

STATIC ELECTRICITY - A BALANCING ACT

Ever give a second thought to why some things cling together, seemingly by magical forces? What is it that causes clothing to cling together in a clothes dryer, or a skirt, dress or trousers to cling to a person's body? What is it that causes our hair to stand on end at times, and what is it that causes a shock to be delivered as we reach for a door knob or a vehicle handle?

All matter is made of single atoms or groups of atoms called molecules. Static electricity is generated when an unbalancing of the molecular construction of non-conductive materials occurs. A balanced atom, stable, electrically neutral, and carrying no charge, consists of positive charged protons that make up the nucleus and an equal number of orbiting negatively charged electrons. .

Static electricity, also known as triboelectricity, is a charge that is created by friction when one material surface is rubbed against another. Static electricity occurs when there is an imbalance of electrons on the surface of a material so that the material has either a positive or a negative charge instead of being neutral and stable. What happens is that electrons belonging to atoms on a material's surface are momentarily worn away. The material that exerts a stronger nuclear pull attracts electrons so that the electron total exceeds the number of protons and the nuclei develops a negative charge. The material exerting a weaker pull gives up electrons and becomes short of electrons so that the number of protons exceed the number of electrons and the nuclei develops a positive charge. When this happens an imbalance of electrons has been generated and static electricity results. The strength of the static charge is a matter of how many electrons have been added or removed from a material's surface. The greater the change the greater the imbalance and the greater the force. The static charge that is created can be measured with either a voltmeter or a fieldmeter. Electro static fieldmeters measure in volts per distance.

The time of the year is a factor as winter and its low humidity dryness is the worse time for static problems, while the moist, warm air of summer leads to a natural dissipation of static.

In an effort to achieve electrical neutrality, a charged material will exert a force on the nearest oppositely charged material. Materials similarly charged will repel each other and oppositely charged materials will attract each other. The forces involved are what we call static electricity.

Basically, insulators generate static electricity, conductors do not. However, both insulators and ungrounded conductors become electrically charged by friction. Proper grounding is effective in preventing undesirable frictional static electricity from building up on conductive materials. Often rollers on equipment are not grounded and present problems as static charges accumulate. It is critical to remember that electricity can be removed from a conductor to ground safely, but electricity cannot be removed from an insulator by grounding.

The two most common ways in which we see static electricity generated are by contact of one material with another, followed by separation and by friction. Every industry sees static electricity generated the same way; friction on an insulative material. The greater the insulator the material is, the greater the static charge that is able to build up on its surface, and the more severe the potential problems of attraction, repulsion and discharge.

Everywhere there is contact of and separation of ungrounded conductors or insulators, we can expect to find static electricity generated. When a page is turned, paper or film is unwound or rewound, substrates are fed from a pile, slid across one another or fed through rollers, we find static electricity generated. It's generated as the result of almost any material handling process including, cutting, slitting, sheeting, folding, printing, hot stamping, heat sealing, jogging, laminating, coating, etc. Static may also be generated by sudden changes in temperature.

Contamination is also a concern in many processes as static electricity attracts and holds onto small particulate matter, whether it be dust and dirt, or of other origins. Effective countermeasures must include cleaning, neutralizing and vacuuming systems.

When static buildup in wood, paper, plastic, cloth, or other insulator materials becomes a problem, several countermeasures may be considered:

1. *Change the material to a conductive one, replacing an insulative one.*
2. *Modify the material by adding moisture (making it more conductive), add a surface antistat or add an internal antistat.*
3. *Neutralize the material.*

Neutralization is the answer to static electricity when simpler corrections are ineffective or not practical. Static bars, ionizing air nozzles and combination static/vacuum systems are available to correct static electricity problems.

Air ionization is the most accepted and widely used method of static electricity control. Air ionization effectively removes electrons from oxygen molecules thereby creating negatively charged electrons and positively charged oxygen molecules known as ions. A positively charged material will attract the negatively charged electrons and its static charge will be neutralized, while a negatively charged material will attract the positively charged ions and become neutralized.

Air ionization principles are utilized in three types of static neutralization equipment: powered, passive and nuclear.

Passive neutralizers utilize conductive bristle arrangements, which are located near the charged material to induce an electrostatic field between the points of the bristles and the material. The field ionizes the air which in turn neutralizes the material's static charge. They are limited to use in preventing excessive accumulation of static on materials.

Powered neutralizers ionize air by using a high voltage discharge. Either positive or negative ions may be produced to effectively neutralize a material's static charge. The distance between the electrode and the material to be neutralized is limited to less than 3 inches.

Static electricity is a problem for high tech and low tech alike. Static electricity can zap the tiny components of a computer chip or cause a computer glitch. It can cause problems for a myriad of other miniature electronic devices. It is behind everything from flash fires at gas stations, to attendant/driver shocks at toll booths as coins are exchanged.

Problems also abound in graphic arts. A static charge can cause a material to be unevenly coated as most coatings will be attracted to areas having the highest static charge. A static charge can cause materials to cling together in a sheet delivery pile, or in a roll, causing intimacy and "set off" of inks. Static can even mimic blocking. Press jam-ups can be caused as static cling results in multiple sheet feeding or misalignment. In web printing/coating, static charges can

cause materials to lose traction, or cling to rollers, causing web breaks and/or poor tracking .

Static electricity and its effects on coating and printing is a naturally occurring problem worth knowing about. The easiest approach to understanding static electricity is to measure it. Inexpensive instruments can locate and measure static electricity levels. Controlling static electricity and its influence on processes is no less important than controlling other process parameters such as *temperature, pressure, speed, humidity, and tension, etc.*

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