INCREASING EFFICIENCY IN NONWOVENS PRODUCTION THROUGH PROFESSIONAL DEVELOPMENT

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Abstract

Encouraging the professional development of the nonwovens technician can favorably influence efficiency in the nonwovens production facility. Keeping the technician at peak performance through proper education and motivation is as important to a quality product as is the proper maintenance of equipment. This paper will introduce the reader to concepts in personal safety, fiber processing, team building, and training that are essential to the professional development of the nonwovens technician.

Introduction

As the popularity of nonwovens end products continues to increase, competition among nonwovens producers also increases. To remain competitive, the nonwovens manufacturer must maximize production potential on two fronts. He or she must invest in the proper maintenance of and advancements in equipment and technology. And he or she must also invest in human resources. Although managers generally recognize the need to achieve and maintain improvements in machinery, they often overlook the importance of investing in the technician.

For the sake of clarity, we will define *technician*, in the context of nonwovens processing, as any individual specifically charged with responsibility for the quality and/or the quantity of the finished product. Therefore, technicians include, but are not limited to, mechanics, operators, process engineers, and middle management personnel responsible for the performance of these individuals.

This paper will present a model for promoting the professional development of technicians in a nonwovens production facility. The availability of astute technical personnel can significantly increase efficiency in production with relatively little cost to the plant.

Foundational Development

Starting with Safety. The most basic matter affecting efficiency in the nonwovens production facility is the safety of the workforce, for two reasons. First, worker injury lowers morale throughout the facility. Second, an injured technician is often unable to participate in the process, perhaps for an extended period of time. Efficiency in other work areas may suffer when technicians must cover for an absent coworker.

The first step in maintaining worker safety must be to determine when a technician should be permitted to approach the machinery. A person is considered safe to work around carding equipment when he or she understands and appreciates the dangers associated with that equipment. The technician should assume that all electrical wires are carrying current and are potentially hazardous. There are also potential dangers from high-speed rolls, from sharp objects, and from airborne contamination. Wearing jewelry or loose-fitting clothing around the equipment will also increase the risks of injury.

The second step in maintaining plant safety is for each technician to recognize his or her personal tendencies toward injury. Technicians must overcome natural inclinations to reach into machines to remove fiber chokes, or wraps around rolls and conveyor belts, while rolls are still moving. Persons tend to step over oil spills or loose fiber on the floor, rather than stopping to clean up or pick up. Persons also tend to lean on equipment or other objects that are near the card. And they tend to put their hands out and touch objects that draw their interest, without considering the consequences.

The third step in creating a safe work environment is to acquaint technicians with all available safety equipment and with all current safety regulations and procedures. Each technician working on and around carding equipment should know the locations of all emergency stops on every machine and how to engage them (see Figure 1). Each technician should locate and test all safety interlocks, machine covers, operational lights, bells or buzzers. Familiarity with these devices can mean the difference between efficient production, and a person or a machine being out of production for an extended period of time. In addition, each technician should know his or her emergency response team members and how to contact them if the need arises.

The final step toward worker safety is to encourage all technicians to respect each other's personal space. Crowding technicians at work can lower efficiency by causing them to rush and become careless, or even agitated. No technician should "help" another technician to perform machine maintenance without an express invitation. Uninvited "helpers" can unintentionally create hazards for others by leaving tools and parts in unexpected places. Or they could inadvertently position themselves directly in the path of other technicians performing maintenance.

Keeping technicians safe keeps them on the job. Once all possible care has been taken to ensure worker safety, managers can focus on increasing plant efficiency through other aspects of the technician's professional development.

Learning the Job. When preparing to introduce a new technician to any job within the nonwovens facility, it is most efficient to define the parameters of that job. The technician's job will include all of the tasks and responsibilities assigned specifically to him or her. A technician may be assigned to equipment operation, equipment maintenance, process engineering, or quality monitoring.

The greatest deterrent to efficient job training is vagueness. Therefore, once the tasks of the technician's job have been determined, they should be detailed clearly in writing. Such lists will aid technicians in maintaining speed and accuracy in the performance of their jobs. They can also encourage standardization among technicians performing similar functions.

Technicians should be shown the most efficient routes to parts, tools, and instructions required to perform their job functions. Supply areas should be readily accessible, properly stocked and neatly organized. Knowledgeable supply room personnel can direct technicians to the proper tool, part, Material Safety Data Sheet, or even equipment manual, with the least amount of time wasted. And plant purchasing can assist technicians in securing non-stock items that might be required to keep equipment running in unusual or emergency situations.

Technicians must know management expectations regarding their job performance. Standards for proficiency on each job should be published and strictly enforced, and technicians should be involved in developing those standards. Managers should establish a support system to aid those technicians who do not meet standards. All technical personnel should be required to complete pertinent training courses and demonstrate competence for required skills.

As they become more skilled, technicians will learn to recognize sights and sounds, like a chute reserve running low or a squealing drive belt, that indicate atypical conditions within the process. A trained technician can

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often maintain or increase processing efficiency by initiating corrective measures before problems become serious. In the event that a problem is more pressing, the technician must know to whom he or she should turn for assistance.

Interactive Development

Building the Team. The fact that the technician requires assistance is simply the result of inexperience. By creating a project team, management can condense the learning curve and maximize training efficiency by exposing the technician to others with expertise in the process. A suitable project team in the nonwovens production facility might consist of an equipment operator, a process engineer, the maintenance manager and a maintenance technician, a quality control technician, and the production manager. Each of these individuals will play an indispensable role in efficient problem resolution.

It is often the equipment operator who first sees a defect in the web. He or she will discuss the problem initially with other operators, in the hope that they might recognize the defect and know the cause. If this avenue proves ineffective, the operator will then approach the department manager, who will create a project team of knowledgeable persons to look into the matter. The process engineer will be a logical choice, since he or she should be the person most familiar with the flow of the fiber and problems that could develop. The maintenance manager, and the maintenance technician for this operator's machine, can lend their experience to correcting the problem. A quality control technician can keep the team informed of how the defect is damaging overall quality. And the production manager can encourage quick resolution of the problem to minimize loss of production.

The project team can begin its research by joining the equipment operator at the machine to study the defect. Once the problem has been observed and identified, the team can consider possible causes. Mechanical, electronic, and fiber-related causes must be investigated and dismissed in turn, until the actual source of the defect is determined. At this point, process engineering and maintenance personnel can aid in correcting the problem. Follow-up observation and testing by quality control can then be used to confirm that the defect has been eliminated.

In the course of eliminating the defect, the project team accomplished other things as well. Efficient problem resolution reduced downtime and increased runtime efficiencies. This minor problem, left unattended, could have led to more serious and costly ones. But equally important were the benefits to individual team members. The team helped technicians learn to speak the same language so that they could draw on each other's experiences. When the next processing problem occurs, each technician is more likely to be able to find a solution without the team.

Understanding the Process. Once the technician has been exposed to more than the narrowly defined parameters of the job, he or she is ready to move forward. Understanding the variables that influence the entire carding process can help the technician to anticipate and prevent certain problems, or more efficiently solve others. The fiber, the equipment, the environment, and the personnel all affect the efficiency of the nonwovens operation.

- **The Fiber**. The type(s) of fibers being introduced to the machinery are accompanied by various types of processing problems. Understanding how fibers behave during processing is helpful in preventing and troubleshooting processing problems that could interfere with efficiency. Of the synthetic fibers, polyester presents the fewest challenges. With a higher melting point and good fiber strength, it generally transitions well through the carding line. Polypropylene, polyethylene, and other low-melt fibers are more sensitive to frictional heat and have a tendency to fuse. Wider settings between carding rolls and plates can reduce this friction, as can the use of less aggressive metallic clothing. Nylon is susceptible to static electricity that causes the fiber to stick to rolls and plates, etc. Acrylic fiber has low tenacity (strength and memory) and tends to lose its crimp under intense carding.

  Natural fibers, such as cotton, wool, and the bast fibers (flax, hemp, and ramie) have natural protective coatings that lessen friction in processing. The problems with these fibers are the dirt, impurities, and the percentages of short, less desirable fibers.

  The *denier* of the fiber also influences its runability. Denier refers to the width of the individual fiber strand, usually discussed in a range of fine to coarse. Finer denier fiber is denser and takes up less space. The experienced technician will know that the large number of fibers in a fine denier mat will give good coverage in a carded web. However, fine denier fibers must be run at lower web weights to avoid overloading metallic clothing. Coarser denier fibers tend to give very good web integrity, with less load per wire tooth at carding. They transfer well from one carding point to another, because there are fewer fibers per given weight and more rigidity in the individual fiber strands.

  How the fiber mat looks at different points along its path can be revealing. Does the web show knots, neps, or other defects? Is it of even density, or does it show heavy and light places? Is there discoloration or some other indication that various types or colors of fibers are not blended well? The astute technician will recognize that all of these web defects can signal equipment problems. Learning to correctly interpret these signals comes only through experience in processing.

- **The Equipment**. Interested technicians will learn the basic functions of each machine in the equipment line. *Feeders* initiate the delivery of fibers into the nonwovens line. These would include feed hoppers, blending hoppers, and automatic milling machines. *Openers*, when required, begin to individualize the fibers, creating a network of fibers with more homogeneous density, finish, and blend. *Fiber reserves* collect large amounts of fiber at various points throughout the line to allow for better blending and processing stability. *Carding machines* intimately blend fibers and present uniform webs to finishing equipment. This category includes cards, garnetts, and airlay machines. Finally, *finishing equipment* such as needle looms, hydro-entangling machines, heated calenders, and through-air ovens, locks fibers into a finished structure.

  Once the technician learns how each piece of equipment functions, he or she can begin to study the flow of the fiber. Each technician should be able to explain the fiber path within each machine (Figure 2), and throughout the equipment line (Figure 3). Knowing the functions of the machines and how the fiber moves through the line will help in pinpointing problems so they can be solved before they intensify. The technician must also understand the functions of the primary components of each machine and the principles governing these functions. For example, feed rolls deliver fibers to a machine, but at the same time, they restrain fibers so that only the appropriate number are introduced at any given point. Feed rolls function in this manner in all types of machines. Rolls that card fibers are also used throughout the

process. This carding function occurs with blending rolls, workers, doffers, carding plates, and even spiked feed aprons. As the technician begins to understand carding principles, he or she can make precise and efficient adjustments from processing one type of product to processing another.

Frequently, an experienced technician can recognize the quality of a machine's performance through sight and sound. The erratic spiking of a photohelic gauge indicates that there is a fiber "rat-tail" in the ductwork. A worn or damaged bearing can knock or scream, requiring the technician's immediate attention. When senses are not enough, the technician can collect additional information by pulling tufts of fibers at various points along the equipment line and studying them for blend, cohesion, and fiber length. Checking the percentage of run time of each machine can also help to determine if the line is running efficiently to achieve the most uniform displacement of fibers possible.

An accomplished technician will eventually be able to understand how the pieces of machinery on the line are interrelated. A problem in one machine can be caused by a previously overlooked problem in another machine. For example, when all of the aspiration ducts on a nonwovens roller-top card are clogged, the cause is most likely low pressure in the filter house. Or if the web weight varies coming off of the card, it is more likely being caused by the feed mat, rather than by the card itself.

- **The Environment**. Any under-standing of fiber processing must include environmental considerations, like temperature and humidity. An ideal processing environment would be 71ºF, with relative humidity of 62%. But in the Southeast, we have higher relative humidity throughout much of the year. As long as the plant temperature does not burn off this humidity, most nonwovens operations can run successfully even at temperatures above 90º. However, if the plant temperature brings the relative humidity below 55%, static electricity will develop, causing fibers to cling to grounded surfaces like rolls, covers, belts, and duct work. Processing must stop while these surfaces are cleaned, lowering running efficiencies. Fiber manufacturers apply antistatic fiber finishes to lessen the effects of static. Unfortunately, this is normally helpful only at relative humidity levels above 50%.

  When outside temperatures drop, more generated heat is required inside the facility, leading to a drop in humidity and subsequently an increase in static. A filter house, which filters the air from the various processes, also generates heat and lowers humidity. Atomizers must be used to pump water molecules back into the dry air to eliminate static.

- **The Personnel.** Technicians who receive the best support will do their best to provide efficient and effective support for the process. Managers can support production personnel by providing an environment where information is shared, trust is earned, and good performance is rewarded. Sharing technical information can increase everyone's awareness of all the job functions in the plant and help technicians to know how to locate help when they need it. And the sharing of information facilitates a shared language for communicating about problems, as mentioned previously.

  Managers must develop trust within the nonwovens facility. Technicians must feel free to reach out for help with professional or personal problems that interfere with their performance. Discouragement, sickness, substance abuse, daily stress, and even misunderstandings with coworkers can misdirect a technician's energies. Attending to each technician's personal needs will let him or her know that someone cares. It will also encourage technicians to trust managers with information about problems affecting their performance, or that of others.

Managers must also provide technicians with goals toward which they can work. Persons with no chance for greater responsibilities or opportunities will stop growing. Hiring with the intent of promoting from within will give everyone the chance to better themselves within the system rather than seeking new opportunities elsewhere. A corrective rather than a punitive reprimand system will encourage further growth by all persons in the system.

As the technician continually accumulates new information about fiber processing, he or she is evolving and becoming more efficient and self-sufficient. Greater success in troubleshooting and streamlining the process will breed enthusiasm for further development.

Professional Development

Growing the Professional. When managers discover technicians with exceptional understanding of the process and eagerness for more education, they can look outside the plant for formal training opportunities. Taking advantage of these opportunities requires managers to commit time and money to increase the efficiency of the individual. This can be difficult in a production environment. Yet plans to cover personal absences, which should already be in place, could be extended to cover training absences. Or managers might consider working in place of the trainee. Becoming a "manager on the floor" can reacquaint them with challenges and problems faced by operators and mechanics. Training opportunities can be found in various regions and in various price ranges. Machinery manufacturers, fiber suppliers, metallic clothing manufacturers, manufacturers of fiber testing equipment, technical colleges, and private consulting firms offer training at their facilities or in the plant. And training must extend beyond machine-specific instruction. For example, modern control systems, which activate and regulate the processes, require technicians to be proficient in programmable logic controllers (PLC's).

Managers will want to earn the highest return on their training investment. One way to accomplish this is to train first those technicians who are inclined to teach others. They will often have a higher aptitude for receiving new information and will be better able to share that information with others. In time, they may become the leaders others go to for information or advice. Managers may also ask technicians who teach to accompany new employees to formal training classes, thereby promoting mentoring relationships or new work teams.

The knowledge technicians gain through formal training must be put to good use upon their return to the plant. Technicians should be encouraged to participate in decision-making and problem-solving sessions that require them to suggest creative but realistic solutions. Access to pertinent industry periodicals can help the self-motivated technician to keep learning. Frequent visits to different processing areas within the facility can help to sharpen problem-solving abilities. And opportunities to visit other production facilities and to talk with recognized industry experts can help build confidence in dealing with a wider range of processing issues.

Expanding the Horizons. When a technician achieves a performance level beyond management expectations, he or she will need even more room to grow. This does not necessarily mean moving the technician into a management position, but it will certainly mean moving him or her into a new role with expanded responsibilities and opportunities. Managers and

technicians can focus their attention on finding ways to make the plant's investment in professional development pay off for everyone. They may explore product development opportunities, or look for new markets for existing products. They can search for ways to improve the organization of plant systems, such as inventories for supplies, raw materials, or finished goods.

Plant managers may also look for opportunities to let technicians expand their horizons through education. Those with teaching abilities can take on more responsibility to share their knowledge and problem-solving skills. For example, technicians with exceptional mechanical aptitude could apply their talents to growing more efficient maintenance personnel.

Those technicians with an exceptional understanding of the equipment and the process may contribute in process engineering. Others may have an inclination toward quality assurance. They may have an eye for a quality end product, or special skills in eliminating problems that interfere with quality. Finally, some technicians may be able to recognize talents in others and effectively match them to new job opportunities within the plant. These persons may be best suited to positions in human resources.

Summary

Careful attention to the professional development of individuals associated with the processes of a nonwovens facility will drive efficiencies up and prepare able staffing for additional production lines. This paper has depicted a model that I have seen played out by many of our training customers. Methodical training, coupled with opportunities for personal growth, will encourage technicians to maximize their efforts and take on new challenges. The challenged, enthusiastic, and efficient professional will pay the highest dividends to the nonwovens facility, and will provide a much-needed edge to effectively compete in the marketplace.

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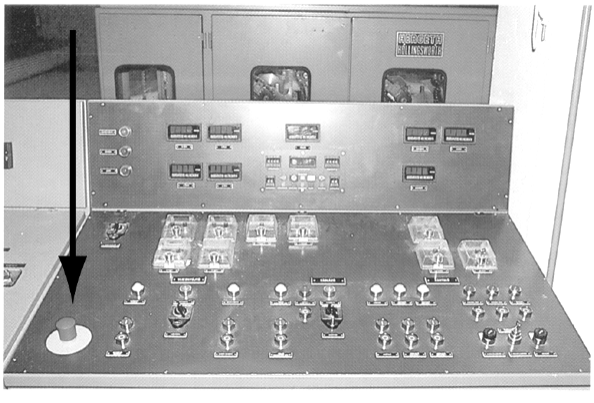

Figure 1. A Machine Emergency Stop.

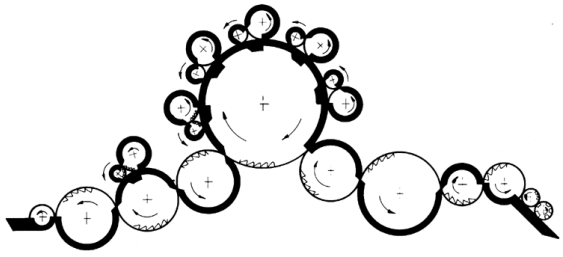

Figure 2. The Fiber Path through a Nonwovens Card.

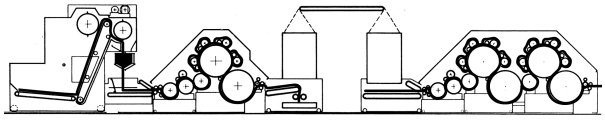

Figure 3. The Fiber Path through a Nonwovens Line.