In Theory – 5

How To Optimize Ionizer Performance While Avoiding Unnecessary Investment.

By Jim Curtis, NRD LLC

In determining your best investment in ionization equipment it's important to consider the specific task you expect the ionizer to accomplish. Ionizers are capable of delivering many benefits including: control of particulate contamination, increased process speeds, improved operator safety, preventing the ignition of volatile materials, and protection of electrostatic discharge sensitive devices. You should decide the purpose ions will serve and the benefit you expect to realize from ionizer usage.

It is recommended you establish performance requirements. Consider the desired speed of discharge required by the dynamics of the process (process speed). The need for positive/negative ion balance will depend on the sensitivity of the product or process. Issues such as ionizer balance can turn an application into a disaster after a few weeks of operation if the ionizer isn't capable of maintaining the required level of balance.

Electrical or high voltage corona ionization (HVCI) systems create particles. Particle generation may not pose a significant problem in some installations, but in others it may cause yields losses or a reduced level of product quality.

Charge Elimination

Air ionizers neutralize charge by creating mobile positive and negative charge carriers. Two mechanisms allow ions to neutralize charge: *first* opposite polarity charge will be attracted to the target object facilitating electron exchange, and *second* ions create a conductive medium in the surrounding air. Conductive air presents a path that allows charge from the charged object to flow to ground potential.

It's important to understand how ionizers work and the effect the environment has in limiting the ability of an ionizer to deliver the ions produced. Neutralization of charge by air ions is dependent on a number of complex interactions. Ions require air flow around the target object and act to neutralize surface charge on an object. Ions are not capable of penetrating equipment cabinets or passing through solid matter, liquid, or thin film.

The industry standard ionizer test (ANSI/ESD Association S3.1-1991) requires a 20 picofarad test instrument utilizing a six inch square conductive plate as the test target. The instrument is intended to approximate a six inch silicon wafer. The standard was designed to determine the discharge and balance performance of four types of ionization equipment. Each test configuration results in an ideal ion environment. This is a good standardized test for comparing the relative performance of various manufacturer's equipment but the results may bear little resemblance to your real world application.

Environment

Frequent ionizer users are aware of the impact charge has on the time it takes to discharge an object. The higher the charge the longer the discharge time. Charge will decay exponentially *if* the ion concentration stays constant, but many factors effect ion concentration.

Among factors effecting ion concentration are the ionizers ability to produce and deliver sufficient ion concentrations consistently and reliably, positive and negative ion balance, distance from the ionizer to the target object, existence of ground planes, and obstructions in the ion path. Electric fields will act on ions causing them to be distorted or redistributed. Unintended air flows caused by equipment and operator movement, even walking through the room will redistribute ions. These issues can be particularly troublesome to room system installations since the distance from the ionizer to the target is usually several feet.

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Delivery

Time and distance have a significant impact on ion concentration and the efficient delivery of ions produced. Increased distance allows additional time for free ions to find a way to become neutral before the intended target is reached.

Opposite charged ions in a gas media are attracted to one another, quickly recombine, and become neutral molecules. Ions must reach the intended target quickly to avoid recombination. There are two ways ions reach the intended destination. The first method is *electromotive force*. Charge fields attract ions of the opposite sign causing ion current and an exchange of electrons. The second delivery method is *air flow*. The important factor in airflow is gas velocity. Efficient air flow is typically provided by an electric fan (i.e. tabletop blower) or from a source of compressed gas such as a blow-off gun.

In either case the distance from the ionizer to the target object or area is very important. An object directly immersed in the ion cloud will have exposure to the largest possible number of ions produced by the ionizer.

As ions travel to the target the concentration is reduced. They become neutral through recombination, encounters with ground planes, or a charged object which is not your intended target. Locating an ionizer close to the object to be neutralized with result in faster discharge times, more efficient use of available ions and better control of electrostatic charge.

Summary

Ions have a high propensity to recombine and are easily distorted or redistributed. They require relatively high velocity air flow when expected to travel distances greater than a few inches. Optimize performance and investment by installing ionizers near the intended target object.

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