How AIRVIA Medical technologies fights against viruses and COVID-19

Warning: It is important to emphasize that air purifiers are by no means a miracle or all-in-one solution to fight by itself COVID-19 or any other epidemic. While the use of our devices can effectively clean the air in a room, this does not in any way prevent the transmission of the virus by other means. The usual hygienic precautions therefore remain essential: wash your hands regularly, wear a mask, do not touch your face, avoid large gatherings or prolonged contact with infected people, etc. Find more information here.

Coronavirus

Biological overview

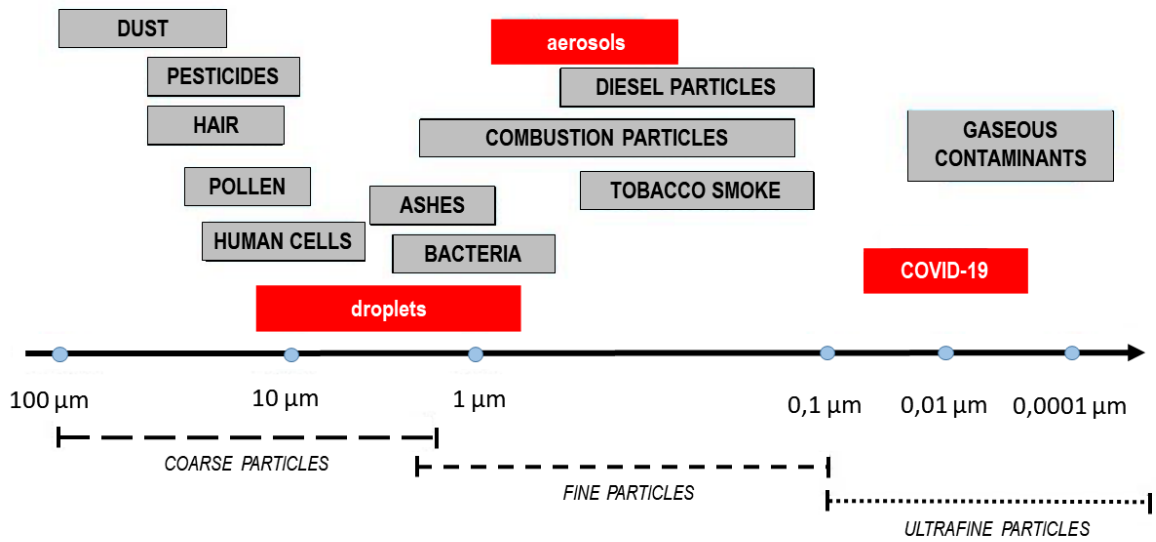
COVID-19 or SARS-CoV-2 is an infectious respiratory disease transmitted by a virus which measures approximately 125nm, or **0.125 µm**[1].
Here is the size of common germs for comparison:

- Influenza virus: 0.08 µm to 1 µm in diameter. Influenza A virus: 0.08 - 0.12 µm
- Coronavirus species, notably MERS-CoV and SARS-CoV, vary in size from 0.06 to 0.2 µm with an average size of 0.1 µm[2].
- Common staphylococci are about 1 µm in diameter.

Coronavirus modes of transmission

Currently, transmission of COVID-19 has been established via three different routes[3]. In order of precedence, they are:

1. By contact of the mucous membranes of the face (eyes, nose, mouths) with contaminated hands or surfaces.
2. By projections of droplets of 0.5 to 60 µm 4 when talking, coughing, sneezing or blowing your nose.
3. By air via aerosols (less common) by speech, breathing, etc.



HEPA Filter H13

Definition

HEPA is an acronym which stands for "high efficiency air filter". It is a standard, defined by European standards[5] EN 1822 and EN ISO 29463, which designates any filter capable of filtering at least 99.97% of particles with a diameter greater than or equal to 0.3 µm (0.3 microns) in one pass.

In order to obtain HEPA certification, a filter passes a “DOP” (Dispersed Oil Particulate) test. This uses oil particles (0.3 µm) to assess the filtration rate.

There are thus 5 classes of HEPA filters according to the efficiency rate:

- H10: 85%, lets through 15000 particles of 0.1 micron per liter of air.
- H11: 95%, lets through 10,000 particles of 0.1 microns per liter of air.
- H12: 99.5%, lets through 500 particles of 0.1 microns per liter of air.
- **H13: 99.95%, lets through 50 particles of 0.1 microns per liter of air.**
- H14: 99.995% lets pass 5 particles of 0.1 micron per liter of air.

AIRVIA Medical exclusively uses HEPA H13 filters. Although slightly more efficient filters (gain of 0.05%) like HEPA H14 or ULPA filters exist, by using these in our air purifiers, they would slow down the flow of purified air and are therefore be counterproductive in quickly and efficiently removing the droplets and aerosols.

Filtration mechanisms

There are three different filtration mechanisms[6,7] that allow the HEPA filter to intercept particles:

1. **Inertial impact**: particles and droplets larger than 1 µm are large enough to be captured directly by the fibers of the filter.
2. **Direct interception**: particles and droplets larger than 0.1 µm are intercepted by the Van der Waals force (intermolecular attraction force) when they pass through the filter.
3. **Brownian diffusion**: the smallest particles which are less than 0.1 µm (like aerosols) have a so-called Brownian trajectory. They have a random movement which makes them strike the fibers of the filter and then find themselves captured via the force of Van der Waals.
4. **Electrostatic forces**: they attract viral aerosols to the filter fiber where they are captured via the two aforementioned processes.

0.1µm particle filtration

Although it is often claimed that HEPA filters are only able to capture particles of 0.3 µm or more, this is simply not true. This erroneous claim is based in part on a misunderstanding of how HEPA filters work. If the HEPA standard distinguishes 0.3 µm particles, it is because these particles are - admittedly counterintuitively - the most difficult to filter. It is for this reason that 0.3 microns is used as a benchmark to measure the efficiency of HEPA filters.

However, particles up to 0.01 µm are indeed captured by a HEPA filter. A 2016 NASA8 study demonstrated this very clearly. This showed that HEPA filters are very effective both in capturing an extremely high percentage of nanoparticles, as well as larger particles larger than 0.3 µm.

For comparison, the currently recommended FFP2 masks are standardized in order to filter at least 94% of aerosols and particles having an average diameter of 0.6 (with a variation of 0.1 to 1 µm)[9]. **A HEPA H13 filter therefore offers superior filtration than an FFP2 mask.**

UVC sterilization

The germicidal effect of UVC rays has been known for more than a century and even won a Nobel Prize in Medicine to Niels Finsen in 1903. UV radiation, invisible to the naked eye, is used in the sterilization of both water and air. This type of radiation damages the DNA of germs (bacteria, viruses and even molds), rendering it possible to inactivate them.

The 254nm wavelength (low spectrum UVC) has been the most studied for its effectiveness against viruses. This is what AIRVIA Medical uses in its purifiers. Its effectiveness against all kinds of germs has been established by hundreds of studies around the world[10]. This wavelength has notably been tested against the coronavirus family and airborne viruses in general[11], and also on the SARS virus and MERS14 in particular[12,13].

Note that the COVID-19 genome shares an 80% similarity to that of SARS[15,16].

An American study also supports the effectiveness of these UVC rays against COVID-19[17].

A Harvard study in 2007 clearly demonstrated the effectiveness of 254nm UVC radiation on all viruses, **regardless of the size**[18].

All of these studies therefore support the complete effectiveness of these rays in inactivating COVID-19.

It should be emphasized that the UVC lamp is primarily used to sterilize filters and the interior of AIRVIA Medical air purifiers. The air flow is generally too rapid to both sterilize the air and maintain an efficient air purification flow.

Conclusion

The effectiveness of HEPA filters and UVC rays in capturing and destroying the coronavirus when it is present in the air has been strongly demonstrated, and this is why these two technologies are at the forefront of many health professionals' recommendations.

In addition to these technologies, our AIRVIA Medical air purifiers also use two technologies which have the potential to act against the coronavirus: photocatalysis[19,20] and ionization[21,22] with favorable results, in particular on the influenza virus. Further studies are required before they can be declared effective or not.

Sources

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