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Sheet sticking caused by charge flow in a buried conducting layer

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ABSTRACT

Electrostatic charge causes sheets to misfeed from the input stacks in inkjet and laser printers. Conductive layers within sheets that suppress discharges and reduce particulate contamination also aggravate sheet sticking. The surface potential of sheet media is a direct measure of the charge in the buried conducting layer. Our experiments find that the times characterizing the voltage transients range from 10 to 1000 s for conductive layers with sheet resistivities in the range from 10^{+9} to 10^{+11} $\Omega/\square$. Our models predict that charge flowing in the conducting layer increases the electrostatic sticking force. Model predictions are in agreement with our experimental measurements.

1. Introduction

As shown in Fig. 1, electrostatic charge causes sheets of media to stick to each other. Initially, these sheets slide apart easily. However, when the contact area becomes small, the attractive force increases and causes the sheets to stick together. Fig. 2 depicts a simple printer, scanner, or other device that feeds a sheet from an input stack, transports it through the device, and collects the finished sheet in an output bin. Even with excessive static charge on the top sheet of the input stack, the sheet initially slides easily when a feeding sequence begins. During the feeding sequence, the static charge may cause the sheet to stick to the input stack, which reduces the reliability of sheet feeding. As the sheet is transported through the device, charge also may cause the sheet to stick to rollers, guides, and other objects in the transport path, which results in jams, reducing the overall reliability of sheet transport.

Preventing electrostatic problems during the transport of flexible media has been extensively studied. Improving static performance by providing a conductive layer on the surface of flexible media dates back to at least 1938 [1]. There are several disadvantages to using a conductive layer on the surface of films or sheets. The layer is exposed to the ambient environment and its properties may change with the relative humidity. Also, the components in the conductive layer may wear or change over time, limiting product shelf life. And, if the media must undergo processing, such as photographic development, the surface layer may cause undesirable foaming and be washed away, which compromises future static performance.

Burying the conductive layer within the media eliminates many of these problems and maintains good performance over time. Burying a layer specifically formulated for conductivity beneath a protective overcoat dates back to at least 1980 [2]. In the same way, resin-coated paper for photographic printing has benefited from the conductivity of the paper core.

However, buried conductive layers aggravate sheet-sticking problems. Buried layers are electrically isolated, so charge within the layer cannot flow easily to ground. As the sheet is fed from the input stack and transported through the device, charge flows through the conductive layer.

Understanding this flow of charge within the buried conductive layer is fundamental to predicting static performance. Because it is difficult to directly measure the charge flowing in the buried conductive layer, we measured the surface potential of a sheet that was lying flat on a grounded plate. The standard size of a medical imaging film sheet is 14×17 in., which is commonly designated 35×43 cm. Voltage was applied to an electrode that was clamped to one end of the surface of the sheet to electrically excite the system. The surface potential over the length of the sheet varied as charge flowed through the conductive layer.

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