Charge Control Antistatic Layers

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Contributing Editor

Product formulations are driven by features and costs. The product must satisfy customer requirements, and the production costs must support an acceptable profit margin. Designing products for good static performance meets both needs. Customers need products with good static performance to avoid sheet sticking, jams, and contamination issues. High levels of static can be the root cause of production downtime and material waste.

Many product formulations include antistatic layers or coatings. Antistatic layers may be categorized in two broad categories: conductive layers and charge control layers. Each type of antistatic layer has advantages and drawbacks as summarized in **Table 1**. Of course, any product design that includes an additional layer, coating, or additive will have a higher cost. The design challenge is to achieve satisfactory static performance at an acceptable cost.

Table I

Antistatic Layer Comparison

	Conductive Layers	Charge Control Layers
Operating principle	Dissipates static	Minimizes static charging
Materials	Polymeric additives, salts, conductive polymer, fibers & particles	Surfactants, charge control agents
Implementation	Additional layer or coating	Additive to existing layer or coating
Location	Surface layer or internal layer	Must be a surface layer
RH sensitivity	High for ionic conductors, low for electronic conductors	Minimal
Process sensitivity	Low	Performance is material specific
Cost	Higher	Lower

Static charge is a problem when there is too much. Charge control layers minimize charging between surfaces. High levels of static often occur on the unwinding rolls for slitting and for sheeting operations where the front and back sides of the film have widely different charging properties. Examples of products prone to unwinding electrification are rolls of film coated on one side; rolls of multilayer, coextruded products; and laminated films. In each case, tribocharging of the film surfaces occurs when the film is unwound as in **Figure 1**. As the roll unwinds, **Figure 2** shows that the outside surface of the roll has a high level of charge while the film span from the unwinding roll to the first roller is nearly neutral.

The charging properties of the front and back sides of the product may be controlled by using charge control agents. If either the front or back sides are coated, the charge control agents are surfactants added to the coating solution. A charge control layer may be coated on the back side specifically to control charging against the feature coating on the front side. The back side coating often includes particles to increase the surface roughness. The increase in surface roughness improves both static performance and wound roll integrity by increasing the coefficient of friction. In addition to improving static performance, the backside layer also may be formulated to control curl.

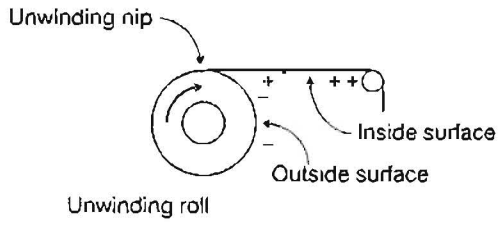

Figure 1. As the roll begins to unwind, charge separates at the unwinding nip as the inside surface peels from the outside surface of the roll.

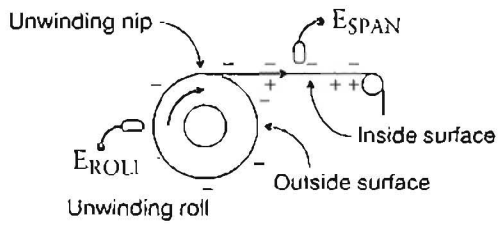

Figure 2. While the roll unwinds, charge separation at the unwinding nip results in a high field electric fieldmeter reading E_{ROLL} on the unwinding roll and a low fieldmeter reading E_{SPAN} because the film between the unwinding roll and the first roller is nearly neutral.

In coextruded products, the skin layers may contain charge control additives in addition to other components. Finally, laminated film presents a unique challenge as there are no coatings or surface formulation options. Good static control in the manufacturing process may be the only option.

Product may be designed with antistatic layers to provide good static performance. Charge control layers work by minimizing tribocharging. The front and back sides of the product should be well balanced, and both sides should be nearly neutral charging in customer applications. PFC

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