A Novel Air Purification Technology: Assessment on the Reduction of Aeroallergen, Dander and Particulate Matter 2.5 (PM 2.5)

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Abstract

One of the top environmental concerns of the world today is air pollution. It is affecting our health every day. There is a gradual rise of allergy and asthma cases all over the world. Particulate matter of size 2.5 microns floating in the air are a major health concern of the present decade. When inhaled, they can reach deep into our lungs and tissues via the bloodstream. PM 2.5 stands for the Particulate Matter 2.5 micron, which may be composed of various elements. We analyzed the aeroallergen and the PM 2.5 in the Texas panhandle and conducted studies with AHPCO nanotechnology to reduce the aeroallergens. There are a high number of fibers coming from the feedlots. Besides the pollen and mold spores, there are fibers, Trichrome (plant hair), insect parts and more. All of these aeroallergens can affect the human health. We spend most of our time indoors; bio analyzing PM 2.5 and using air purifiers inside can help maintain cleaner air indoors. We assessed and evaluated the capacity and safety measures of the *i-Adapt* air purification unit in terms of reducing the air borne particulate matters present in the room air. The fungal and bacterial colonies were analyzed from the tissues in room air after 24, 48, 72 and 120 hours. We also tested the efficiency of the unit in reducing the mold concentration in the room air and capacity of the different filters in cleaning the air.

Methodology-Indoor air quality testing:

We built a fiberglass chamber (AO) to assess and evaluate the efficiency of the *i-Adapt* unit. We purchased the ISO 12103-1 Ultrafine Dust Particle with an average size of 2.75 micron (PTI Powder Tech., Minnesota). We have calculated the rate of natural decay of the particulate matters. We placed the equipment and the meters inside the AO chamber (Fig.4D). Once the aerosol equilibrium was achieved, we began recording the air quality readings from the *Dylos* and *Garosa Air Quality Monitor* at 24 hrs., 48 hrs., 72hrs. and 120hrs.We also compared efficiency of the *i-Adapt* unit with the natural decay rate of the PM.

Fig. 1. Testing on Ozone emissions using Ozone meter (Forensic Detector). All the units showed very low or no Ozone production after running for long time.

Current aspects of PM 2.5

Many types of Particulate Matters are composed of VOCs. VOCs or the Volatile Organic Compounds can cause serious health hazard known as the Sick Building Syndrome (SBS). PM 2.5 is a mix of tiny invisible solid and liquid particles that are in the environment. If in abundance in a particular environment, we can only see the haze that blurs the spread of sunlight. The size of these particles are 2.5 microns in diameter or smaller. These particles are so tiny that even some bacterial strains have larger sizes than those particulate matters. The bacterial cell size ranges between 0.5-5.0 microns in length. No matter what the size, particles can harm our health. It is so dangerous that it can shorten our life. Our natural defenses help us to cough or sneeze particles larger than 10 microns out of our bodies but PM 2.5 penetrates deeply into the alveolar region of the lung and may even be able to cross into the blood, just like the essential oxygen molecules we need to survive. Evidence suggests that PM 2.5 triggers an inflammatory response and causes oxidative damage, among other organs.

What did we do to prevent this?

Collaborative research between West Texas A&M University and Air Oasis developed Advanced Hydrated Photo Catalytic Oxidation (AHPCO) and Plasma technologies. There is ongoing research to apply AHPCO and Plasma technologies to develop commodities like air purification systems, food preservation systems, ice makers, and cell phone sterilizers.

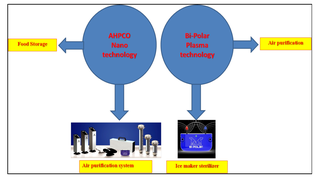

Fig. 2. Dr. Jeff Bennert with Dr. N. Ghosh. Use of the technologies for air purification, food preservation.

Public Education in Collaboration with Allergy ARTS

Fig. 3. Aubrey Howard with Dr. N. Ghosh on Health Watch Channel 10 TV.

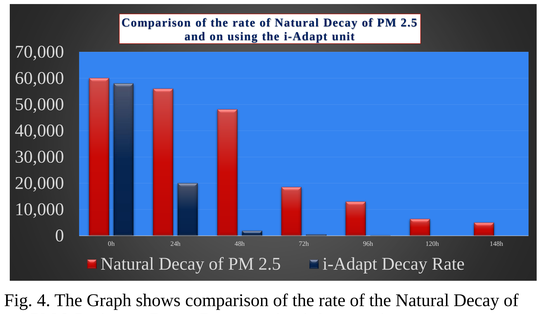

Fig. 4. The Graph shows comparison of the rate of the Natural Decay of the PM 2.5 with the Decay Rate on using i-Adapt unit.

Assessing the reduction in Microbial Spore Concentration in the Air:

We prepared petri-plates with Brain Heart Infusion Agar (DIFCO) and exposed them in a room the size of 100sq. ft. (NSB 215). We found the development of colonies of fungi and bacteria distributed on the petri plates on incubation for 24 hours in the incubator at 37ºC. In the next step, we ran the *i-Adapt* for 48hrs., 72 hrs. and 120 hrs. and placed the petri-plates for exposure in the closed room. We restricted the entrance in the room to avoid any external contamination. We found development of no colonies after the stated exposures. AHPCO and Bi-polar ionization technologies are recommended as very efficient in sanitizing the indoor air and reducing the PM 2.5 and the mold concentrations. This technology could be promising to decrease the incidence of allergic rhinitis, asthma and other more extensive lung conditions in the future. There was a significant reduction of PM 2.5 on using the *i-Adapt* unit that corroborated with the data of the microbial spore reduction on the petri-dishes in the first 24-48 hours. Jon Bennert has tested the efficiency of the Bi-Polar® unit in reducing smoke in the indoor air. He built a fiber glass chamber and installed a Bi-polar® Unit in it. He pumped smoke into the chamber keeping the Bi-Polar® unit on and recorded the time with a stop watch. The chamber was connected with a duct to pump smoke inside. The time lapse photography clearly showed a significant reduction of smoke within 60 seconds.

Conclusion

i-Adapt is the air purification unit that uses AHPCO and Bi-Polar technologies with the HEPA filters to have the best air purification system that can be used for indoor air purification and to control the exposure to airborne pathogens, allergens and dust particles in a residential or commercial facilities. Our experiments with the PM 2.5 showed significant reduction in PM 2.5 concentration with time using the *i-Adapt* unit.

Assessing the efficiency of AHPCO using PM 2.5

Fig.5. Steps of testing the *i-Adapt* unit: A. *i-Adapt* unit B & E. Meters for reading HCHO, Total VOC and PM 2.5 C. Weighing the Particulate Matter. B. PM 2.5 testing dust. D. Uniform spreading of the Particulate Matter in the AO Fiberglass chamber by using 4 fans on each 4 corners of the AO chamber. E. Meter readings.

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