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Locate Static Dissipaters Using Web-Roller Electrification

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Abstract

Insulating webs accumulate static charge from repeated contacts with conveyance rollers. The theory of web-roller electrification is reviewed and used to predict the charge on the web surface exiting each roller using two empirical constants; Q_0 and S. At each roller contact, the web surface charge Q_S increases by an amount Q_0 and decreases by an amount $(1 - S)\ Q_s$ where parameter S is the percentage of charge that remains after contact as in (1).

$$Q_{S,EXIT} = Q_0 + SQ_{S,IN} \tag{1}$$

The static performance of specific rollers may be quantified by empirical parameters Q_0 and S. The charging parameter Q_0 is typically in the range $\pm 100 \frac{nC}{m^2}$. The percentage S of charge remaining after contact is typically in the range 80 – 100%. The charging parameters Q_0 of polymer covered rollers and nip rollers are higher in magnitude than those of metal and hard coated rollers. The discharge parameters S of conductive rollers and fabric covered rollers are lower than those of insulating rollers such as hard coated aluminum rollers and polymer covered rollers.

The web surface charge approaches an equilibrium charge Q_{EQ}.

$$Q_{EQ} = \frac{Q_0}{(1-S)} \tag{2}$$

The equilibrium charge Q_{EQ} is very large when the discharge parameter S approaches 100%. When the level of charge reaches a critical threshold Q_{DIS}, static discharges will occur in the exiting nip of roller contacts. The threshold charge density Q_{DIS} is on the order of $\pm 10 \frac{\mu C}{m^2}$. Exiting nip ionization causes web surface charge that is positive on one surface and an equal and opposite charge on the opposite surface. This pattern of charge is very difficult to neutralize and causes static issues at the winder and in subsequent operations including customer applications.

The location of static dissipaters such as tinsel, conductive brushes or active ionizers may be determined by requiring that the web charge Q_S remain below the threshold Q_{DIS} for exiting nip ionization. Web-roller electrification is used to estimate the maximum number of rollers that is permitted between static dissipaters. Rollers such as polymer covered rollers and nip rollers generate such high levels of charge that discharge can occur in the exiting nip of these rollers even when the entering web has no charge. Static dissipaters must be positioned on the web span exiting these “high static” rollers. The static dissipaters must be located on the correct side of the web to minimize static at the winding roll and in subsequent operations including customer applications.