SHEPROS®

Safety, Heath & Environment Product Solutions

High Performance Air Purifier for Particulate Matter, Odors, VOCs, Germs, Photochemical Smog and Ionizing Radiation

SHEPROS AIR PURIFIER

THE HIGH PERFORMANCE AIR PURIFIER

SHEPROS Sdn. Bhd.

An Alliance of SHEPROS International (USA) LLC.

An Introduction to Indoor Air Quality (IAQ)

What Causes Indoor Air Problems?

Indoor pollution sources that release gases or particles into the air are the primary cause of indoor air quality problems in homes. Inadequate ventilation can increase indoor pollutant levels by not bringing in enough outdoor air to dilute emissions from indoor sources and by not carrying indoor air pollutants out of the home. High temperature and humidity levels can also increase concentrations of some pollutants.

Indoor Air Pollution and Health

Health effects from indoor air pollutants may be experienced soon after exposure or, possibly, years later.

Immediate effects

Immediate effects may show up after a single exposure or repeated exposures. These include irritation of the eyes, nose, and throat, headaches, dizziness, and fatigue. Such immediate effects are usually short-term and treatable. Sometimes the treatment is simply eliminating the person's exposure to the source of the pollution, if it can be identified. Symptoms of some diseases, including asthma, hypersensitivity pneumonitis, and humidifier fever, may also show up soon after exposure to some indoor air pollutants.
The likelihood of immediate reactions to indoor air pollutants depends on several factors. Age and preexisting medical conditions are two important influences. In other cases, whether a person reacts to a pollutant depends on individual sensitivity, which varies tremendously from person to person. Some people can become sensitized to biological pollutants after repeated exposures, and it appears that some people can become sensitized to chemical pollutants as well.

Certain immediate effects are similar to those from colds or other viral diseases, so it is often difficult to determine if the symptoms are a result of exposure to indoor air pollution. For this reason, it is important to pay attention to the time and place symptoms occur. If the symptoms fade or go away when a person is away from home, for example, an effort should be made to identify indoor air sources that may be possible causes. Some effects may be made worse by an inadequate supply of outdoor air or from the heating, cooling, or humidity conditions prevalent in the home.

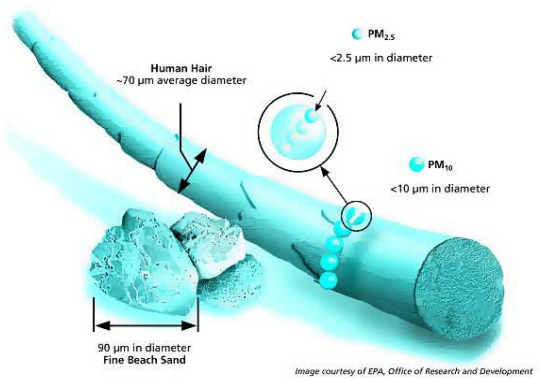
Long-term effects

Other health effects may show up either years after exposure has occurred or only after long or repeated periods of exposure. These effects, which include some respiratory diseases, heart disease, and cancer, can be severely debilitating or fatal. It is prudent to try to improve the indoor air quality in your home even if symptoms are not noticeable.

While pollutants commonly found in indoor air are responsible for many harmful effects, there is considerable uncertainty about what concentrations or periods of exposure are necessary to produce specific health problems. People also react very differently to exposure to indoor air pollutants. Further research is needed to better understand which health effects occur after exposure to the average pollutant concentrations found in homes and which occurs from the higher concentrations that occur for short periods of time.

Basic Information on Pollutants and Sources of Indoor Air Pollution

Particulate Matter



Particle pollution (also called particulate matter or PM) is the term for a mixture of solid particles and liquid droplets found in the air. Some particles, such as dust, dirt, soot, or smoke, are large or dark enough to be seen with the naked eye. Others are so small that they can only be detected using an electron microscope.

Particle pollution includes "inhalable coarse particles," with diameters larger than 2.5 micrometers and smaller than 10 micrometers and "fine particles," with diameters that are 2.5 micrometers and smaller. How small is 2.5 micrometers? Think about a single hair from your head. The average human hair is about 70 micrometers in diameter – making it 30 times larger than the largest fine particle. These particles come in many sizes and shapes and can be made up of hundreds of different chemicals. Some particles, known as *primary particles* are emitted directly from a source, such as construction sites, unpaved roads, fields, smokestacks or fires. Others form in complicated reactions in the atmosphere of chemicals such as sulfur dioxides and nitrogen oxides that are emitted from power plants, industries and automobiles. These particles, known as *secondary particles*, make up most of the fine particle pollution.

Particle pollution - especially fine particles - contains microscopic solids or liquid droplets that are so small that they can get deep into the lungs and cause serious health problems. Numerous scientific studies have linked particle pollution exposure to a variety of problems, including:

- increased respiratory symptoms, such as irritation of the airways, coughing, or difficulty breathing, for example;
- decreased lung function;
- aggravated asthma;
- development of chronic bronchitis;
- irregular heartbeat;

- nonfatal heart attacks; and
- premature death in people with heart or lung disease.

People with heart or lung diseases, children and older adults are the most likely to be affected by particle pollution exposure. However, even if you are healthy, you may experience temporary symptoms from exposure to elevated levels of particle pollution.

Volatile Organic Compounds (VOCs)

Volatile organic compounds (VOCs) are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects. Concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors. VOCs are emitted by a wide array of products numbering in the thousands. Examples include: paints and lacquers, paint strippers, cleaning supplies, pesticides, building materials and furnishings, office equipment such as copiers and printers, correction fluids and carbonless copy paper, graphics and craft materials including glues and adhesives, permanent markers, and photographic solutions.

Organic chemicals are widely used as ingredients in household products. Paints, varnishes, and wax all contain organic solvents, as do many cleaning, disinfecting, cosmetic, degreasing, and hobby products. Fuels are made up of organic chemicals. All of these products can release organic compounds while you are using them, and, to some degree, when they are stored.

Household Cleaners

Glues and Adhesives

Paints

Odors

An odor is commonly referred to as a smell. It is caused by one or more volatilized chemical compounds, generally at a very low concentration, that humans or other animals perceive by the sense of olfaction. Odors are also commonly called scents, which can refer to both pleasant and unpleasant odors. The terms fragrance and aroma are used primarily by the food and cosmetic industry to describe a pleasant odor, and are sometimes used to refer to perfumes. In contrast, malodor, stench, reek, and stink are used specifically to describe unpleasant odors.



Cigarette Smoke | Body Odor | Cooking Odor

Biological Pollutants

These biological chemicals can arise from a host of means, but there are two common classes: (a) moisture induced growth of mold colonies and (b) natural substances released into the air such as animal dander and plant pollen. Moisture buildup inside buildings may arise from water penetrating compromised areas of the building envelope or skin, from plumbing leaks, from condensation due to improper ventilation, or from ground moisture penetrating a building part. The primary hazard of mold growth, as it relates to indoor air quality, comes from the allergenic properties of the spore cell wall. More serious than most allergenic properties is the ability of mold to trigger episodes in persons that already have asthma, a serious respiratory disease.

Legionellosis or Legionnaire's Disease is caused by a waterborne bacterium *Legionella* that grows best in slow-moving or still, warm water. The primary route of exposure is aerosolization, most commonly from evaporative cooling towers or showerheads. A common source of Legionella in commercial buildings is from poorly placed or maintained evaporative cooling towers, which often release aerosolized water that may enter nearby ventilation intakes. Outbreaks in medical facilities and nursing homes, where patients are immuno-suppressed and immuno-weak, are the most commonly reported cases of Legionellosis. More than one case has involved outdoor fountains in public attractions. The presence of Legionella in commercial building water supplies is highly under-reported, as healthy people require heavy exposure to acquire infection.

Photochemical Smog

Photochemical smog (or just smog for short) is a term used to describe air pollution that is a result of the interaction of sunlight with certain chemicals in the atmosphere. It is the chemical reaction of sunlight, nitrogen oxides and volatile organic compounds in the atmosphere, which leaves airborne particles and ground-level ozone. One of the primary components of photochemical smog is ozone. While ozone in the stratosphere protects earth from harmful UV radiation, ozone on the ground is hazardous to human health. Ground-level ozone is formed when vehicle emissions containing nitrogen oxides (primarily from vehicle exhaust) and volatile organic compounds (from paints, solvents, and fuel evaporation) interact in the presence of sunlight. Therefore, some of the sunniest cities are also some of the most polluted.

This noxious mixture of air pollutants can include the following:

Aldehydes - *Example: formaldehyde and acetaldehyde*

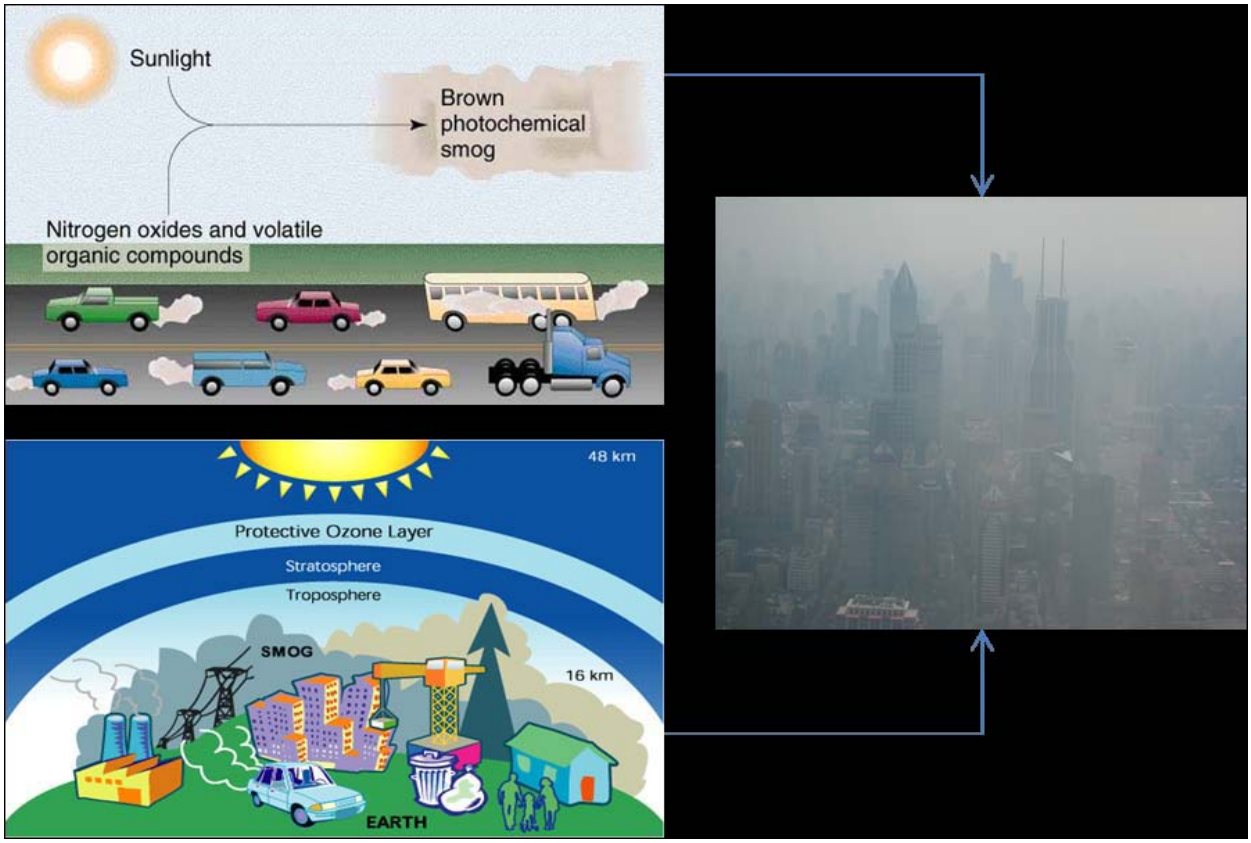
Nitrogen oxides - *Example: nitrogen dioxide*

Peroxyacyl nitrates - *Powerful respiratory and eye irritants*

Tropospheric ozone - *Greenhouse gas and initiates the chemical removal of methane and other hydrocarbons from the atmosphere.*

Volatile organic compounds - *Organic chemicals that have a high vapor pressure at ordinary, room-temperature conditions*

All of these chemicals are usually highly reactive and oxidizing. Photochemical smog is therefore considered to be a problem of modern industrialization. It is present in all modern cities, but it is more common in cities with sunny, warm, dry climates and a large number of motor vehicles. Because it travels with the wind, it can affect sparsely populated areas as well.



Photochemical Smog Formation

Ionizing Radiation

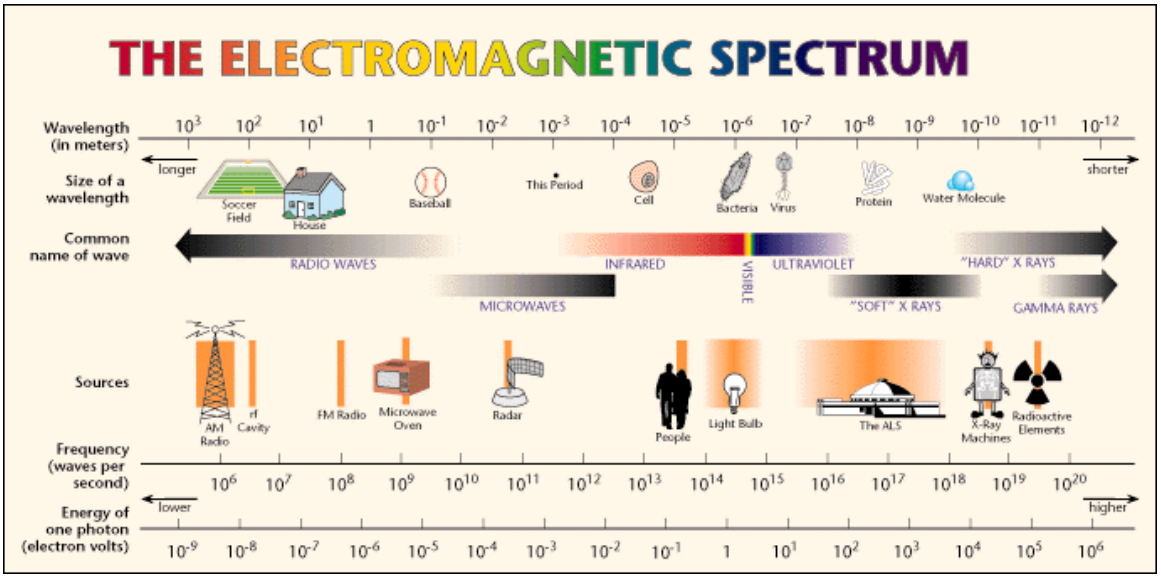
Higher frequency ultraviolet radiation begins to have enough energy to break chemical bonds. X-ray and gamma ray radiation, which are at the upper end of magnetic radiation have very high frequency --in the range of 100 billion Hertz--and very short wavelengths--1 million millionth of a meter. Radiation in this range has extremely high energy. It has enough energy to strip off electrons or, in the case of very high-energy radiation, break up the nucleus of atoms.

Ionization is the process in which a charged portion of a molecule (usually an electron) is given enough energy to break away from the atom. This process results in the formation of two charged particles or ions: the molecule with a net positive charge, and the free electron with a negative charge.

Each ionization releases approximately 33 electron volts (eV) of energy. Material surrounding the atom absorbs the energy. Compared to other types of radiation that may be absorbed, ionizing radiation deposits a large amount of energy into a small area. In fact, the 33 eV from one ionization is more than enough energy to disrupt the chemical bond between two carbon atoms. All ionizing radiation is capable, directly or indirectly, of removing electrons from most molecules.

There are three main kinds of ionizing radiation:

- alpha particles, which include two protons and two neutrons
- beta particles, which are essentially electrons
- gamma rays and x-rays, which are pure energy (photons).



Types and Sources of Radiation

The Importance of Air Purifiers

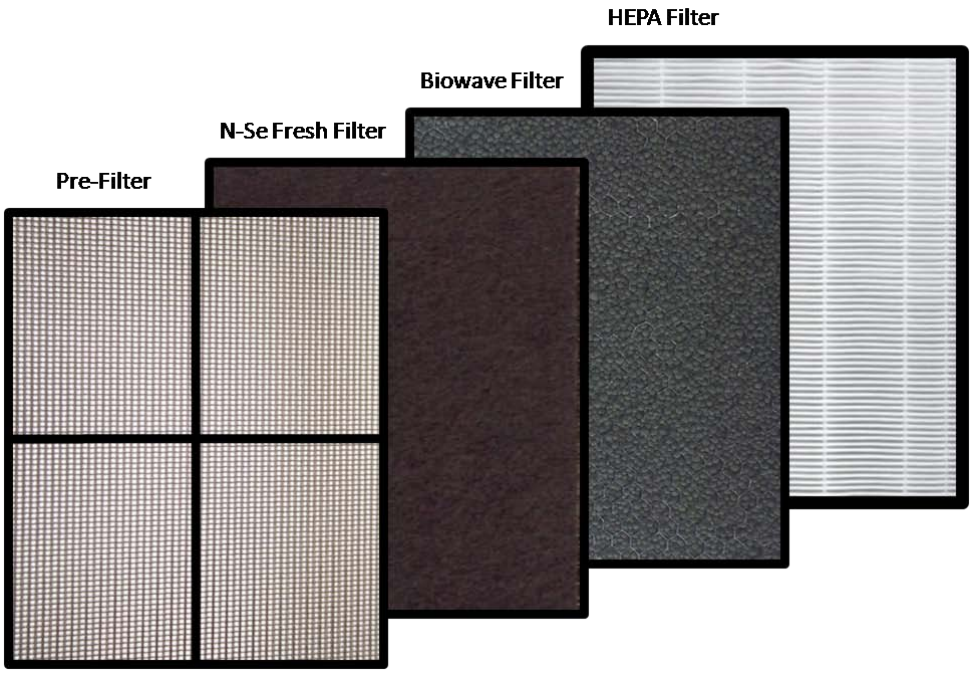
Pollution has become a wide topic of discussion nowadays. Research has shown that day by day the ratio of pollution is increasing. Air, which is a natural gift and necessity of living beings, is no more clean and pure. Outdoor air is full of germs and pollutions. It would not be wrong to say that now to breathe outdoor is to inhale air contaminated with germs and pollution. The remedy to this problem is to use a device that ensures clean air, free of germs, bacteria, volatile gases, pet dander, smog, radon gas and many more. Only an air purifier is the solution for this general problem.

The next thing that would come to mind is that why to spend money on a device that provides you fresh air, when this result can be achieved by keeping house clean and tidy. Yes! Keeping or maintaining the house properly can be a solution but invisible germs and bacteria cannot be tracked down by cleaning unless a device works for this special purpose. Air purifier keeps your indoor air free of hazardous pollution and invisible germs that can later on cause serious health issues. Therefore, buying an air purifier is not wastage of money but it actually saves you from spending money on hospital bills.

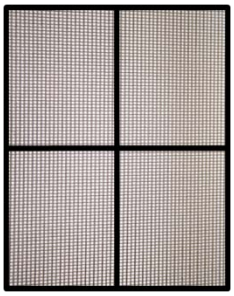
WHY SHEPROS AIR PURIFIER IS THE BEST AIR PURIFIER?

Understanding SHEPROS's Air Purifier Technologies

The best performing air purifier features more than one filtration technology. The combination of Pre-Filter, BIOWAVE Filter, N-Se Fresh Filter and HEPA Filter are the key to optimal results. No other air purifier combines these 4 leading Passive Technologies.



PRE- FILTER



The pre-filter is used to keep large particles and debris from entering the air purifier. This could include hair, dust, pet fur, and other larger particles. Without a pre-filter these larger particles would clog HEPA or other filters faster and causes them to be less effective. The pre-filter keeps the inside of the air purifier cleaner and functioning better. The addition of a pre-filter helps minimize cleaning. The pre-filter is reusable and can be vacuumed or rinsed and then put back to work.

N-Se FRESH FILTER

Axena Technologies, with Brown University, has developed a revolutionary decontamination filtration technology that can lead to improved indoor air quality (IAQ). The application of this novel technology in air purification is very efficient for the removal of pathogens, volatile organic compounds (VOCs) and radon contaminants. Normal air filtration systems are at risk for air pathogens growth and are unable to remove VOCs and radon contaminants. These pathogenic microorganisms grow and gain strength on filters and system surfaces, ultimately becoming air-borne and adversely affecting human health and well-being. Killing pathogenic microorganisms and removing VOCs and radon contaminants lead to cleaner indoor air and improved human quality-of-life.

N-Se Fresh Filter is made of 100% activated carbon fabric impregnated with nano selenium filter. It adsorbs a large volume of organic or inorganic molecules from various gases and acts as a high purity filter, a method of separation or as a protective layer. It has a **micro-porous** structure which results in rapid adsorption kinetics and the capability to adsorb to a higher level of purity. Unlike activated carbon filter, N-Se Fresh Filter is suitable for use in applications where there is a high humidity as its adsorption capacity is less adversely affected by moisture.

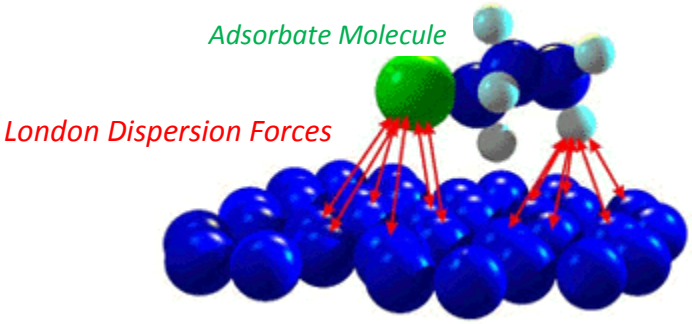
N-Se Fresh Filter – Woven Cloth

What makes molecules adsorb on N-Se Fresh Filter?

Due to its micro-porous structure**,** N-Se Fresh Filter has an extremely large surface area for physical adsorption. To put its capabilities into perspective, just 1 gram of N-Se Fresh Filter cloth has the surface area of over half the size of a football pitch. In simple terms, physical adsorption occurs because all the pore walls within the N-Se Fresh Filter cloth have strong electrostatic forces to attract other gas molecules to adhere to.

N-Se Fresh Filter adsorption is caused by London Dispersion Forces, a type of Van der Waals Force which exists between molecules. The force acts in a similar way to gravitational forces between planets.

London Dispersion Forces are extremely short ranged and therefore sensitive to the distance between the N-Se Fresh Filter surface and the adsorbate molecule. They are also additives, meaning the adsorption force is the sum of all interactions between all the atoms. The short range and additive nature of these forces results in N-Se Fresh Filter having one of the strongest physical adsorption forces of any material known to mankind.



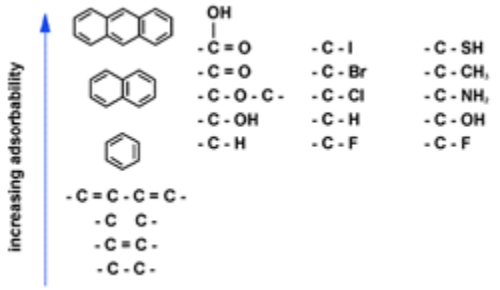
Gas Phase Adsorption - This is a condensation process where the adsorption forces condense the molecules from the bulk phase within the pores of the N-Se Fresh Filter. The driving force for adsorption is the ratio of the partial pressure and the vapor pressure of the compound.

What compounds are adsorbed?

All compounds are absorbable to some extent. In practice, N-Se Fresh Filter is used for the adsorption of mainly organic compounds along with some larger molecular weight inorganic compounds such as iodine and mercury.

In general, the absorbability of a compound increases with:

- increasing molecular weight;
- a higher number of functional groups such as double bonds or halogen compounds;
- increasing polarisability of the molecule. This is related to the electron clouds within the molecule.



How does N-Se Fresh Filter kill air pathogens?

Selenium nano-particles naturally adhere to filter fibers introducing antibacterial properties to the material. This allows for a permanent surface coating that resists biofilm and cellular growth of bacteria and fungi. Most importantly, a nano-selenium coated surface will not leach out into the environment, making the product environmentally friendly. Airborne pathogens die as they come into contact with the antibacterial agents.

Selenium breaks the characteristic sulfur-carbon bond in thiols and proteins. This removes the microbes' protection for oxidative stress (Reactive Oxygen Species), chlorine compounds, osmotic stress, pH fluctuations, and reduced sulfur fluctuations. Thiols are provided by the microbes' intracellular cytoplasm and the protein in the cell walls and fungi cell membranes. Thus, the bacteria themselves actually bring the activating agents to begin the catalytic process resulting in their death.

Nano-selenium depletes thiols

During the natural metabolism of oxygen, oxygen ions and peroxides known as Reactive Oxygen Species (ROS) are formed. Although they play a necessary role in cell signaling, these molecules are highly reactive and need to be closely regulated to prevent damage to cell structures, DNA, nucleotides, proteins, enzymes and more. The most important intracellular redox buffer is the thiol glutathione, which has the primary role of regulating ROS, but also provides protection from chlorine compounds, acts as a reserve form of reduced sulfur, and maintains the levels of potassium ions. The regulation of potassium ions by glutathione protects the cell from damaging pH fluctuations as well as osmotic stress, which can induce cell shock when low glutathione levels causes potassium ions and water to leak out of the cell. Glutathione is one of the most abundant thiols in bacteria and fungi.

Nano-selenium particles draw out glutathione, among other low molecular weight thiols, and destroy them by breaking the characteristic sulfur-carbon bond. Even under reducing conditions such as that in the cytosol, selenium is able to oxidize thiols and break the sulfur bonds. The cell membranes are particularly vulnerable to this effect due to its proximity to the nano-selenium particles. The depletion of glutathione and its protective functions has the following effects:

- Natural and self-produced ROS damage the cells' systems and structures.

- Osmotic stress from the internal loss of potassium ions and water, which can induce cell shock.
- Prevent microbial growth in low pH environments.
- Prevent microbial growth in low reduced sulfur environments.

Nano-selenium breaks zinc proteins

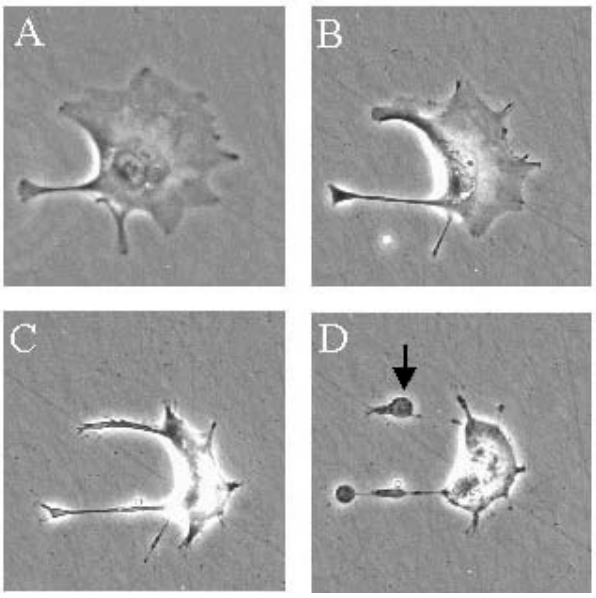
Selenium also breaks the zinc-sulfur bonds in metallothionein and zinc finger proteins, which interferes with the transcription of genetic information from DNA to mRNA. The resulting imbalance of zinc and selenium causes genomic instability and thus disrupts cell replication. Cells that replicate quickly, such as bacteria and fungi, are more susceptible to the negative effects of genomic instability than mammalian cells that replicate slowly.

Nano-selenium also causes apoptosis in fungi

Apoptosis, or programmed cell death, is a normal component of the development and health of multicellular organisms. Cells die in response to a variety of stimuli and during apoptosis they do so in a controlled, regulated fashion. Apoptosis is a process in which cells play an active role in their own death.

In fungi, the depletion of thiols has additional adverse effects and ultimately induces apoptosis. The loss of ROS regulation ruptures the outer membrane of the mitochondria, which is basically the source of chemical energy - adenosine triphosphate (ATP) - for cells. The mitochondria is most vulnerable because it is the main generator of ROS and therefore accumulates oxidative damage faster. With the collapse of the mitochondrial membrane, not only are metabolism and respiration affected, but a release of pro-apoptotic proteins begins the process of apoptosis.

Apoptosis Process



A. *The cell begins to shrink as the rigid proteins (microfilaments and microtubules) within it break down. In the cell nucleus, chromatin (combination of DNA and proteins) in the nucleus also condenses.*
B. *As the cell continues to shrink, rounding and a "horse-shoe" appearance often occurs.*
C. *The nuclear envelope (membrane of the nucleus) breaks down and begins to split into separate bodies.*
D. *The cell breaks apart into separate bodies.*

BIOWAVE FILTER

Normal air filtration systems are not highly efficient in removing VOCs, odors, smoke and ionizing radiation contaminants. These pollutants are becoming the major pollution in indoor air quality and adversely affecting human health and well-being.

SHEPROS with vast experience in air purification technologies, has developed a novel revolutionary molecular sieve adsorbent called BIOWAVE Filtration Media. BIOWAVE Filtration Media is crystalline solids structures made of silicon, aluminum and oxygen that form a framework with cavities and channels inside where cations, water and/or small molecules may reside. BIOWAVE's porous crystalline structure provides nano-pores or "cages" which have high affinity to adsorb air pollutants. The application of this technology in HVAC products and air purifiers is very efficient for the removal of volatile organic compounds (VOCs) odors, photochemical smog and ionizing radiation particles.

Biowave Media

BIOWAVE Filtration Media has several properties, which explain their superior performance in a wide range of applications:

Increased surface area

The material is designed with large surface area to enhance filtration performance. Aided by strong ionic forces (electrostatic fields) caused by the presence of cations such as sodium, calcium and potassium, and by the enormous internal surface area up to 1000 m^2 / g, molecular sieves will absorb a considerable amount of pollutants. If the pollutants to be adsorbed are polar compounds, they can be adsorbed with high loading even at very low concentrations of the pollutants.

Enhanced adsorption

Adsorption is the physical process of binding a thin film of gas molecules to a large surface area. BIOWAVE Filtration Media exhibits high rapid reaction and adsorption kinetics. Therefore, BIOWAVE Filtration Media filters are very effective when short contact time, high air flow speeds or small bed depths are required.

Flexible material

The material's flexibility offers superior handling in filter and product manufacture. It can come in powder or pellet form and makes lamination or bonding to other materials possible.

Chemical air purifiers (gas phase purifiers)

It can be used as an adsorbent to capture molecular sized pollutants, odors and non-particulates such as cooking gas, out gassed paint and building material vapors, and vehicle exhaust gas. Gas molecules are 0.001 micron and smaller and cannot be removed by even the best HEPA filter alone.

Chemisorption

Chemisorption is a sub-class of adsorption, driven by a chemical reaction occurring at the exposed surface. A new chemical species is generated at the adsorbent surface (e.g. corrosion, metallic oxidation). The strong interaction between the adsorbate and the substrate surface creates new types of electronic bonds - ionic or covalent, depending on the reactive chemical species involved.

BIOWAVE Filtration Media uses chemisorption to remove low molecular weight gasses, including formaldehyde, hydrogen sulfide, carbon monoxide and ammonia where activated carbon doesn't perform efficiently.

Environmental advantages

• Regenerable (high thermal stability)

• Non toxic and non-corrosive

• No waste or disposal problems

Specification

Color	Diameter	Pores Volume	Pores Diameter	pH	Thermal Stability
Reddish brown	1 to 5 mm	Up to 40%	0.29 – 0.70 nm	6 - 8	250 - 500°C

HIGH EFFICIENCY PARTICULATE AIR (HEPA) FILTER

Conventional air filters with a MERV of 1 – 7 are usually used to trap large particles that are too big to pass through the filter, but allow smaller contaminants such as harmful airborne bacteria, molds, pollen, chemical residue and dust mites to pass. These filters are not reliable to filter airborne microbial contaminants in air purification systems.

HEPA filters are perhaps the best-known technology for reducing exposure to airborne microbial contamination in air purification systems. A HEPA filter is a type of air filter that satisfies certain standards of efficiency such as those set by the United States Department of Energy (DOE). By government standards, an HEPA air filter must remove 99.97% of all contaminants and particles greater than 0.3 microns from the air that passes through. Once trapped, contaminates and particles are not able to flow back into circulation.

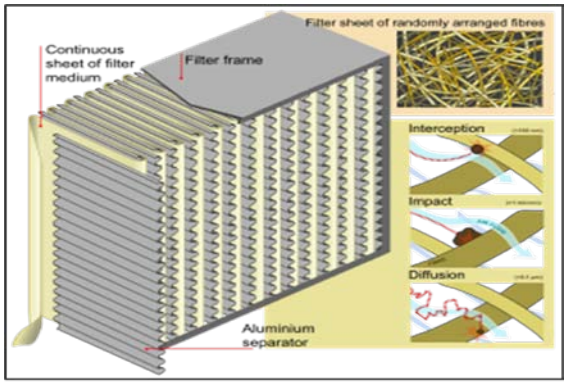
Mechanism of HEPA Filter

The HEPA filter is composed of a mat of randomly arranged fibers. The fibers are typically composed of fiberglass and possess diameters between 0.5 and 2.0 micrometers. Key factors affecting function are fiber diameter, filter thickness, and face velocity. The air space between HEPA filter fibers is much greater than 0.3 µm. The HEPA filter is designed to target much smaller pollutants and particles. These particles are trapped and stick to fibers through a combination 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 effect increases with diminishing fiber separation and higher air flow velocity.
3. **Diffusion** - an enhancing mechanism that 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 most penetrating particle size (MPPS) 0.3 µm, both diffusion and interception are comparatively inefficient. Because this is the weakest point in the filter's performance, the HEPA specifications use the retention of these particles to classify the filter.



HEPA-Filter with functional description.

What will a HEPA filter remove?

Airborne particles like Pet Allergens (0.3 to 100 microns), Dust and Dust Mite Allergens (10-40 microns), Pollens (10-100 microns), Plant Spores (10-70 microns), Airborne Fungi Spores (0.5 to 5 microns), Airborne Mold Spores (2-20 microns), and larger particles of tobacco smoke (0.003 to 0.04 microns).

What won't a HEPA filter remove?

Pure HEPA Filters do not remove most odors, chemicals, or gases as these particles are too small to be trapped by HEPA filters. They also are less effective against particles smaller than 0.01 micrometers such as tobacco smoke (0.003 to 0.04 microns). The HEPA filter will not remove most VOCs (Volatile Organic Compounds) such as paints, varnishes, cleaning supplies, glues, and adhesives, nor microorganisms such as Viruses, Antigens, Pathogens, and Bacteria. Note: some of these substances may become trapped in the HEPA filter, but removal is not guaranteed. In the case of microorganisms, the particle(s) may become trapped but will not necessarily be killed.

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