

Controlling Static Alternatives to Tinsel

by Charlie Acquista

Converters of non-conductive web surfaces, such as pressure-sensitive adhesive (PSA) tapes, need to be constantly vigilant in controlling static electricity. High levels of electrostatic charges can be dangerous, and moderate levels can destroy an adhesive system permanently, cause fouling and jamming of production processes and damage to finished products.

New technology allowing faster production speeds exacerbates static-related problems. To reduce static, operators sometimes will slow down the production process intentionally—a costly practice, indeed.

The Cause: Contact and Separation

Static electricity is an accumulation of electrical charges on a surface. The polarity of the charge can be the result of an excess of electrons (negative charge) or a deficiency of electrons (positive charge). Charges accumulate on

the surface of non-conductive material such as paper or plastic film, and they also can accumulate on ungrounded conductive materials such as machine parts and the human body.

When surfaces are in contact with each other, a transfer of electrons occurs. Friction, pressure and web speed will accelerate this transfer. When separated, the surface that has gained electrons becomes negatively charged, and the mating surface giving up the electrons becomes positively charged.

This process, known as triboelectrification or tribocharging, results in the generation of static charges on the surface of PSA tape as it unwinds from the roll and as it contacts and separates from surfaces such as idler rolls, nip rolls and printing or coating rolls. The build-up of electrostatic charges is a cumulative process, increasing each time the web contacts another surface. PSA tape can, therefore, accumulate a high charge as it

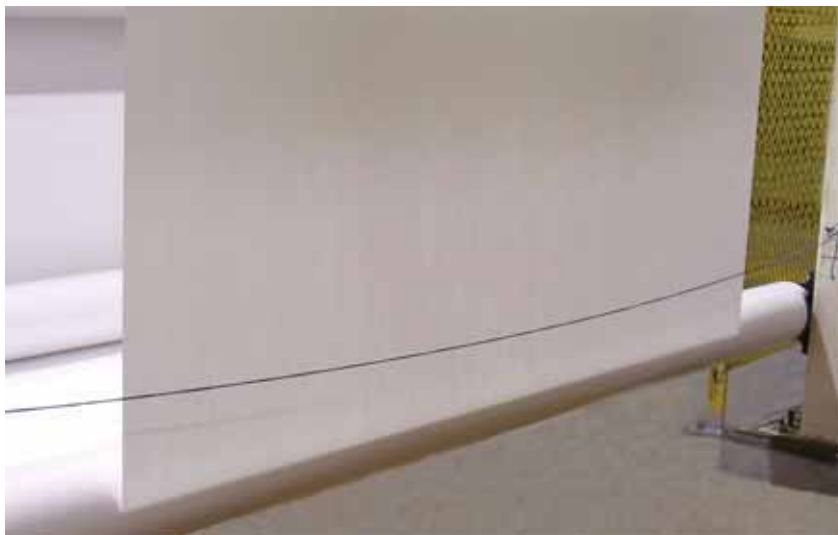
passes through transport systems where it comes in contact with several idlers.

On non-conductive materials, such as the papers and films used for PSA tape, charges do not build up uniformly across the surface. A single contiguous surface may accumulate a positive charge in some regions and a negative charge, or no charge, in other regions. The intensity of charge also will vary dramatically. For example, a positively charged “island” of 30 kV might coexist twelve inches from a positively-charged island of only 500 volts and eighteen inches from a negatively charged island of 2.5 kV.

The Impact

We are all familiar with the shock or spark caused by so-called electrostatic discharge (ESD) events. On a small scale, you feel an ESD in the form of a spark when you touch a door knob after walking across a carpet. On a much larger scale, you observe an ESD when lightning storms flash across the sky. An ESD occurs when a static electrical field exceeds a certain threshold value, causing an ionized conductive channel to form in the air as nature’s desire for balance plays out. There are a number of adverse effects of ESD. Specifically:

- **Personal safety.** An ESD can be painful and cause burns, cardiac problems and even death. In addition to the direct health effects of exposure to electrical current, there also is the secondary hazard of operators suddenly recoiling from the shock and injuring themselves by falling against dangerous machinery.
- **Explosion and equipment damage.** Static discharge is a spark.



Because the static string does not need to make contact with the web, it lessens the possibility of web damage, coating damage or contamination.

Areas with flammable liquids or gases, such as solvents, must remain spark-free at all times. Electrostatic discharge can have sufficient energy to ignite hazardous vapors in coating heads and gravure printing operations. An ESD event also can disrupt logic in PLCs and sensing equipment causing processing errors and costly down time.

- **Damage to the adhesive system.** Static buildup and ESD events can damage the PSA release liner of the product being unwound. When the silicone coating is disrupted by static it will no longer function as a release system in the area affected by the discharge. The adhesive will “split” between two sides of release

liner. Alternatively, the liner can fail to release where it is damaged, making it difficult to remove the liner as designed.

- **Equipment jams.** The accumulation of electrostatic charges can cause problems, even if ESD events do not occur. If static charges are not neutralized, sheets of materials will stick together, creating jams in downstream processes.
- **Product damage.** Electrostatic fields also attract dust particles, fibers, bugs and hair, which results in surface contamination. This causes obvious quality problems in printing, coating and laminating, as well as cleanliness problems with medical PSA applications. Moreover, static

charges can cause uneven coatings and “wicking” of inks, and pressure-sensitive tape carrying a static charge can damage sensitive electronic components.

Common Static Control Methods

To control static on coating and converting machines, two general types of ionizers are available—passive ionizers and active ionizers. Passive ionizers, also called induction ionizers and non-permanent static control devices, include static tinsel and static string, which simply are grounded emitters placed parallel and close to the charged material. The electrical energy of the charged material will excite the passive ionizer, causing it to gener-

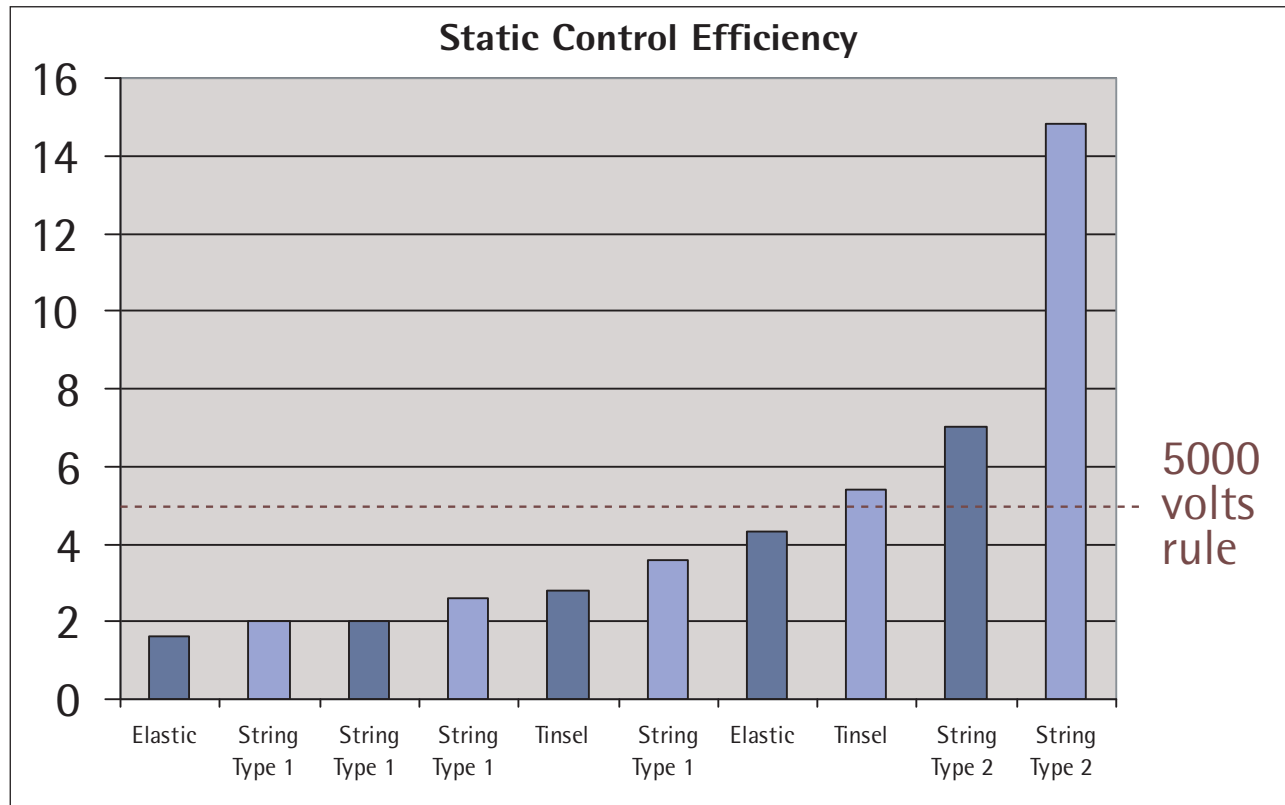


Table 1: Static control efficiency results from one series of tests performed by Adchem engineers. Static String Type 1 and Elastic (both from Alpha Innovation) consistently produced results below the 5000 volts rule.

Controlling Static

continued

ate air ions of the opposite polarity. If positioned properly, a passive ionizer can reduce the electrostatic charge successfully.

Active ionizers (also called permanent static control devices), such as high-output static neutralizer bars and static blowers, are powered by an external source of electrical voltage. Alternatively, radioactive material can be used as an ion source. The relatively high purchase cost of active ionizers has limited their use in the converting industry.

Tinsel, also known as garland, is relatively inexpensive and remains one of the most widely used methods for controlling static. However, anti-static tinsel is composed of copper, and pieces of this soft metal can break off and contaminate the product.

Extensive Testing

To address this problem, engineers at our company tested a variety of passive ionizer products to determine whether any of these methods could provide equal or better static control compared to tinsel, without tinsel's risk of product contamination.

Side-by-side evaluations were performed at our 200,000-square-foot engineering and manufacturing facility in Riverhead, N.Y. Five different passive ionizer products were tested: anti-static tinsel, static elastic, static wire and two types of static string. Each anti-static product was prepared and then installed one after another in static "hot-spots" along the production line.

The static level was measured in a free space (an ample distance from any rollers) 10 minutes after the start of a production run. Precise measurement of the static charge over a free-span web surface was performed with a hand-held



Installation of Stop Static string at Adchem's facility in Riverhead, N.Y., for static control efficiency testing.

electrostatic field meter.

The testing procedure was repeated for five different PSA products with non-conductive web surfaces composed of a variety of materials.

Superior Performance of "Stop Static" String

The test results showed that alternative passive ionizer methods can provide better static control than tinsel. In fact, one product, the Static String from Stop Static, a division of Alpha Innovation of Marblehead, Mass., provided significantly better static control for all five web surfaces tested. The Static String product maintained static levels consistently below the "5000 volts rule" established by Albert E. Seaver in 1993 and generally accepted as the industry safety standard. The Static String product from Alpha Innovation outperformed other passive ionizer products including a similar string product from another manufacturer.

An advantage of the Static String

product is that it is effective when installed 0.25 to 2.0 inches away from the web. Because it does not need to make contact with the web, it lessens the possibility of web damage, coating damage or contamination. The Static String product also was found to be relatively easy to install and remove, especially compared to tinsel.

Conclusion

When installed correctly, tests show that Static String reduced electric charge consistently below the desired level of 5kV in all products tested to date. We have replaced tinsel with Static String on all our coating and converting machines. As a result, the measured static level on all machines has been reduced. Moreover, our plant has eliminated the risk of product contamination by pieces of copper tinsel and can now guarantee a higher level of quality control. ■

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