

Increase in 2.5 Micron Airborne Particulate Matters, AHPCO[®] and Plasma Nanotechnology in Reducing the Symptoms of Asthma and Allergic Rhinitis

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Abstract

Increase in the particulate matter of size 2.5 microns are a major health concern of the present decade that led to a gradual rise of allergy and asthma cases all over the world. When inhaled, they can reach deep into our lungs and enter tissues via the bloodstream and contribute to health conditions ranging from coughing or lung irritation to chronic bronchitis and cardiovascular complications. These substances are generally composed of the combustion particles, organic compounds and metals. Levels of the most dangerous particles, called PM 2.5 reached beyond the prescribed safe level in all the major cities of the world: Beijing in China, Delhi in India, Los Angeles and New York in the US.

PM 2.5 is becoming an ever-increasing problem that must be addressed. We are aiming our research towards the reduction of PM 2.5 in the indoor air by using a novel hybrid technology. The newly developed AHPCO[®] or Advanced Hydrated Photocatalytic Oxidation and Plasma Nanotechnology in the Bi-Polar units were tested to evaluate the reduction of the particulate matters with a focus on PM 2.5 as well as animal dander and fungal spores. Utilizing two fiber glass chambers, we analyzed the particle count to assess

and evaluate the efficiency of the hybrid AHPCO[®] and Plasma Nanotechnology in reducing the particle count present in the indoor air in course of progressive time intervals. The air purification system developed with the novel hybrid technology reduced the indoor particulate matters and animal dander efficiently.

Keywords: PM 2.5 micron, air pollution, air purifier, AHPCO[®]

Introduction

There is a gradual rise of allergy and asthma cases all over the world (Ghosh et al. 2017). Particulate matter of size 2.5 microns are a major health concern of the present decade since when inhaled they can reach deep into our lungs and tissues via the bloodstreams. These are generally composed of the combustion particles, organic compounds, metals.

In November 2016, in Delhi, India 1,800 Schools were closed due to dangerous smog that obscured the city. Levels of the most dangerous particles, called PM 2.5 reached 600 micrograms per cubic meter in different parts of the city in that week, according to the Delhi Pollution Control Committee. Sarath Guttikunda, the director of Urban Emissions has reported that a sustained exposure to that concentration of PM 2.5 is equivalent to smoking 40 cigarettes a day (Raj and Barry, 2016). People of all ages in Beijing, China have to wear masks to avoid the dense smog that covers the city every morning. The air in New York City is significantly polluted. Due to the airborne pollutants and greenhouse gases, the health of residents in cities across the country is regularly put at risk by the ground-level ozone (forming smog); New York is one of those cities affected. A report published earlier showed that the tristate area had 92 days of "elevated smog pollution" in 2015. Granted, the smog in New York is a drop in the bucket compared to that of southern California—Los Angeles evidenced 213 days of heavy smog during 2015. The five most polluted cities in the US are all in the Southern California (Kirkpatrick, N., 2015). According to the report, ground-level ozone brings about a whole host of health risks, ranging from coughing to an inflammation that is like a "sunburn on the inside of the lungs". High truck and traffic volume, industrial facilities and older heating systems can all contribute to increased levels of air pollution in impoverished neighborhoods. Other environmental factors such as poor building maintenance, mold or insect infestation can also trigger asthma symptoms (Hinsdale, 2016).

AHPCO[®] and Plasma Nanotechnology and Indoor Air Quality (IAQ)

The indoor air surrounding us plays an extremely important role in our well being and efficiency. Breathing pure and clean air allows us to think more clearly, sleep soundly, and stay healthier. Studies show that we receive 56%

of our energy from the air we breathe, more than from water and food combined. On average we breathe 37 pounds of air a day that is equivalent to a volume of an Olympic sized pool (Ionic Healing, 2017). Sick building syndrome (SBS) is a combination of ailments associated with an individual's place of work or residence. A 1984 WHO report into the syndrome suggested up to 30% buildings worldwide may be linked to symptoms of SBS. Most of the sick building syndrome is related to poor indoor air quality (EPA, 2017). Two decades ago NASA developed an ethylene scrub air purification machine using a titanium dioxide catalyst in conjunction with UV lamps to remove the ethylene gas. Subsequent tests revealed that this PCO/TiO₂ air purifier technology also helped to destroy harmful organisms such as bacteria that passed through the system. Air Oasis has utilized this early NASA UV PCO air purifier technology to develop a revolutionary line of filterless air purifiers. We have applied the knowledge of Photo-Catalytic Oxidation Nanotechnology to build the air purifier that reduces the indoor VOCs, air borne pathogens, aeroallergen and particulate matters and thereby improves the air quality.

A collaborative research between the West Texas A&M University and Air Oasis has developed Advanced Hydrated Photo Catalytic Oxidation (AHPCO[®]) Nanotechnology and Plasma Nanotechnology. AHPCO[®] was applied to develop an air purification system to reduce all sorts of indoor aeroallergen to improve the air quality, better food preservation. Plasma nanotechnology is applied to sterilize the ice makers. Air Oasis air purifiers utilize a new generation AHPCO[®] technology that simply produces a blanket of redundant oxidizers that not only clean the surrounding air, but target the particulate matters in the air as well as on the surface and sanitize the air eventually. The AHPCO[®] Nanotechnology has proved to be efficient for net reduction of microbes, VOCs with the specific effect on Methicillin resistant *Staphylococcus aureus*, MRSA. The collaborative research is going on to apply these technologies to develop commodities like efficient air purification system, food preservation system, producing clean ice cubes in the ice makers and cell phone sterilizers. Air Oasis LLP, USA is developing strategies to promote small businesses all over the world. The implications of Nanotechnology can improve the quality of life and add new features to the original functions of the product. Improving the quality of life of individuals is imperative in business because it will improve the well-being of the society as a sum.

Materials and Methods

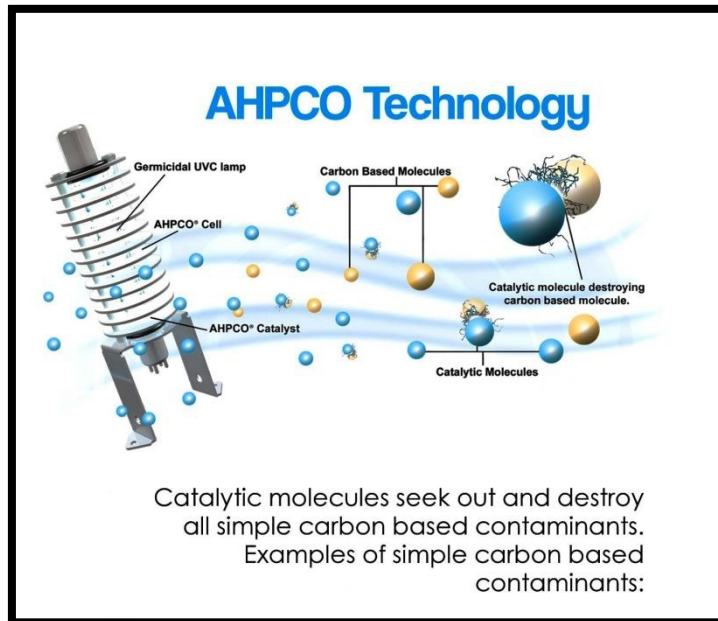


Fig.1 showing how the catalytic molecules produced by the AHPCO[®] technology destroy the carbon based contaminants.

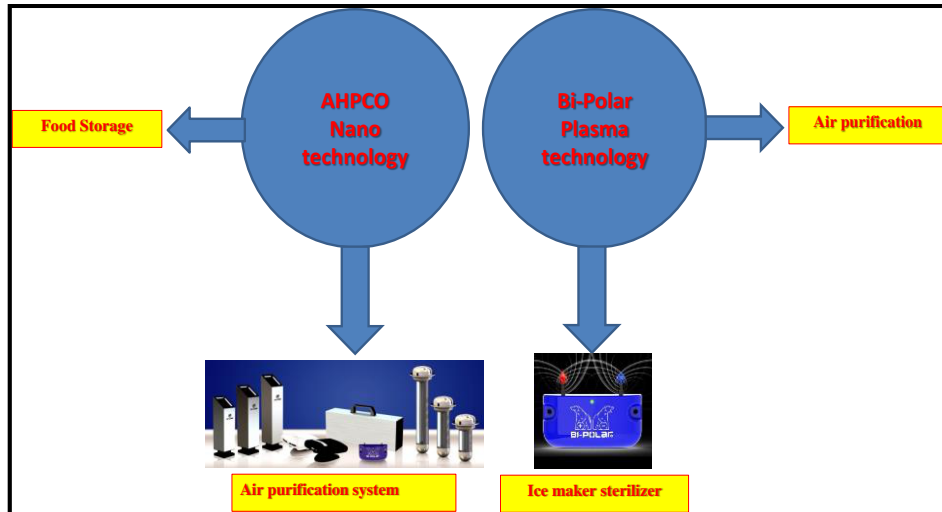


Fig. 2 showing various applications of the AHPCO[®] Nanotechnology and Plasma Nanotechnology in the Bi-Polar[®] units.

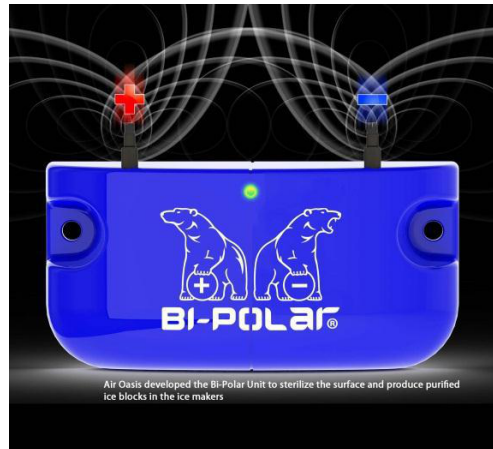


Fig. 3. The Bi-Polar[®] unit created by Air Oasis proved to be efficient in cleaning the air and reducing the contaminants in the ice makes.

Results and Discussion

Experiment 1: Smoke was gone in 60 seconds on using Bi-Polar[®]

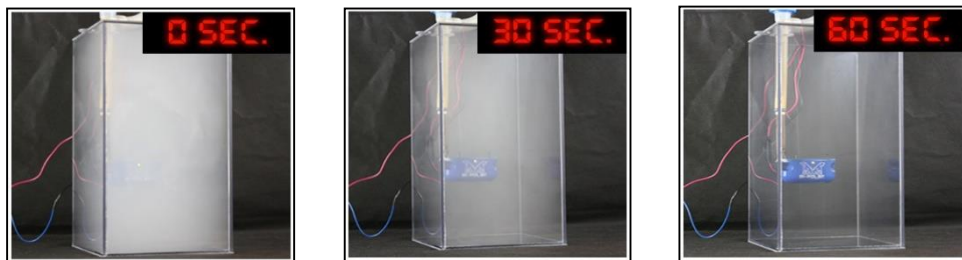
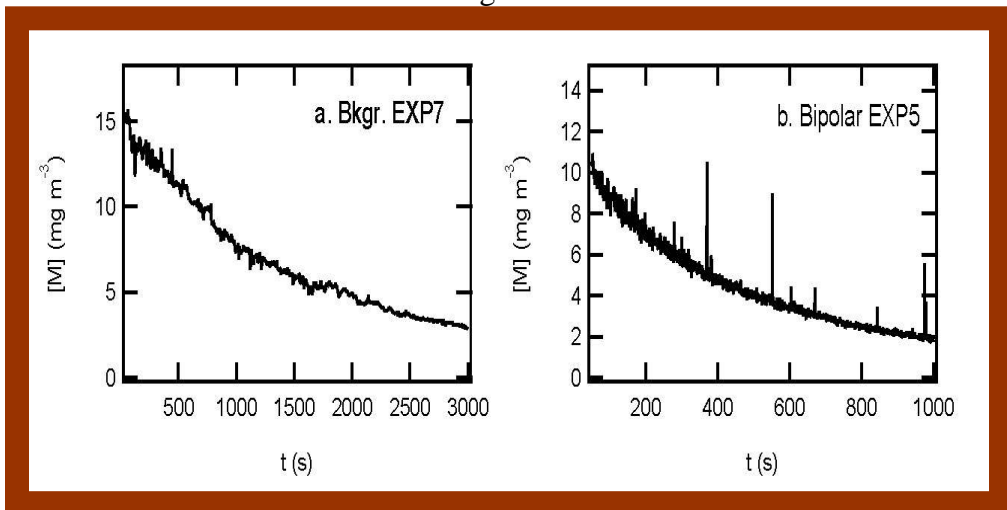


Fig.4. On running the Bi-Polar[®] unit the smoke in the fiber glass chamber was gone in 60 seconds. Cigarette smoke was inserted into a fiber glass chamber through an inlet while a Bi-Polar[®] unit was running inside. The stop watch showed the time for reduction of the smoke concentration. The video recording of the experiment showed a complete reduction of smoke in the fiber glass chamber. The video is available on the YouTube with a link: https://www.youtube.com/watch?v=LpB6qZv0n_M (Ref. Bennert, J, 2016).

Experiment 2: Particulate matters gone in 1000 Seconds



Fig. 5 Arrows from the left showing set up of Air Oasis 3000 unit(A), connecting outlet(B) and DustTrack 8520 Monitor(C). Utilizing a fiber glass chamber, we analyzed the particle count to assess and evaluate the efficiency of the hybrid AHPCO[®] and Plasma Nanotechnology in the Bi-Polar[®] units in reducing the particle count present in the indoor air. We estimated the rate of the decay of the aerosol concentration as a function of time before and after using the AHPCO[®] nanotechnology with the Air Oasis air purifier 3000 and the plasma nanotechnology in the Bi-Polar[®] unit. Through an inlet, the aerosols were injected and dispersed in the chamber in controlled way and particle count was recorded using the DustTrack connected to the outlet. The DustTrack 8520 spectrometer counted the aerosols in the chamber on injecting 12 mg/m³ of NX solution into the chamber; we turn on the DustTrack and let the aerosols settle to the lowest concentration. We used the illite NX powder as aerosol since it has a similar mineralogical composition of the atmospheric mineral dust. Health professional in all the countries expressed their concerns on the increasing trend of allergy and asthma cases due to a significant increase in the PM 2.5 micron particulate matters in the air. Our experiment showed a gradually decay of the particulate matters, PM 2.5 is possible on using the AHPCO[®] and Plasma Nanotechnologies.



Graphs A and B show the reduction of particulate matter in relation to time with and without using the Bi-Polar[®] unit.

To evaluate the animal dander and fungal spores, we used a Dylos Air Quality Monitor. We detected and compared the animal dander counts on running the air purifier for 24, 48, 72 and 120 hours of exposures in the animal vivarium.

Conclusion

The air purification system developed with novel AHPCO[®] and Plasma Nanotechnology efficiently reduced the indoor particulate matters, fungal spores and animal dander in course of progressive time interval. The major conclusive points from our research are summarized below. Investigation on assessing the efficiency of the AHPCO[®] and Plasma Nanotechnology used in Air Oasis air purifiers showed the improvement of the Indoor Air Quality (IAQ) by--

- Reducing the indoor particulate matters and aeroallergen concentration
- Reducing the MRSA, (Methicillin Resistant *Staphylococcus aureus*) concentration
- Reducing the VOCs (Volatile Organic Compounds)
- Improving the odor from cigarette smoke
- Assessing the safety measures showed no harmful effect of the AHPCO[®] Air Purification system on the living system and cell culture.

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