Cost Saving Applications for Bi-Polar Ionization in the Commercial and Industrial Marketplace

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IAQ and Ionization

As a method of cleaning air, ionization is not a new concept to the US and other worldwide marketplaces. Sales of IAQ (Indoor Air Quality) products exceeded 1.4 billion dollars in the US in 2005. Ionization as a means of cleaning air has become quite popular due to the success of the Sharper Image "Ionic Breeze' and other similar products. The majority of these products work on the "electrostatic precipitator" principle, which means to generate a single polarity ion to attract dust or some other particle and to draw it back and collect it to an oppositely charged collector cell.

Bi-polar or dual polarity ionization works on a different principle. Bi-polar systems generate both negative and positive ions. The systems are designed to provide sufficient ionization to the space to be treated and allow the energy imparted by the ions to transform ordinary oxygen into Reactive Oxygen Species, Superoxides, Peroxides, and Hydroxyls. These reactive oxygen species can provide a number of air quality benefits including, particle diffusion, VOC (volatile organic compound) breakdown and microbial (molds, bacteria) reduction.

Because of the variety of applications that can benefit from these systems, bi-polar ionization has been used in Europe for many years and is now beginning to be applied in the US marketplace. Studies have shown that these systems are beneficial to improving overall indoor air quality and help to alleviate the factors which cause "Sick Building Syndrome" that can affect the physical and psychological health of building occupants, affecting productivity.

IAQ and Commercial Buildings

The term "Sick Building Syndrome" has been coined to describe a building in which 20% or more of its occupants complain of symptoms such as; eye irritation, sore throat, headaches, drowsiness, dizziness, fatigue and nausea to name a few. The person feels relief when the leave the building and the causes for the symptoms are not obvious. When a building is labeled as a "sick building" it will often have serious financial impact on the owner of the building.

The most prevalent method of improving IAQ in buildings is to increase the amount of outside air that is introduced into the building. Increasing the outdoor or "fresh" air introduced will dilute chemical off-gasses (VOC's) which are often the cause of sick building syndrome type situations. This can be a very effective, but costly solution as will be detailed further.

Improving IAQ Increases Performance

As mentioned earlier, increasing outdoor air introduction will improve IAQ and positively effect occupants in buildings. In a study conducted by the Harvard School of Public Health, two very similar buildings studied one with an outdoor air ventilation of 25 cfm (cubic feet per minute) per person and one with an outdoor ventilation of 50 cfm per person. In the building with increased ventilation HSPH concluded a cost savings of $480 per worker per year due to decreased absenteeism and increased productivity. They also concluded that US companies might lose as much as 22.8 billion dollars per year due to poor ventilation causing poor IAQ. The study does go on to say that some of the cost savings would be reduced due to increased energy costs to condition the increased outdoor air.

Bi-Polar Ionization to Improve IAQ and Reduce Energy Costs

Conditioning outdoor air can be quite costly. The USEPA in its report "Energy Cost and IAQ Performance of Ventilation Systems and Controls" has determined that if a building where occupancy averages 7 people per 1000 square feet can reduce its outdoor introduction by 10 cfm per person, this action can result in a 4% savings in the building's total energy bill. As occupancy become more concentrated, the savings become greater. Also different types of buildings studied produced different results. Please see the chart below:

Type of Building	Size	Occupant Density	CFM Reduction	Energy Savings
Office	338,633	7 per 1000 ft2	10 cfm	4% approx.
Office	338,633	15 per 1000 ft2	10 cfm	8% approx.
Education	50,600	30 per 1000 ft2	10 cfm	15-32% approx.
Assembly	19,600	60 per 1000 ft2	10 cfm	35-40% approx.

This is where bi-polar ionization systems can be quite beneficial to both enjoying the productivity gains of improved IAQ, while reducing costs by not increasing outdoor air introduction. In the Harvard study much of the productivity losses were due to transmission of airborne illness. Bi-Polar ionization can curtail the spread of these illnesses. Its ability to decay particles out of air more rapidly, takes them out of the breathing range where they pose the most threat to people's health. Also particles are often the vehicle for many bacteria, germs and viruses to become airborne. The effect of bi-polar ions on forming reactive oxygen species also has a direct effect on bacteria, germs and viruses by disturbing their reproductive cycle and eventually destroying them. Additionally many building complaints and irritations are caused by VOC off-gasses, the two most common in office environments being ammonia and formaldehyde. The reactive oxygen species break down these hydrocarbons eliminating the source, which effects many occupants' productivity and comfort. Bipolar ionization systems can provide these benefits with a minimum of outdoor air introduction. Typical office systems require only 5 to 10 cfm per person of outdoor air to be effective. Bi-Polar systems are also quite efficient. A typical unit that can serve 10,000 square feet of office space, will consume only 45 watts of power.

BiPolar Ionization and Reduced Energy Costs in Industrial Applications

In industrial process manufacturing many dollars are spent and energy used to control exhaust emissions. To conform with US clean air standards and the state's DEP (Department of Environmental Protection) regulations on permissible outdoor exhaust emissions, many manufacturer's have had to incur significant costs to control emission concentrations and /or modify their manufacturing processes. The most common systems in use in the US employ a catalyst or oxidizer to burn off the emissions and reduce VOC concentrations that would pollute the outside air. These systems use large amounts of electricity and either natural gas or oil to perform their function. Also because of the ramp up time they require to function, when these systems are down for maintenance or service significant production time is lost waiting for systems to come back on line. Bi-Polar ionization emission control systems have been used for many years throughout Europe to perform the same emission control functions. There are significant cost saving benefits with these systems as they require no fossil fuels, use less electricity and can be taken down and brought back on line quickly when maintenance or service is needed. Please see the chart below for a comparison of a typical thermal oxidizer system used to control exhaust emissions and a bi-polar ionization system to perform the same function:

Comparison of Thermal Oxidizer to Bi-Polar Ionization Scrubber

Thermal Oxidizer Index = 100

	Thermal Oxidizer	Bi-Polar Ionization Scrubber
Initial Investment	**100%**	**25-30%**
Electric Energy Consumption	**100%**	**1.5%**
Fossil Fuel Cost	**100%**	**0**
Maintenance Costs	**100%**	**15-20%**
Process Gas Purification	**100%**	**100%**

Summary

Bi-Polar ionization provides an attractive option for both commercial buildings and industrial manufacturing facilities in their efforts to reduce energy costs. In commercial application bi-polar ionization systems can allow the operator of the building to reduce energy costs by minimizing outdoor air introduction without compromising indoor air quality and occupants' comfort and productivity. In industrial manufacturing, bi-polar ionization systems provide a cost saving option to allow manufacturers to comply with emissions regulations and with minimal impact on their businesses

References

Harvard School of Public Health – "Risk of Sick Leave Associated with Outdoor Air Supply Rate, Humidification and Occupant Complaints".

USEPA – "Energy Cost and IAQ Performance of Ventilation Systems and Controls" Executive Summary

EPA Journal – "Economic effects of poor IAQ".

USEPA – "Indoor Air Quality and Work Environment Study, Volume IV".