Improving Ionizer Balance Using External Feedback Sensors At The Work Surface

Manufacturers of ESD-sensitive devices strive to limit electrostatic charge accumulation on surfaces where the sensitive devices are processed. To prevent these charges from accumulating, every effort is made to ground all surfaces where the ESD-sensitive devices are processed. However, process-essential insulators and isolated conductors may remain in the process (including the ESD-sensitive device itself). Ionizers are frequently employed to neutralize charges that accumulate on those process-essential insulators and isolated conductors.

However, perfect charge neutralization is not achieved. Even the best ionizers exhibit some variation in their ability to produce positive and negative ions in balance, and many ionizers feature an internal feedback system to sense and correct air ion imbalances. Using this internal feedback system, the best ionizers limit ion imbalance at the work surface to several volts over long periods of time.

An analysis of ion balance (offset voltage) at the work surface demonstrates that these internal feedback systems in ionizers are not fully effective in controlling ion balance near the work surface. Ionizers appear to remain blind to some external factors effecting ion balance at the work surface, such as variations in temperature and humidity. The ionizer balance can easily exceed desired limits due to the effects of these external factors.

Testing Demonstrates Ionizer Imbalances At Work Surface

The ion balance (offset voltage) near a work surface was measured using a Trek Model 540 Ion Balance Monitor. Figure 1 shows the offset voltage near the work surface while an ionizer is in operation above the work surface. Over a 24-hour period, the offset voltage varied by several volts despite the fact that the ionizer features an internal feedback system to sense and correct air ion imbalances. This variation correlates to changes in room temperature. (See page 2 for details about the tests.)

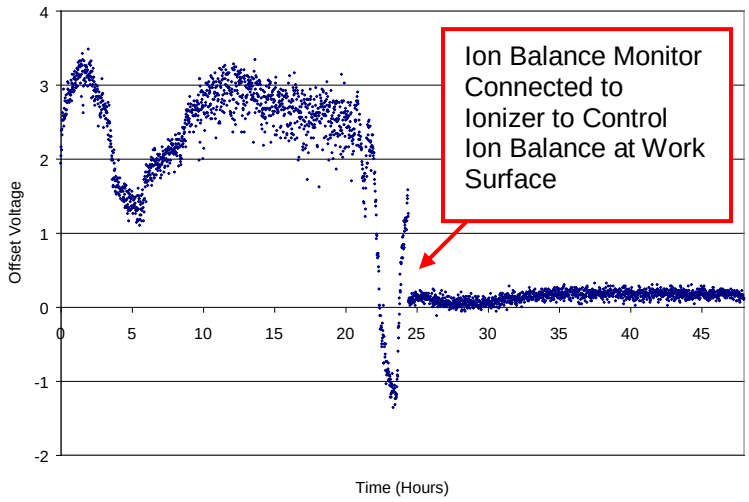

Figure 1: Effect of External Feedback Sensor On Ion Balance

Feedback Sensors At The Work Surface Improve Ion Balance

Some ionizers accept a control signal from an external (feedback) sensor to control the balance of positive and negative air ions. The output of the external sensor, such as the Trek Model 540 Ion Balance Monitor, causes the ionizer to generate extra positive or negative air ions, as required, to bring the ion balance near the work surface back into balance.

Figure 1 shows that when the output of a Trek Model 540 Ion Balance Monitor was connected to the ionizer as a feedback signal to control ion balance that, ion balance at the work surface was improved by a factor of ten.

Conclusions

Ionizer balance can easily vary by several volts due to external factors, despite internal systems to control balance.

An ion balance monitor used as a feedback sensor will compensate for external influences, such as variations in temperature and relative humidity, and control ionizer balance to within fractions of a volt.

The ion balance was measured using a Trek Model 540 Ion Balance Monitor, which uses a one-inch-square floating plate to measure offset voltage on the ion collecting plate. Figure 1 shows that, over a 24-hour period, offset voltage changed at the work surface by several volts. The ionizer balance was subsequently tested while also monitoring temperature. See Figure 2.

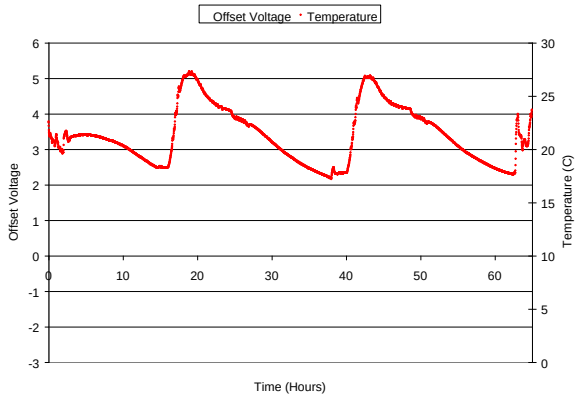

Figure 2: Ion Balance Versus Room Temperature

Note: The Model 540 was tested in an environmental chamber (without the presence of ionization) to determine if part of the variation in balance was due to the effects of environmental factors on the Model 540 that was used to monitor the offset voltage. The ion balance monitor was placed in an environmental chamber and its ion collecting plate was grounded through a 100 GΩ resistance. The offset voltage, temperature, and relative humidity were recorded while temperature and relative humidity were changed.

The Model 540 Ion Balance Monitor was not influenced by the environmental factors and did not contribute to the measured variances.

Effects of Temperature. Tests of an ionizer in an environmental chamber shows that temperature has a direct effect on ion balance. (Relative humidity was held constant.) See Figure 3.

Effects of Relative Humidity. Tests in the environmental chamber showed that relative humidity *usually* demonstrated an inverse effect on ion balance. (Temperature was held constant.) See Figure 4.

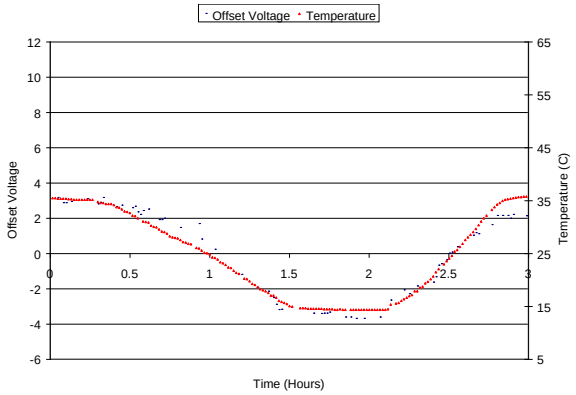

Figure 3: Offset Voltage Changes Directly With Temperature

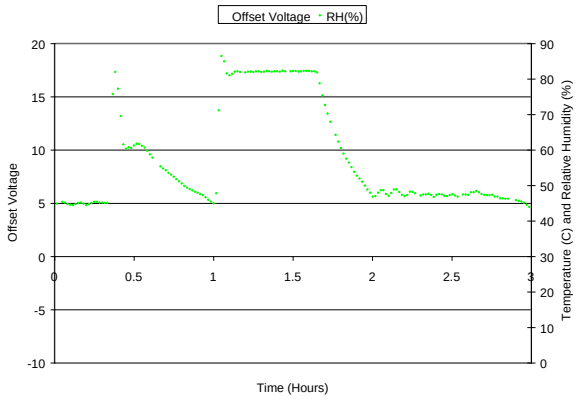

Figure 4: Offset Voltage Changes Inversely With Relative Humidity

Effects of Line Voltage. Variations in AC line voltage did not affect ionizer balance. However, only DC ionizers were tested. No AC ionizers were tested.

Note: These experiments were limited, and the effects of external factors on ionizer balance may vary from one model of ionizer to another.

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