# What's So Different About Clustered Ions?

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*I was attending an international air conditioning conference when a mechanical contractor walked up to my booth and asked, "So I know about ionization, of course, but how is that different from clustered ions and what's the benefit of those?*

This question regarding the clustered ion opens a discussion that can be too technical for most folks. My role, as an educator, is to take the complex and make it simple so I thought it best to direct our discussion here toward that goal.

I've been working with ultra-violet (UV) lights in air purification equipment for many years. There is quite a bit of science behind this technology and it's always fascinated me as to the many ways this technology can be incorporated into equipment that cleans the air. When UV lights first became popular in the 1990s, they were installed by air conditioning contractors in the air handler (or furnace) to keep the coils clean, free of mold and bacteria. They weren't really used for cleaning the air but for keeping the air conditioning equipment clean. Both clinical and field testing clearly showed that UV lamps at a very specific wavelength (called the "germicidal wavelength") could be extremely effective in killing biological contaminants.

On October 18, 2001, the Route 130 US Post Office in Hamilton, NJ closed its doors for five years while it took nearly five years and $65 million to clean-up the building after four anthrax-laced letters were processed through the Hamilton distribution center.[i] One of the strategies used to prevent this from happening again was the introduction of mail sorting equipment that bathed mail with UV light. The mail would be placed on a conveyor belt and, when exposed close enough and long enough, it was understood that bacteria (anthrax is a bacteria) on the surface could be deactivated. In many places across the country, this has become very common.

Please notice that the two factors that limit the effectiveness of UV light, as a stand-alone technology, are proximity and exposure time. Bugs need to be close enough to the UV light and dwell there long enough to have any effect. Obviously with the high velocity air movement in an air conditioning system, bugs, as I say, "barely get a sunburn". UV lights are effective on the coil but did not contribute much to cleaning the air downstream or in the ductwork. Good at keeping the equipment clean but not so good at improving the air quality in the living environment.

To enhance this technology, several companies began adding a flat plate covered with a TIO2 (Titanium Dioxide) coating. What resulted was a remarkable process that occurs in nature on a regular basis. Bi-polar, or clustered ions, would be produced through what's been called a PCO (photo-catalytic oxidation) process. Those oxidizers could then be pushed downstream, away from the source of the PCO, and clean the air and surfaces downstream through the ductwork and into the environment. Through the recent years, this pro-active technology has proven to be extremely effective in improving indoor air quality and many companies have tweaked to wavelength of the UV, the configuration or shape of the plate and the coatings to enhance and perfect the effectiveness of this technology. The most current testing data showed that a multi-faceted target plate coated with multiple metals will strengthen to production of these bi-polar ions and increase the efficacy of the technology.

In 2011, I was invited to speak at an IAQ Conference in Seoul, S. Korea. My task was to simplify the complex nature of indoor air quality contaminants and explain the value of PCO technology in reducing those contaminants in living environments. One of my companies had been manufacturing PCO equipment for several years and my hosts were interested in knowing how it had been improved. At the time I was invited, I didn't know that they had been involved in manufacturing a technology that also created bi-polar ions but without producing high levels of ozone. The UV technology integrated in the PCO process I was familiar with required the production of ozone to create the ions. The production of ozone is problematic for a large segment of the population, so I was especially interested in what the Korean manufacturer had developed.

The Korean company called their bi-polar ions H-clusters because of science behind the actual process. I won't go into that discussion here as it would most definitely get us lost in the weeds. What was important to me was that this company had patented a unique component called a dielectric barrier ionizer (DBI) that was much smaller that the UV technology and produced so little ozone that it was negligible by the time it left the equipment, meaning that the ozone would not pollute the environment. This seemed revolutionary to me and could be, I thought, the answer to "turbo-charging" the PCO technology with which I was familiar. Could combining these technologies create a super-charged ion? Could it produce an clustered ion that was stable enough to go downstream into the environment and remain strong enough to annihilate mold and bacteria off surfaces in the environment? These were intriguing questions that could only be answered through clinical and field testing.

So, what is a "clustered ion"? Ionization itself is a very natural process which occurs by sunlight, lightning strikes, waves and other natural processes outdoors. Simply stated, an ion is a charge that is produced as either negative (-) or positive (+). Once introduced into the air, it can reverse the polarity of some of the dust particles. When some are positively charged, and some are negatively charged, they clump together and become large enough to drop out of our breathing zone and/or get trapped in a filter. Sub-micron particles, the smallest of them all, can be easily removed once they are made larger. The ionization process does that. Incidentally, IAQ professionals are mostly concerned about these sub-micron particles because they often remain suspended in the air and never get to a filter.

I have been familiar with negative ionization because of my construction background. As a remodeling contractor it was always important that we keep dust down and our work space as clean as possible. By installing negative needle-point ionizers in the work place, much of the dust can then be aggregated then filtered out of the environment. Negative ionization is also a great solution during the air scrubbing process of a mold remediation project and, in our NORMI training, we recommend that option to mold professionals. It's very effective.

But the clustered ion is different from a straight ion. Clustering ions is the clumping of both negative and positive ions into a single mass. The effectiveness of reducing dust certainly remains but the clustered ion results in more benefits regarding its effectiveness in reducing other indoor air contaminants that neither negative nor positive ions can do independently. In a synergistic way, these clustered ions work harder and are more effective that either straight ions could be by themselves. The testing data is very clear on this.

When I was a kid, our most advanced electronic was the hand-held transistor radio. The good ones had a great little 9v battery that seemed to last forever. Imagine taking a small 9v battery and touching it to your tongue. I remember doing this as a kid and I enjoyed watching my friends do this because of the

variety of faces they'd make. There wasn't enough voltage to hurt anyone but it produced a bit of a jolt or tingle on the tongue. Imagine stringing a hundred 9v batteries together and then touching your tongue. That would be quite the shock. The clustered ion does just that. Where one straight ion wouldn't be enough to destroy biologicals, the clustered ion can zap mold and bacteria, causing it to explode. We actually have electron-microscopic pictures that show it.

The clustered ion destroys mold and bacteria faster and more completely than straight ionization. Distributed by the air conditioning system with air purification equipment, when properly installed, these clustered ions help keep surfaces clean, prevent cross-contamination and, in the process, keep the air we breathe clean and free from dust and biological contaminants. The more clustered ions you have, the more effective the process and, unlike negative ions by themselves, you can't have too many clustered ions. You simply can't over-drive the technology. And you don't get the problem of creating a lot of static electricity or plating particulates to the wall, which happens with straight ionization. This is sometimes called "the black wall effect" and you simply don't get it with the clustered ion.

As effective as the clustered ion is on dust and biologicals, it also effectively reduces odors. Much of the odor in any environment is the result of bacteria or VOCs (volatile organic compounds) and the clustered ion reduces both. The science behind the reduction of VOCs is very technical but, simplified, it involves the altering of molecules. If you can change a chemical makeup by altering the molecule, which of course you can with an oxidation process, you will eventually break it down to its basic form. By breaking down VOCs, you are removing them from the indoor environment and when you remove the VOCs you are reducing odors.

Sometimes I'm asked, "If this clustered ion is so powerful, how does it affect humans or pets?" That's a valid question and you should know that the safety of the clustered ion has never been questioned by professionals because the science is clear. This is a process that is seen in nature and we are simply synthesizing it in air purification equipment. To add to the discussion, I asked, "Is there were a way to enhance the clustered ionization process without creating any negatives?" The benefits would be incredible and the answer is "yes!".

In April 2013, the MCI™ (multi-cluster ionization) process received a US Patent Office trademark #4,320,186. The following January 2014, ASHRAE (American Society of Heating, Refrigeration and Air Conditioning Engineers), at its annual conference, awarded an honorary mention Innovative Award for the MCI™ technology. What makes the MCI™ technology unique?

When I came back from Korea, what I learned about enhancing this technology was, in fact, innovative. Typically, the manufacturers of air purification technology build their equipment around a single component. If they like a filter, then they try to design a better filter and build equipment around that. If they like PCO technology, they try to enhance that technology and build equipment around that. I knew that if we could take multiple components and put them together we would get the benefits of each but enhance them synergistically into a much more powerful and wholistic technology. That's how multi-clustered ionization was born.

When you combine an improved PCO technology with a DBI technology, the amount of clustered ionization is increased from 6,000 ions $pm^3$ to 1.5 million ions $pm^3$. That's significant. Increasing the effectiveness of each technology individually enhances the efficacy and efficiency of the combined technologies synergistically. When you increase the clustered ionization process, you are able to reduce the ozone production. That's a win-win.

PCO technology is dependent on the shape and coatings of the target plate. The more surface area you have, for instance, the more the production of clustered ions. Instead of using only TIO2, you could increase the clustered ion output by using additional metals in the coating. These are some of the changes that can be made to increase the clustered ion output and improve the effectiveness of the equipment. Of course, it's important as to where the technology is placed, how the air moves through the equipment and many other factors considered by the IAQ professional.

But, the benefits of the multi-clustered ion can hardly be overstated. In my IAQ presentations I normally say that, "IAQ is a multi-faceted problem that needs a multi-strategic solution". The multi-clustered ion does that. A single piece of equipment can deal with the particles floating in the air, the odors, the gases (includes VOCs) and biologicals. But more importantly, the multi-clustered ion is extremely effective on surfaces. In fact, 80% of the testing that has been done on this technology, both clinical and in the field, has been done on surfaces rather than the air. Why? Because it is much easier to quantify contaminants on surfaces. Air quality is extremely dynamic and difficult to test, especially in living environments. It goes without saying that if this proactive technology is keeping the surfaces clean, it's certainly keeping the air that it's moving through clean, too.

As an IAQ Professional, I do assessments of indoor environments in both commercial and residential settings. The mold/bacteria sampling always includes both air and surface samples. We take enough samples throughout the entire environment to create an IAQ profile of that environment. Typically, we will take VOC samples along with relative humidity and temperature because each plays a part in effecting the indoor air quality. Once the IAQ profile is created, problems can be identified and addressed. We address those problems with the NORMI Sanitization Protocol, a wholistic approach to improving any indoor environment.

Part of a sanitization process in any contaminated environment will include this type of multi-cluster ionization technology. Post testing, that is, testing after the sanitization process is in place, always shows a reduction in particulates, odors, gases (VOCs) and biological in both the air and on surfaces. It's a complex solution to a complex problem made simple through a single MCI™ technology.

This book has been written to help the consumer make sense of the options for improving indoor air environments. I always say, "I don't fix people, I fix buildings" because I know that when your indoor air environment is improved there is often an improvement in your health and well-being. Educate yourself and the truth will become very clear. There are answers, and they are usually easy to understand.

[i] http://www.nj.com/mercer/index.ssf/2011/10/after_a_decade_the_legacy_of_t.html