



Electronic Air Cleaning (EAC)

Air pollution and its consequences – the Bioload

Air pollution continues to pose a significant threat to human health worldwide. The World Health Organization (WHO) have estimated that urban outdoor air pollution is estimated to cause about 1.3 million premature deaths per year worldwide¹.

In the quest for cleaner air we have to look at what constitutes the main problem. Everyone agrees it the burning of fuel and unfortunately, it is the car we all regard as the sign of wealth and freedom that is a key factor. With more than 20000 new cars on the road/month in Beijing, there is little to be done. On March 8 2014, the Lancet (leading medical journal) had an editorial with the title: **(barely) living in smog: China and air pollution.**

“There is increasing evidence about the effects of air pollution and, in particular, fine particulate matter on cardiovascular and respiratory diseases (myocardial infarction, heart failure, asthma exacerbation, respiratory infections, and lung cancer). There is emerging but as yet inconclusive evidence about the effects on premature births, intrauterine growth restriction, and lung development throughout the life course”. To this one may add that no safe levels with regard to Furthermore, the editorial stated “Clean air should be the expectation of all, not the luxury of some”. The problem is that not even are home are safe – the hazardous ultra-fine particles will enter our homes to add on to the pollution caused by the activities indoors. Airborne particles constitute the biologically active components of the ambient air – the **Bioload**. Not only the particles originating from the modern diesel engine but also other very fine particles such as mycotoxines (originating from different moulds and fungi) become essential biologically active components. However, there is one aspect that may be useful – small particles may be captured, either by expensive filtering techniques such as HEPA or by the more affordable action of electrons liberated into the room.

An electronic solution

Our surroundings are positively charged as are the fine particulate matters. Thus, a negatively charged electrostatic field will capture the particles and bring those to a surface with a lower electrical potential. This observation captured the mind of Prof Karl G Rosén, paediatrician and physiologist, 20 years ago and research commence to demonstrate what were the possibilities. Firstly it was demonstrated that electrons liberated into the ambient air combined with oxygen and vapour to produce hydrogen peroxide (H₂O₂) in a low concentration², which meant there was a mechanism of stopping the growth of mould³. Secondly, to study the impact of EAC on a group of children exposed to poor indoor air. This “Swedish Day-care study” showed that the non-attendance rate among children <6 years of age decreased by 65% and we saw a reduction in fine particles (>0.3 µm) by



AirRevival unit applied in a children's day-care centre in Sweden

¹ WHO. Air quality and health. <http://www.who.int/mediacentre/factsheets/fs313/en/index.html>, 2011.

² Richardson G, Eick SA, Harwood DJ, Rosén KG, Dobbs F. Negative air ionisation and the production of hydrogen peroxide. Atmos Environ 2003, 37(26): 3701-06

³ Peng M, Kue J. Peroxidase-generated hydrogen peroxide as a source of antifungal activity in vitro and on tobacco leaf disks (1992) Phytopathology. 82, 696-699.



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80%⁴. The increase in attendance was due to less upper airway infections caused by viruses. We may only speculate on the reason for less viral infections but two mechanisms related to less particles come to the fore: Firstly, fine particles combines with vapour to form a cluster to enable the virus to survive the hostile environment of the ambient air. Secondly, cleaner air means fewer particles are inhaled and the immune system is not preoccupied with handling those but can focus on the viruses instead.

To capture these findings, the AirRevival technology has been developed and tested. A problem in applying an electrostatic field is to have sufficient strength to capture the particles and to direct those onto a cleanable surface. This has been solved by using a conductive polymer on which bundles of free ending carbon fibres are attached. The charged polymer surface (Fig 1) serves as an electron mirror facilitating the release of electrons from the free ending carbon fibres. A charge of -7 kV at very low amperage (current) of approx. 100 μ A is all that is required. Furthermore, no ozone will be produce under these conditions.

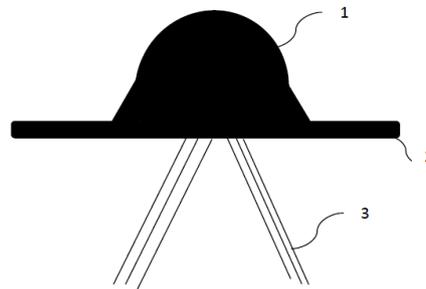


Figure 1. Transection of the emitter band; 1. Conductive polymer, 2. Surface to serve as an electron emitter, 3. Free ending carbon fibres

This construction delivers a negatively charged electrostatic field extending 1m. By positioning the AR unit onto a glass plane (window, wall hung poster or mirror) that is positively charged, most particles will be captured and the smaller they are the more easily will they be captured. When positioning the AR unit in a bed room it has to be placed >1m away from the head, otherwise there is a risk that the person will serve as a collector of the particles. These very fine particles are distributed through the flow of air and through a concentration gradient. This means that an air conditioner or a fan (ceiling mounted at low speed) adds to the air cleaning capacity. Once the air has been cleaned by running the air conditioner for 30 – 45 minutes, it may be turned off and the continuing air cleaning will be handled by the AR-unit serving as a silent and electronic particulate cleaner attracting the fine particles. Once these are captured, they will remain and will not be released into the air.

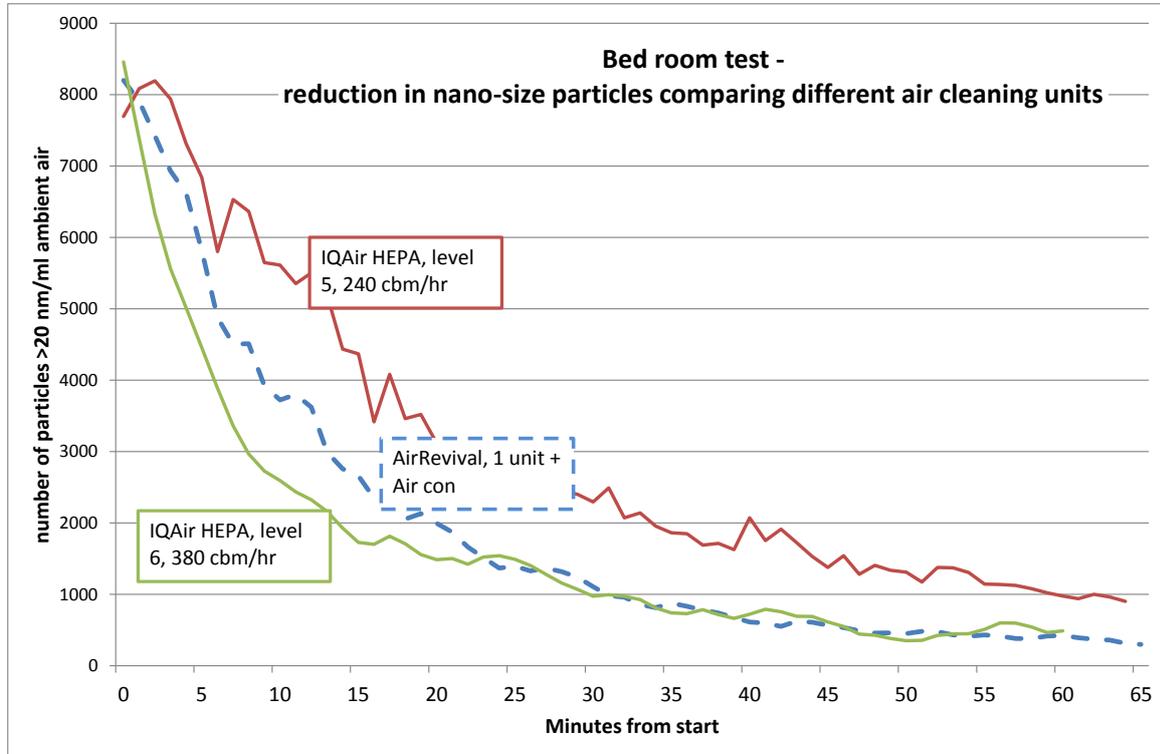
⁴ Rosén KG, Richardson G. Would removing indoor air particulates in children's environment reduce rate of absenteeism - a hypothesis. *Sci Total Environ.* 1999, 234.: 87-93



Test of air cleaning capacity

Comparison to HEPA filtering technology

Test nr 1 – Figur 2



HEPA filters are the most efficient air cleaning technologies so far. The test was done in Hong Kong in a 15 sqm bedroom equipped with an air conditioner (circulates the indoor air). The room had an AR-unit placed on the window plane and the HEPA system (IQAir) was placed in the middle of the room. The concentration of particles was recoded with a P-Trak 8523 (TSI, USA) equipment.

These data indicates little difference between HEPA filtering run at its highest speed and AirRevival.

Test nr 2 – Car cabin test

The health hazard of air pollution is related to particle size and nano size particles with their large relative surface serving as a binding site for free metal ions constitutes an important component in the pathophysiology of oxidative stress⁵.

Drivers and passengers in heavy traffic are at special risk for nano-size particles exposure and epidemiological data show an association between exposure in traffic and the onset of myocardial infarction within 1 hour afterward⁶. Thus, it appears most relevant to investigate potential technologies to reduce the bioburden of cabin air.



⁵ Miyata R, van Eeden SF, (2011) The innate and adaptive immune response induced by alveolar macrophages exposed to ambient particulate matter. Toxicology and Applied Pharmacology 257, 209-226.

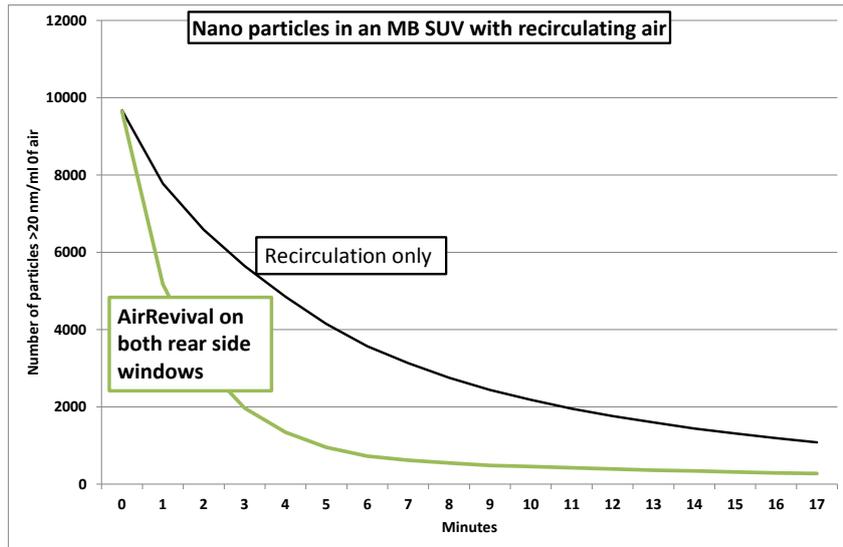


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Figure 3 illustrates how long it takes for the nano-size particles to disappear from the cabin air. This is a photo of the rear



electrical wires.



of the AirRevival unit placed on the rear side window. If you look closely, you may see the deposition of particles along the

Safety aspects

The very low current (approx 100 μ A) makes the device electrically safe.

A [static electric field](#) is part of our natural environment and has not been associated with any health risks, for further information, see www.greenfacts.org/en/static-fields/.

The device is only allowed indoors.

AirRevival is approved according to EN 2004/108/EC, the so called EMC directive. The AR-unit is powered by a earthed 12V DC adapter.

AirRevival
Cleans the air from fine particles

Carbon fibers emitting a cloud of electrons generating a negatively charged electrostatic field attracting particles, moulds and allergens

Clean air prevents viruses from staying in the air
Clean air makes the whole body rest.

A static electric field brings the particles to the window

Positively charged air pollution particles from the traffic, wood and oil burning, viruses, bacteria, allergens, moulds and mycotoxins

Each unit covers one room of 20m³.
Cost to run <€0.01 per day, no maintenance

⁶ Peters A, von Klot S, Heier M et al. (2004) Exposure to traffic and the onset of myocardial infarction. N Engl J Med 351:1721–1730.