CDF Technical Memo

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Introduction to Anti-Static and Conductive Liners

Sources of Static Electricity

* Flow of flammable and combustible liquids
* Mixing and blending operations
* Coating operations
* Printing and lithography applications
* Spray finishing
* Explosives manufacturing

What is Static Electricity?

A static charge results from an imbalance of electrons surrounding an atom. In a stable atom or molecule, each proton is balanced by an electron in orbit around it. Although protons and neutrons are held tightly in an atom's nucleus, electrons can move freely, including movement from atom to atom.

A positive charge occurs when an atom has lost one or more electrons and has an excess of protons in the nucleus. A negative charge is generated when at atom gains electrons and they out number the protons. A charged atom is called an "ion".

Some materials, like plastic, hold their electrons tightly and do not allow them to move much. These materials are called insulators. Other materials, like steel, hold electrons loosely and allow them to move freely. These materials are called conductors.

The magnitude of an ion's static charge is a function of the number of electrons which have been gained or lost and is generally measured in kilovolts (kV).

Generating Static Electricity

Static electricity is the result of physical action between two or more materials. For example, plastic or paper traveling over and then away from a steel roll picks up electrons from the steel and becomes negatively charged. Since the plastic or paper is an insulator, a charge builds up on the surface and will attract anything with an opposite charge.

If the surface charge reaches 7-10 kV and is brought near a ground or a positively charged object, a rapid discharge can occur a static spark. Friction is the other major cause of static charges-walking across a rug, rubbing a balloon and even filling a drum with paints, dry powders or solvents. Static electricity will be manifest wherever highly insulated objects or isolated conducting objects are found.

If a hazard is suspected, the situation should be evaluated to determine:

(a) Can a charge be generated?
(b) Will the charge accumulate?
(c) Can discharge occur?
(d) Will an ignitable mixture be present at the site of the discharge?
(e) Will the discharge have sufficient energy to ignite the mixture?

Sources: NFPA 77 Static Electricity 1993 Edition
"Facts You Should Know About Static," Herbert Products, Westbury, New York. Form 3697

Controlling Static in the Plant

There are three methods of static control available. Each has its place and helps eliminate or minimize the problem. Each also has its limiting factors.

Conductive material is the grounding of all equipment and materials, provides control but will be limited by the conductivity of any given material. Paper, plastic and rubber are not naturally conductive, yet making them conductive with embedded carbon or other conductive materials will affect their properties and allow electrostatic charges to freely flow. This type of material is not affected by atmospheric conditions.

Anti-stat additives reduce a material's surface resistance, allowing a static charge to flow to ground or drain from the surface of a material on a continuous basis. Anti-stat additives are not permanent. Additives bloom to the surface during manufacture and can be removed from the surface by friction or washing. Anti-stat materials are also affected by atmospheric conditions (relative humidity and temperature).

Air ionization offers a third method of static control. The ionizer separates electrons from oxygen molecules creating a positive oxygen molecule that in turn neutralizes the static charge on a material's surface and dissipates into the atmosphere. The limitation of this technology is that it must be used in relatively close proximity to the material carrying the static charge. This method is sufficient to pass some but not all standard specifications.

Liners for Controlling Static Charge

CDF Conductive Liners are manufactured from carbon-loaded polyethylene to create an obvious path for static to escape. Material used meets MIL-P-82646, MIL-B-82647 and NFPA-56A specifications.

Surface Resistivity:	10^3 to 10^5 Ohms/square
Volume Resistivity:	< 3,000 ohms-cm

For maximum effectiveness, conductive parts need to be grounded or bonded during use.

CDF Anti-Static Liners have an internally incorporated amine compound that migrates to the surface of the liner allowing for atmospheric dissipation of the static charge. CDF's highest-rated anti-stat inserts meet the MIL-B-81705-C specification, which requires testing that ensures a 100% static decay time of less than 2 seconds in 12% relative humidity. This requirement represents CDF's highest anti-stat quality and is standard for most 55-gallon DrumSaver™ anti-stat products.

All other anti-stat products meet FPA-99 (National Fire Protection Association) standards, which require the decay time to be measured to the 10% (500 Volt) cutoff level and are sufficient for all but the most demanding applications. All CDF anti-stat products have a resistivity rating of 10^{11} Ohms/square. They are best suited for use in high relative humidity and non- or low-hazard environments. Shelf-test analysis shows anti-static properties remain at least 18 months following the date of manufacture.

Grounding of Containers with Liners in Place

There are many variables involved when determining how effective conductive liners will be in controlling static charges. Conditions in each plant vary, so it is best to contact your Plant Safety Manager for instructions on the proper handling of materials that may create a spark or ignition. The following is provided as basic information on grounding with a conductive liner and with an anti-stat liner. Contact your safety manager before implementing these suggestions.

To install a black, carbon-loaded conductive liner, first bond the liner to the steel drum with a bonding clip and then attach the grounding wire from that point. Be sure to attach the grounding wire to just the steel drum. Do not use anti-stat liners for materials that need to be grounded. CDF's anti-stat liners contain an internal anti-stat agent that is intended as an aid in reduction of static build-up. They cannot be used in a highly volatile area including, but not limited to electro-static coating systems.