, condominiums or recreational vehicles or any place that good air quality is wanted, yet there may not be the room available for a quality whole house air filtration system.

More information about these systems can be found at www.pureairsystems.com.

It is possible to survive a pandemic, it will take planning and resources, but it can be done. Remember, it is your life and it is your health.