SOME USEFUL TIPS FOR CARDING COTTON IN A NONWOVENS LAB

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Abstract

Carding is a critical operation in processing cotton for both woven and nonwoven fabrics. Basically, a carding machine opens, cleans and aligns fibers, as far as cotton is concerned. However, there are many different types of cards and carding systems for processing different types and qualities of fibers. To achieve optimum carding performance and efficiency, it is therefore imperative to select a proper card and set it according to the input fiber quality involved and the output fiber quality desired. It is unwise to use the same card for all types and qualities of fibers that are typically investigated and processed in a nonwoven research laboratory. This paper reviews some useful technical tips for processing, especially carding, cotton in a nonwoven lab. Selection, settings and clothing of a card and manipulation of other factors that influence carding effectiveness are briefly discussed.

Today, there are numerous carding systems and their modifications for processing fibers for nonwovens. Selection of a particular system chiefly depends on the nature and quality of the fibers and end-product involved. No matter what system is adopted, the quality of the final product largely depends on thoroughness of the fiber mixing, opening, cleaning, bleaching (if involved), blending and, above all, carding. Carding of synthetic fibers and carding of cotton for the nonwovens are two somewhat different processes. Synthetic fibers generally are long, strong, uniform and clean, whereas raw cotton fibers are relatively short, weak, irregular, and dirty or trashy. A standard bale of raw, ginned cotton has billions of compressed fibers which vary in length, strength, fineness, and maturity. Different bales of cotton may vary in trash content, color and hence grade. However, we should still expect a cotton end product, whether woven or nonwoven, to be uniform and homogeneous in its properties, especially the appearance.

To achieve the desired "homogenity" of a cotton or a predominantly-cotton nonwoven, we must first prepare the stock accordingly. Preparation of fibers for a nonwoven application includes a thorough initial-mixing, opening and cleaning, any blending, and carding. These fiber preparatory processes can, in fact, make or break a nonwovens operation. Although systematic planning and execution of all of these fiber preparatory processes are critical, the carding is at the top.

The purpose of carding cotton for the nonwovens is four-fold:

1. to effectively open and clean (by removing contaminants, approximately ½%, such as coarse and fine/pepper trash, etc.) the fibrous stock with minimal fiber damage and waste/loss;
2. to partially individualize and parallelize the fibers;
3. to remove too short fibers, motes and neps; and
4. to condense the fibers to the desired form (batt) of uniform linear density.

Carding basically is accomplished by two layers or sets of card clothing (on rolls) mostly consisting of a saw-tooth wire (occasionally embedded pins). The two sets of wires rake or tease the fibers, hold them for a while, and then release them. For example, the coarse wires of the licker in(s) rake the fibers from the feed roll/plate; the fine wires of the cylinder tease fibers into a filmy layer, so that a thin web of fibers is formed on the cylinder. The doffer wires gather the web from the cylinder to form a batt for the subsequent operations of a nonwoven project.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:731-732 (2001)
National Cotton Council, Memphis TN

There are a host of important factors that can make a considerable difference in the quality and cost effectiveness of the cotton web or batt produced in a nonwoven Lab. Some of them are briefly mentioned below:

Fiber Preparation

Because of the desired high throughput rates of a "nonwovens card" (for nonwoven applications), it generally is not as effective a cleaner as a regular cotton textile card. Therefore, it is imperative that the stock fed to the card is sufficiently opened and cleaned. If bleaching is involved, it is preferred to mechanically clean the fibers before bleaching, because 1) any foreign matter imbedded in the fibers during bleaching is difficult to remove in the subsequent opening and cleaning, and 2) bleached cotton fibers generally are more difficult to process in the cotton opening and cleaning equipment (K. beaters, card-like openers/cleaners, etc.), even though the bleached fibers generally are treated with an antistat, card finish.

Selection of Card

As stated previously, carding of synthetic fibers and carding of cotton fibers really are two different processes. It is unwise to use the same card for all purposes and projects. It will not give reliable results. At least two "versatile" cards, which can be easily and quickly modified and/or adjusted/set for different fibers and conditions should be available to a nonwoven lab.

Stock Feed

The gap spacing and the distance to the opening point should be adjusted, depending on the feed parameters, density, and stock-compression-at-the-card.

Selection of Card Clothing

Each wire tooth of a metallic clothing on any roll/flat is intended to pull fibers and later release them without any fiber damage or loss. However, in practice, many things can go wrong and the wires do not function as intended, resulting in unsatisfactory carding results. The common problems are: 1) improper selection of the wires for various card clothings, 2) excessive loading of the fibers with diminishing capacity and consequently diminished carding/combing effectiveness, and 3) dullness of and/or damage to the wires due to improperly opened and cleaned feed stock and excessive speeds of the various rolls such as the licker-in, cylinder and doffer. For a typical cotton nonwoven project, which does not involve much of linters, too short comber noils, waste fibers, and recirculation of fibers, the following wires should be adequate for effective carding actions, viz., separating, opening, cleaning, individualizing and parallelizing the fibers:

Licker in (first/breaker):	15-25^{0}FA and 60-120 wire points per square inch.
Cylinder (first/breaker):	10-25^0 FA and 200-300 p/in^2
Doffer (first/breaker):	The same for a condensed or a parallel web.

Generally, finer wire counts allow higher levels of opening and cleaning and higher roll speeds permit greater throughput, provided other influencing factors remain under control.

Settings and Speeds of Card Components

The settings and speeds of the feed roll, licker-in, cylinder, tip rollers/plates/flats, and doffer are critical and should be properly adjusted whenever a substantial change in stock fiber occurs. Again, it is unwise to process all materials such as different grades and qualities of cotton, wool, kenaf, milkweed, hairs, feathers, fruit, synthetic and other (novelty) fibers on the same card with almost same settings and speeds. Card

manufacturer's operation manual must be consulted for any such changes in the settings and speeds of the various card components. A card with capabilities of remote settings and adjustments between various card components such as main cylinder and doffer is desirable.

Suction and Air-Flow

Internal suction system should be simple and operator friendly. It should allow a slight vacuum in relation to the ambient atmospheric pressure. This will reduce cotton dust (and hence any risk of byssionosis) and fiber pollution in the card room. However, the fibers will have a tendency to load the edges of the rolls, which eventually may increase maintenance cost.

Effective use of Card Width

A typical card in a typical nonwoven lab has either a 40-inch wide main cylinder or a 50-inch wide cylinder, although 2.5 to even 5.0 meter wide, multiple cards are now common in the nonwoven industry, which mostly processes synthentic fibers. In a lab scenario, we occasionally use only a fraction of the cylinder width, which should not be expected to yield perfect or even reliable carding results. However, in certain research projects, it really does not matter much whether the carding was totally effective. For example, if antibacterial effectiveness of a certain chemical modification or treatment on a cotton nonwoven is to be investigated, the carding efficiency or effectiveness may not be critical. On the other hand, if an evaluation of the uniformity or homogeneity, hand and appearance of a cotton/polyester blend blanket is important, the effective carding is essential.