Alvin W. Boese Papers.

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AMERICAN ASSOCIATION OF TEXTILE TECHNOLOGISTS, INC.

January 31, 1952

Mr. A. Boese
Minnesota Mining and Manufacturing Company
St. Paul, Minnesota

Dear Al:

As you will remember, we discussed sometime ago the proposal of your speaking before our Association on non-woven fabrics, and specifically the products that you are producing in this field. We have tentatively reserved May 7th, which is the first Wednesday in May, for your presentation of this paper.

As you realize, we must have some time to prepare proper publicity and I hope that you will reassure me in the near future that you can accept this date and be on our program. Since your speech will be published in our PAPERS, we will require a biographical sketch, a photograph and copies of your speech prior to the meeting.

Will you please let me have your plans just as soon as possible.

With kind personal regards,

Sincerely yours,

George

G. H. Hotte
President

GHH/ehh

AMERICAN ASSOCIATION OF TEXTILE TECHNOLOGISTS, INC.

June 5, 1952

Mr. A. W. Boese
Minnesota Mining and Manufacturing Company
St. Paul, Minnesota

Dear Al:

The PAPERS OF THE AMERICAN ASSOCIATION OF TEXTILE TECHNOLOGISTS is just off the press and as I promised, I am sending you a copy for your files. As you will note, your talk appears on pages 141, 142, 143 and 144.

With kind personal regards,

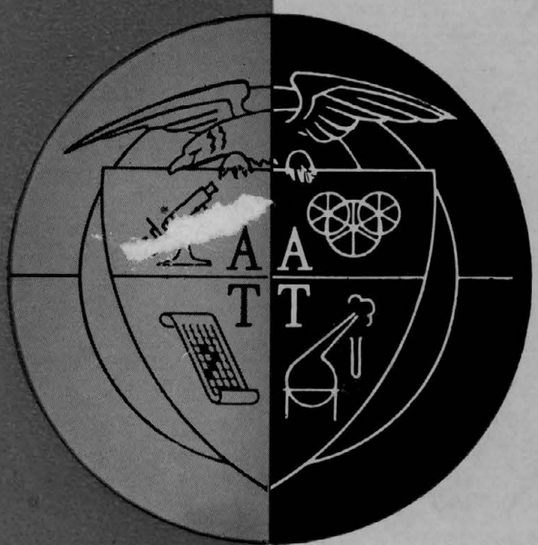
Sincerely yours,

George H. Hotte
President

GHH/ehh

AATT

JUNE, 1952



Papers of the

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PAPERS *of the* AMERICAN ASSOCIATION *of* TEXTILE TECHNOLOGISTS

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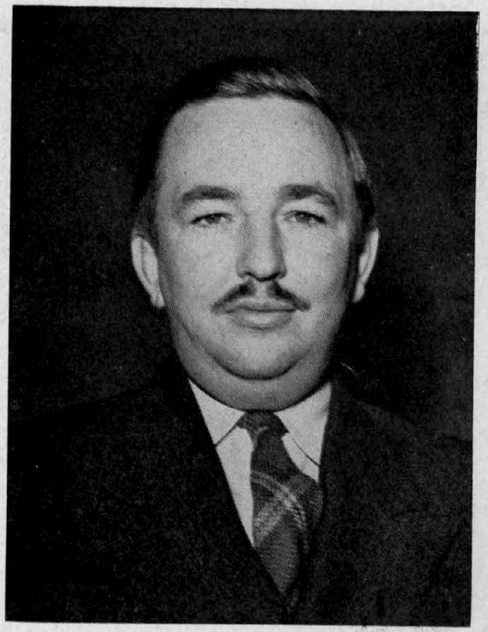
Edited by Kenneth A. Howry

Bonded Fabric Development

· By A. W. Boese



Having worked on the research and development of non-woven textiles in the products fabrication laboratory of Minnesota Mining & Manufacturing Company for ten years from 1939 to 1949, Mr. Boese has followed these fabrics into the manufacturing end. At present he is product manager in the ribbon department. A native Minnesotan, he joined the company as an office boy in 1930 and shortly worked his way into the tape laboratory and later the gasket department as quality supervisor and in research.

THE creation in a broad sense of the non-woven fabric industry has taken place in the last 12 or 15 years.

While it is true that battings or webs of non-felting textile fibers bonded with adhesives have been known and used for many years, these fabrics are not of the type which constitute the products of this new industry. These older materials depended for their characteristics on a heavy proportion of filler material applied in adhesive form, and it is the combined properties of filler material and fibers which constitute the quality of the finished product. The parent natural product which suggested the desired qualities to be striven for in these fiber-adhesive combinations was probably leather.

Therefore, with this background, the suggestion of non-woven fabric development was only remotely connected.

What then is meant by the term, non-woven fabrics?

To reduce it to a broad generality, I believe that a non-woven fabric can be defined as a web or sheet of textile type fibers, bonded together by the application of narrow stripes or patterns of adhesive material, or by autogenously bonding the fibers through activation of the surface, either by chemical action, or heat if thermoplastic fibers are used.

The main point is that expanses of the web have freedom of fiber movement because the bonding material is in minor proportion to the fiber content, or the adhesion is self-developed from the fibers themselves.

The fibers, by their nature, constitute the quality of a sheet of this type, and the unification material serves only to hold the fibers in place so that advantage can be taken to the fullest extent of the physical properties of the fiber. Webs of this type would have certain physical properties of a textile nature through the use of textile fibers, and would have paper-like properties which are a contribution of the bonding or unifying method and the materials employed. These properties preclude classifying the products so developed as papers or textiles because the unique combination, in a broad sense, of bonding and raw materials used give a sheet material with properties that can not be exhibited by either of the previously mentioned products.

Methods of Manufacture

I believe it would be well here to summarize briefly the important methods of manufacture, and products developed, which are used commercially in the non-woven fabric field today.

Most of the processes use either garnetts or cards for the production of the fiber bats. Variations of these machines are used in some instances, such as doffing by air or suction, and a new type of bat forming machine designed by Frank Buresh and produced by Curlator Corporation is used in some instances to improve cross strength.

The relationship of strength in the longitudinal to the transverse direction also varies with the arts developed by the manufacturers; however, in the main, the tensile strength is greater in the longitudinal direction.

Generally present day non-woven fabric materials fall into two classes of unification: Class 1, autogenous bonding; and, class 2, adhesive bonding. There are two types of autogenous bonding: (a) Bonding by chemically activating the surface of the fibers to an adhesive state; and (b) Activating the surface of thermoplastic fibers through the application of heat.

A means of compressing the fiber webs so activated is necessary for both methods. In the chemical

application, one method would be to pass the fiber bats through a sulfuric acid bath of proper concentration and temperature, followed by compressing with a calendar, washing, and drying.

By heat bonding, it is possible to use the various thermoplastic fibers produced today, and unification is accomplished with heat and pressure. As an example, "Plas-TECA" brand fibers produced by the Tennessee Eastman Corporation can be softened and unified on a hot calender in one operation. Conditions of temperature and pressure must be closely controlled for satisfactory results.

Wide Variation Possible

By either process, the blending of various types of fibers which will be inert to the process involved opens a wide field for the production of fabrics with greatly differing characteristics.

Adhesive bonding is accomplished by the application of adhesives such as vinyl acetate, etc., in stripes or open patterns. As one example, a diamond shaped pattern could be applied by means of a printing roll.

Proper spacing of the adhesive stripes and design of the pattern are both very important in determining the quality of the finished product, and will determine to a great extent the strength and texture of the sheet, the quality and type of fiber used contributing, as does the flexibility of the resin employed.

The operating speed is in the range of carding or garnett speeds, and is therefore a very important contribution to the relatively low cost of manufacture. Chemically bonded fabrics made of cellulose fibers have a tendency to be stiff and boardy. While this is true of the heat bonded fabrics also, this stiffness can be reduced considerably and good drape and hand developed by incorporating a percentage of inert fibers, such as viscose or cotton.

Viscose, of course, gives a cleaner web and produces a fabric of much higher quality than is possible with cotton.

However, in some instances cotton would be superior; for example, to give better absorbency or moisture-retaining qualities.

Adhesive-bonded fabrics have a better drape and softer texture than chemically bonded fabrics, but have a tendency to pipe easily in the direction of the bonded stripes.

As you may note from the above brief description, the non-woven field produces numerous varieties of webs and it would not be possible to give technical data on all.

However, some generalizations can be made. Tensile strength is ordinarily in direct relation to the types of fibers used and the weight. The fabrics are much more porous than most woven fabrics of paper but, compared to textiles, the fiber coverage is very good at high porosities. Other qualities needed for specific jobs can be and are incorporated according to the projected use.

Applications Numerous

Non-woven fabrics find applications in many fields today such as reinforcing for plastic laminates, disposable napkins and table cloths, shoe polishing cloths, milk filters, gas and chemical filters, polishing cloths, bandages, applicators for finishes, casket-liners and covers, decorative ribbon fabrics, and many others. Many of these fabrics can be laundered and dry cleaned. Some have to be washed by hand, and others can be washed in normal home washing operations. Ironing can be accomplished if conditions of heat and pressure are carefully controlled. The temperature should be determined by the type of fabric and fiber content, as is the case for textiles today. At present none of the fabrics are used for clothing insofar as the writer is aware, except for baby diapers and costuming. However, it is conceivable that with the use of new high strength fibers and improved spreading of the fibers to increase cross strength, some uses for clothing are possible.

It is interesting to note the wide diversity of interests of the concerns which have entered the non-woven field. Their interests lie in such areas of endeavor as textiles, abrasives, pressure sensitive tapes, sausage casings, and surgical dressings.

What impelled all of these people to set up research facilities to design and manufacture their sheet products?

I believe that primarily it was the fact that new products had been developed or were being considered for development in which paper, felt, or textiles could not answer the needs. This started the search for sheet materials which would have the necessary properties. Some impetus was added, of course, from purely economic reasons, such as utilizing cotton wastes that did not have weaving properties.

This diversity of research and manufacture all acted favorably towards putting the industry on a sound footing in a relatively short period of time.

While it is true that the industry is in a primitive state today as compared with the long-established textile and paper industries, I believe that progress is being made rapidly, and consumers are accepting products developed in this field with the same assurance of quality with which they accept the synthetic fiber products of the textile field today.

Production and Use

The 3M company has developed and marketed two types of non-woven fabrics, both of which stem from the thermoplastic bonding process. The trade names are "Mistlon" and "Sasheen." I would like to describe briefly their manufacture, characteristics and uses.

A research project was set up some time before the start of World War II to develop unique types of sheet materials to be used in 3M products. Many methods of forming webs and bonding were tried and discarded.

We finally settled on the thermoplastic-bonding method as being the most versatile and offering the

greatest opportunity for developing a wide variety of products. For some time now we have been manufacturing a web which contains approximately 60% "Plas-TECA" (3 denier, 1¼" staple) and 40% viscose rayon (1½ denier, 2" staple). The fibers in proper ratio are weighed out in small batches and blended in an ordinary picker. The blend is carded on a garnett machine consisting of two breaker sections, a cross-lapper and two finishing sections. The final finishing section has a double doffer arrangement. Webs of various weights can be made by taping the doffers and collecting several plies of carded fiber on a series of cross-aprons. The final apron, carrying two or more layers of web, feeds the material into a nip roll in contact with an electrically-heated bonding drum. The partially bonded web travels around the drum, and final bonding takes place at a second press roll. The temperature used is from 340° to 375°F. Finally, the material is wound into jumbo rolls for further processing. Speed of operation is about 40 feet per minute.

The material has been and is being used for many purposes. In the light-weight web of about four pounds per 100 square yards, it has found ready utility applications, such as lint-free lens tissue, polishing and dust cloths, covering for lawns and seed beds to retain moisture and protect the young plants. Incidentally an interesting characteristic of these fabrics containing acetate is the development of an electrostatic charge through friction when it is used in polishing. The charge has a tendency to pick up and hold small particles and dust on the web.

It can be used for filtering light in photographic work and as a texture screen. Many other uses are indicated and only await further trial and development. This fabric, made as described, has a tensile strength of approximately three pounds in the longitudinal direction and one pound in the tranverse. Heavier fabrics have many utility uses such as tape backings, abrasive backings, filters, etc.

Since this sheet is composed of viscose and acetate fibers, any solvents used will have to be governed by cellulose acetate solubility or swelling in the solvent. As these properties are well known, I will not go into detail.

Continuous Dye Method

The major uses for the "Mistlon" brand fabrics have been decorative. To make production economically feasible, a continuous dyeing method was necessary. Our first really successful continuous method of dyeing and finishing this material was to run two or three jumbo rolls at a time, with the webs stacked, through a cold, aqueous dye solution containing a mixture of direct dyes, dispersed acetate dyes, and wetting agents. Excess dye liquor was removed by a set of squeeze rolls and the webs were then run through an enclosed flue with an atmosphere of steam and air at about 180°F. Following the steaming operation, the material was subjected to two washes, a squeeze to remove as much wash water as possible, and drying by means of hot air. During these processes, light to moderate tension was maintained on the webs, and after drying, the layers were separated to produce individual jumbos again. By this process we dyed much of our early "Mistlon" brand ribbon and all of our light-weight window display materials.

As we developed ribbon and display fabrics in the decorative market, a search was continued for new decorative medias to fulfill the needs. We found that uniquely decorative fabrics could be produced by introducing various materials for colored or metallic flecks directly into the garnett operation, thereby getting relatively even distribution with just enough variation to produce a custom effect.

The fabrics with metallic flecks were made by passing a sheet of light weight aluminum foil into the garnett with the fiber. The garnett broke up and distributed interesting uneven flecks of the foil throughout the web, which, when dyed or left white, gave very interesting effects. Dyed "Mistlon," when passed through the garnett by the same means, distributed oddly shaped colored flecks throughout the web. Color mixtures and mixtures of color and foil were also made as the samples we have here will show. Would not decorative materials of this type, slit into narrow widths, and either twisted or in ribbon form, offer a challenge to textile designers for use in giving both texture and decoration to fabrics?

Effect of Tension

Soon after we started the pad-steam method of dyeing outlined above, it was observed that greater tension applied to the material stretched it in the machine, or longitudinal, direction and at the same time reduced its width. The result was a material of higher weight and greatly improved strength and sheen. Apparently the network of bonded acetate fibers when stretched in length and reduced in width allowed the viscose fibers to slip within the network and become better aligned. This improved alignment of the viscose fibers resulted in the increased strength and better sheen already mentioned. The "tensilized" variety of our "Mistlon" product has been described in patent number 2,503,024 (A. W. Boese and E. Michl).

The fabric we marketed as ribbon made by this process weighed approximately 11 pounds per 100 square yards. Tensile strength was 10-13 pounds per 1-inch width, LW. This type of fabric has very good drape and many other interesting properties. If the fabric is pulled in a tranverse direction it will stretch some 30-35% without fiber separation.

By applying tension longitudinally, the fibers assume their previous relationship, and the web does not show any disruption. At the present time we are not manufacturing this type of fabric, but we plan to resume activity in marketing these fabrics again in the near future. They have shown desirable qualities for such uses

as drapery materials, place mats, napkins, aisle cloths for weddings, display fabrics and many others.

I might add that much of our ribbon material dyed by this method was also made water-resistant by padding with a wax emulsion between the washing and drying stages of the operation. Also some of the display material was made flame-resistant by means of this additional padding station on our dyeing range.

By their very nature, these fabrics are subject to rather high flamability due to the amount of surface area exposed. On the other hand, this property increases the opportunities to coat the fabric with flame resistant materials which, because they can cover substantially all of the individual fiber surface, make them very effective.

Ribbon Data

The ribbon and fabric material we are marketing at the present time under the "Sasheen" brand name is made with a relatively light backing of the bonded garnett material, to one side of which parallel continuous filament-yarns of 150 denier cellulose acetate are heat-bonded.

We consider our "Sasheen" brand ribbon to be a "built" product—that is, we have repeatedly modified the construction in order to get the properties which make it an outstanding gift ribbon. Our three big advantages as a ribbon for the decoration of packages are: 1—Ease and speed of tieing bows; 2—Crush resistance; 3—High sheen.

Thus far we are competing only in the gift-wrap field in 7/16″, 5/8″, 7/8″, and 1½″ widths and in 14 solid colors. In the near future we are going into wider widths and will actively enter the floral field. Also we have striped, printed, and embossed ribbons in the latter stages of development, some of which may be announced this year.

The ribbon we are manufacturing today has the following physical properties: 1—An average weight of 15 pounds per 100 square yards or about 2.4 ounces per square yard; 2—Backing constitutes about one-quarter of the weight, filaments the balance; 3—Caliper averages 6.5 mils; 4—Tensile strength about 40 pounds in longitudinal direction for a 1-inch sample; 5—Approximately 85 yarns per inch, each yarn 150 denier.

Many additional or different properties can be incorporated into fabrics of this type to meet specific demands and needs.

We have on display a representative group of fabrics and products developed by 3M. I would like to have you make a closer inspection and will try to answer any questions you may ask.

Discussion Period

FOLLOWING the presentation of papers by Harold Ashton of Courtaulds, Ltd., and A. W. Boese of Minnesota Mining & Manufacturing Co., Gerard K. Lake of Pepperell Manufacturing Co. conducted the question and answer period.

CHAIRMAN LAKE: Both speakers have been so stimulating that we ought to be swamped with questions. They both say that they are ready and willing to take them on. Have we any questions? There must have been some thinking going on somewhere during those speeches.

H. C. OLSEN (National Starch Products Co.): I would like to direct a question to Mr. Ashton. Does the dope dyeing of these spun fibers affect the warp sizing properties of the yarn prior to weaving?

LAKE: Does the dope dyeing of these fibers affect the warp sizing characteristics?

H. ASHTON: The answer, sir, is very simple and direct—not at all.

M. WILLIAMSON (Quality Pad, Inc.): The question is asked of Mr. Boese. I was wondering whether nonwoven fabrics, as they become thicker, more stiff, or in view of the number of textile people here tonight, as they get heavier, are they more textile-like?

LAKE: As the bonded fabrics become heavier, do they change their hand so that they become more textile-like, more familiar to us?

A. W. BOESE: They have more of the body of textile when they are heavier, of course. And the heavier fabrics can be made with the same soft hand and drape that the lighter fabrics can. That is a matter of after-treatment.

STEPHEN S. MARKS (Daily News Record): Just on the basis of nomenclature, is there any point at which

these bonded fabrics stop being textiles and begin being papers? Have you drawn a line?

BOESE: I think we feel it is neither a textile nor a paper and, in fact, we are not quite sure right at this time just what it is. (Laughter)

CAMERON BAKER (U. S. Testing Co.): Has any effort been made to cross the fibers in forming the web so as to increase the transverse strength?

BOESE: Yes, we have done some work on that and the Draper Corp. is now working on a method of cross-laying web so as to square the tensile strength.

OLSEN: I have two questions. One: Which is more widely used, resinous binders or a chemical binding or heat binding of the fibers?

The second question is: What are the properties that are most desirable in the web and which are most efficient? That is, where can we expect the most improvement in that type material?

LAKE: The first question is: Is the resin method or the chemical method the more common in the manufacture of bonded fibers? Let's take that one first.

BOESE: Well, I don't know the figures, but I would presume that the resin-bonded fabrics are sold in greater proportion today.

LAKE: I am frank to admit I would like a repetition of the second question.

OLSEN: Briefly, what are the deficiencies in bonded fabrics that would indicate how they may be improved; what are their principal deficiencies? (Laughter)

LAKE: The question is: What are the deficiencies in bonded fabrics? I think it is a fair question, but I think I will ask if he wants to answer it.

BOESE: I will try. I think it depends on what use you are going to make of the material. For instance, as a lens tissue there are very few, if any, deficiencies. If you are going to use it where tensile strength is needed, the non-woven fabrics do not have that necessary strength today. The improvements to be made—I think most every one in the bonded fabric field would agree—are to get higher strength and also to improve the cross-strength of the fabrics.

L. S. ZISMAN (Fabric Chemical Co.): I am interested in knowing a little more about their use for wiping cloths, as a lint-free fabric. How does the price line up with ordinary wiping cloth, cheesecloth, for example, and where is it obtainable? Is it obtainable right here in the city?

LAKE: What are the economics of the situation as as far as wiping cloths, lint-free fabrics are concerned, and where can this product be obtained?

BOESE: Well, in polishing and wiping, both papers and cloths are used. In relation to paper the non-woven of course is higher priced. In relation to material such as cheesecloth and others, it is a very similar price. The lint-free material can be obtained from the Minnesota Mining & Mfg. Co., either in our New York branch here or direct from the factory in St. Paul.

DR. DONALD H. POWERS (Richard Hudnut Co.): There was discussion of a 40% and 60% blend, and I didn't catch the name. Is that a special fiber used in the original blend?

LAKE: What is the name of the 40% viscose and the 60% acetate blend? Is that the question? What is the name of that particular bonded fabric?

DR. POWERS: No. What is the name of the 60% fiber?

LAKE: Oh! What is the fiber that is 60% to the blend of 40% viscose? Is that a secret?

BOESE: No. It is plastic, a fiber manufactured by the Tennessee Eastman Corp. It is an acetate with a plasticizer in it. (Applause)

LAKE: Will Mr. George Hotte, our President, take a bow?

PRESIDENT HOTTE: The only fiber that we don't have an inventory on. (Laughter)

STEPHEN I. RUDO (Werner Textile Consultants): Is there any use for bonded fabrics in tea bags?

LAKE: I think we need a representative of another company here. The question is: Is there any use for bonded fabrics in tea bags?

BOESE: Bonded fabrics are used in tea bags today. Our company is not in that end of the field at all, but they are being used.

LAKE: I am not looking for a question now. Does anybody want to make a statement here?

RUDO: Who makes it?

LAKE: Kendall Mills. There is no one from Kendall here, I believe. Now we go to a question.

MARKS (Daily News Record): Just to supplement that, I don't know if it is being done at the present time, but at one time they used Vinyon staple in that tea bag paper.

A VOICE: They still do.

LAKE: We have got a statement: they still do, there is no change.

Does everybody understand this spun-dyed problem thoroughly? There are no questions on that subject? Well, I have one question I would like to ask.

I think something was said about acetate bonded fabric developing a good deal of static electricity when rubbed against things. I assume that also presents some problems in manufacturing. Has your experience in making use of these static charges given you any leads as to how those of us who are faced with a somewhat opposite problem can solve our problem in getting rid of those static charges?

BOESE: I don't believe so, Mr. Lake. We have had very little trouble with static. We keep our humidities up in the mill and we have had very little trouble in actual operation.

RUDO: Is there any possibility of making spun-dyed tows for the Pacific converter?

LAKE: Any possibility of making spun-dyed tows for the Pacific converter?

HAROLD ASHTON: Spun-dyed tows are made before staple can be cut, but at the moment there is no supply

of tow for "Pacific" or "Perlok" systems. That obviously is quite possible. It is entirely a question of practicability, and we naturally hope that supplies will be available sometime, and, even though I can make no promises, before long.

LAKE: No more questions? Well, I have one for Mr. Ashton. We can dye rayon and we can dye acetate, and it is very interesting to find out that there are ways of avoiding the necessity of doing so. Are you people on the other side of the Atlantic doing anything about dope-dyeing some of these fibers that we can't dye? (Laughter and applause)

ASHTON: I suggest the answer is very obvious—pigments in the solution. (Laughter)

LAKE: Send them over.

DR. A. FRANK TESI (Celanese Corporation): Does your dope-dyed staple have the same physical characteristics as the unpigmented staple would have, or are the physical characteristics changed?

ASHTON: No, for the reason that the pigment which gives color to the fiber is very similar in physical effect to the titanium used for dulling. The fiber remains substantially what it was, viscose staple fiber, and carries the direct dyeing affinity, with only a slight reduction in strength as compared with bright fibers. This slight reduction in filament strength reduces the yarn strength slightly and pulls down the count spinning limit slightly.

It is not a severe disadvantage at all. Obviously it arises from the inclusion of very finely ground pigments in the fibrous structure. On the other hand, these colors do not interfere with the spinning properties of the fiber. And that, I think, is the most important thing we ought to remember.

B. J. BROWN (Fothergill & Harvey, Ltd., Littleborough, Eng.): I would like to ask Mr. Boese one question on this fabric bonded material. I notice that he gave quite a number of figures on tensile strength, and I wondered whether he had done any tests on bursting strength or some other criterion of performance? Stretch, for example, or resistance to flexing, and things like that. I should appreciate it if Mr. Boese could give us a clue.

BOESE: We have tested much of our material in various ways. It depends on the type of material we have made. In bursting strength and stretch, for instance, the amount of bond we give our material determines it. For instance, we have made loosely bonded materials that have had very high bursting strength. I don't have the figures here. I am sorry. As you press the web and unify it more, the bursting strength and stretch go down rapidly and appreciably.

Any more questions? Well, if there are no more questions, going, going, gone! We will adjourn.

Tricot Discussion

(*Continued from page* 136)

knitted? In other words, if it is 168 inches wide, how would that be possible?

WALMSLEY: As I told you, you can normally pull a fabric one way, but you can't pull it both. Due to custom, the finished width of a piece of tricot has gotten to be 108 inches. That is the normal width. It has only come about due to the fact that in normal reel dyeing the fabric pulls itself out in length and narrows in width and the most suitable width was finally found to be 108 inches. You can finish at 130 inches, but if you do the length will be shorter, so it wouldn't make any difference. The main thing is that you should have your fabric yield approximately what your grey yield is to get the best shrinkage value out of your material as well as strength. If you pull the fabric out on the drying machine and at the same time pull it out sidewise in order to increase yield, you will have higher shrinkage and you will have lower strength.

SIMMONS: We tried to experiment by running down very narrow widths and reducing all the pull lengthwise and we got pretty low shrinkage, but we also got a counteraction in that the garments made up afterwards began to sag and bag and went the other way. If you finish at 168 inches, that would mean double dipping.

WALMSLEY: You couldn't finish at 168 inches, because when it comes off the knitting machine it is only 145 inches. I would say your limit would be 145 inches, and even at that, due to the fact that no matter how carefully you put it lengthwise through any finishing bath, it would come out narrower. Your maximum probably would be about 125 to 130 inches, and I don't know that it would be any advantage whatsoever to the fabric so finished. I think that by using customary widths you can obtain good shrinkages and the same yield as you would if you tried to finish it wider.

DITTON: I don't want to cut off any more questions, but I know our friends have a train to catch, so if we give them a rising vote of thanks we will call the meeting adjourned.

April 30, 1958

TAPE ENGINEERING EDUCATIONAL MEETING

I have been asked to speak to you on product development, particularly as it functions at 3M Company. This is a wide and varied subject, and, of necessity, has to be reported on from a personal point of view so my presentation is not a technical paper but a story; however, as a description of a development to commercial status some general techniques can be drawn that apply broadly to any creative procedures.

First, the main elements of a development man seem to be:

1. Incentive of the individual
2. Work
3. Frustration
4. Humor

Incentive is the individual drive for achievement or expression.
Work is the tool used by the individual to achieve his results.
Frustration is the atmosphere in which the program develops. It is the most necessary condition that the individual has to accept and control. The basic cause is, of course, the unknowns he has, through his incentive, created to explore.

Another fertile frustration is a superior's coldness to the project usually generated by the lack of appreciation and inability to see clearly and optimistically the individuals hazy conception of the objective.

Humor, I am sorry to say, comes at a later date when a retrospective review of the approaches to the problem turn up many situations of procedure that resemble Ed Wynn's famous contraptions. This should offer an individual better approaches to later problems, but the seemingly inexorable pattern of development though haphazard mistakes seems classical in its continuity.

So to a review of the development which led to ribbon products.

On July 25, 1940, the project was initiated by Mr. Drew in the Tape Laboratory under the direction of Grant Merrill to develop non-corrosive backings for electrical tapes. I was assigned by Mr. Merrill to learn something about fibers, and spent several months in the Home Economic Library of the Farm Campus pursuing this objective. With this background and a review of equipment, it was decided to approach the problem with a small paper beater and forming screen, which was purchased. This, incidentally, was also the start of paper making by 3M, which was carried on later by other individuals of ProFab.

The only apparent non-corrosive fiber available commercially was cellulose acetate. Upon beating and forming on the screen, the fibers did not develop the adhesive surface which natural paper fibers do and so did not unify or bond. The addition of bonding resins formed brittle, weak sheets.

A monumental frustration was created at this point and progress was static.

One day while walking by the rubber calendar in the Laboratory which was heating and running slowly, for no apparent reason I put a small tuft of acetate fibers I was carrying through the rolls and it came out glazed and bonded due to heat activation of the acetate.

It was like hearing the dog bark in Sputnik as it circled overhead. A break through for the bonding media was found. Also, the longer fiber mass was flexible even after bonding, so the raw material was found.

Paper making methods could not be used to handle the long fibers and the next major frustration developed.

Textile equipment was not known to us at this time. Through trial and error, it was found that passing fibers between revolving brush rolls would separate the fibers and project them into the air to be collected on a screen by suction. Remember, at this time an Engineering Staff was not available for help and consultation.

As I depended on my sister to fix the chain on my bicycle when it broke, earlier in life, due to her superior mechanical ability, this made designing and building equipment difficult for me to cope with. However, I designed a cluster of brush rolls differently imbedded in each other and of varying stiffness which was mainly directed by my intuition. This cluster was mounted between two wood panels in a stack with the twisted wire shafts of the brushes protruding as drive shafts. Upon these I mounted sprockets driven from a single motor by chain.

John Pearson, then a member of the Tape Laboratory, watched my progress with what I thought was envy, but later found was wonder. The day arrived when I switched the motor on and the shafts bent and gathered in a cluster like the stems of a bouquet of flowers. This, of course, was frustrating and my wife almost returned to her mother that night.

John, however, entered the project out of sympathy, and I might add mainly on his own time, and a workable piece of equipment resulted. This was my first experience with Engineering and proved the major part, often unrecognized, which Engineering plays in product development. The work and thinking they offer is a basic creative effort every bit as important as the more directly involved development personnel. George Netherly, the Head of the Abrasive Laboratory, viewed my work one day and suggested that I go over to North Star Woolen to see textile carding equipment. There it was cheap, available, commercial equipment with several hundred years experience behind it doing the job we were stumbling to design equipment to do. A small laboratory card was purchased and the basic elements of the project were complete--the raw material and carding equipment. The bonding means at this time was to card out webs, lay them on the floor, and press with a hot hand iron. Inherent lack of strength of acetate fiber could not meet the demands for tape backing, and at this point the objective changed to new product development. Many end uses were attempted and

failed. A modest success was achieved in lint-less lens tissue.

Pearl Harbor arrived, chaning company objectives and the project was shut down. I was sent to Kugler's Resin Laboratory to cook alkied resins from castor oil and citric acid. To this day I detest the smell of castor oil as much as any small boy being doused to cure his internal plumbing problems.

In the spring of 1943, the ProFab Laboratory, under Dick Drew, was organized and Pearson, Hurd, and myself constituted the original staff.

The non-woven project, as we now called it was exhumed and new constructions and end uses were explored. Lens cleaning tissue continued modestly and many exploratory field trips were taken. Here developed another frustration. The accounts we called on did not have a burning desire to replace their time tested materials with something new.

It was on our shoulders to prove the value of our developments and many times we found that we had more optimism than proven facts to back up our hopes. John Pearson continued developing equipment and methods. To make the first wide material we sent fiber to St. Louis to a small batting mill and John and I supervised the runs. The carded bats were wound with a paper liner and taken to Chicago to be heat bonded on the rubber calendars of Inland Rubber Company, then a company owned subsidiary.

Management, in the persons of Messrs. Drew and Carlton, certainly frustrated at this point, from the flimsy evidence we had of a product and certainly no defined end use, but with a nebulous faith in our project authorized the money for a garnett machine of production size and several hundred dollars for a hot calendar to unify the web. John Pearson with the help of Vic Potter begged and scrounged up the essentials for the calendar out of scrap and extra parts accumulated at 3M and assembled a monstrous but workable making unit in the old dairy garage. We could now make moderate amounts of salable material.

The search for products went on and John Pearson was called into service. No other Engineer saw fit as did John earlier, to attach himself voluntarily to the project and engineering was conducted through correspondence with John and his suggestions, abetted with work and ideas of Herb Walden and Vic Potter helped develop the methods and products.

Having had an interest in art and stage, the decorative aspects of our materials interested me and in 1944 the Emporium's displayman used the materials in window display.

This point was a milestone in the non-woven project.

After the failure to solve the tape backing problem due to available raw materials, the project had been a general study for making new kinds of sheet material somewhere between paper and cloth. It was most difficult, as I have pointed out, to sustain interest with little results or progress. The end uses thought of were vague, the knowledge of problems to be solved to attain them, nebulous.

At this point the project became purposeful and an individually dedicated incentive developed. As I happened to be the individual at this period, I have to be modestly egotistical to describe further developments. However, it is interesting to note that any given individual at this point, with a product incentive, could have directed the project in another direction and equal or superior successful products could have resulted.

However, now the direction was clear to develop decorative fabrics. Ribbon, of course, suggested itself along with other display fabrics. Management, at this point, was not completely sold on becoming a factor in this business. I believe they had an uneasy feeling that they were being asked to become participants in a Christian Dior Fashion House.

Also, at this time the war was ending and industrial directions could look towards consumer products for the future rather than those which had military application. We had a small experimental roll printing unit in the Laboratory, and I cut out a holly-berry and holly-leaf pattern for a two inch ribbon, and we printed up several hundred yards. These were wound five yards to a three inch core and shown to the Golden Rule ribbon buyer who reluctantly agreed to take them on consignment--200 rolls printed and 200 rolls white at $ .25 selling price per roll.

The ribbons sold off the counter not because of their beauty or value, but the shortage of materials for this use at the time. I did, however, accomplish a purpose in that Jack Bordon, Sales Manager for Tape, felt that ribbon would be a good companion product to tape. This gave us the backing of a senior Sales Manager hungry for a product and with an active sales force.

A trial sales program was developed and a line of colors and put ups established for a fall, Christmas program.

Herb Walden formed a small production program to make the web; and the laboratory scrambled madly to find methods of developing a line. Printing seemed the fastest approach and as we had a twelve inch printing unit, so the coloring work was directed along these lines. Slitting and packing was done by the Tape Department. Through blood, sweat, and tears, that is frustration, the group produced the necessary yardage which at this time seemed to have beauty and useability beyond all other.

In retrospect it seems that we had foisted on the sales force and through them the public a primitive product as useless as a stone headed spear in the atom age. The public's reaction bore out our present day thinking and the amount sold only reflected the current shortage of materials.

However, the failure of our ribbon to meet the needs did give us some necessary direction to improve the product, and the following year a more textile-like material which was dyed instead of printed was offered for sale. The shortage of competitive materials did allow us to sell enough to keep management interested and provide information for further improvement. Another milestone developed at this point.

All our efforts at this time was to sell small rolls for over-the-counter sale. Mr. Poole, a tape salesman in Fort Worth, Texas, asked that we produce long rolls for use within the store for gift wrapping. This product was produced and Mr. Poole's success in selling was a major point in getting managements reluctant approval to continue the product; nationally, the program was disappointing.

In 1948 Mr. Bordon recommended to management that ribbon be dropped from consideration as a 3M product. We had pursued the development about as far as we could to produce a ribbon from carded and unified webs. There did not seem to be a wide enough demand for a product of this type to warrant its continuity. A management meeting, however, confirmed one additional year of effort; with some merchandising changes made, and using Mr. Poole nationally to try to establish the product. The future, however, looked bleak for the product. Competition was keen again after the war and satin and other ribbons with sheen and strength made selling difficult.

The laboratory had to come up with something new. Several times in the past the thought of laminating yarns together using our non-woven as a backing was considered, but difficulties in handling multiple ends of yarn seemed insurmountable. It is well to take note there that the difficulties were imagined and no proper res arch had been done to test this theory. This type of negative thinking is one of the major obsticles in product development. A more agressive approach to solving our problem earlier would have been invaluable to establish the product and substantially reduced the cost engendered in development. An experiment was written in December, 1948, outling the development.

The equipment assembled to carry out the program consisted of 50 sewing machine bobbins to handle the yarn ends and a $ .10 fine tooth comb to position them. A small calendar was available in the Laboratory, and a one pound cone of acetate yarn was received. "Mistlon", the trade name of non-woven ribbon, was to be used to bond the yarns and form a flexible workable backing. Because of loose filaments in the yarn, the experiment called for a bonding technique of heat and resin to compact and bond the combined structure. After several failures, the proper combination of heat and resin bond was developed which gave us the first satin type ribbon.

By May of 1949 our techniques had progressed to making ribbon four inches in the laboratory, and in June the first actual "Sasheen" type ribbon was sold to Marshall Fields. It is well to point out that all the difficulties we had envisioned in handling yarns were not as difficult as our imaginations led us to believe. Difficulties there we aplenty, but the tenacity for survival of the group overcame or minimized them.

This takes us through the basic development stage that led to a ribbon division and, of course, development and improvement continue.

What actually has an individual as one personality contributed to a development that became a successful commercial product.

First, the original idea and incentive to achieve it.

At that point, he needs help--money being the major need, and at least one personal contact in a superior position with a sympathetic attitude.

Certainly the flow of ideas which make the product successful is contributed by many people in an effort to reach a satisfactory conclusion. The individuals major contribution as the development progresses, I believe, can be likened to a drive shaft. Many units can hook into this shaft and contribute to the operation, sometimes only one brief contact and moving out; some for a more extended period; and some become fixed positions continuing the efforts and gaining the strength and continuity of operation keyed together that the drive shaft contributes. In other words the sponsoring individual collects and organizes all of these activities and gives them historical continuity and cohesiveness.

While, as I pointed out, product development has to be a personal report and in the interests of brevity, many people who made major contributions, without which a Ribbon Division would not have been created, are not mentioned.

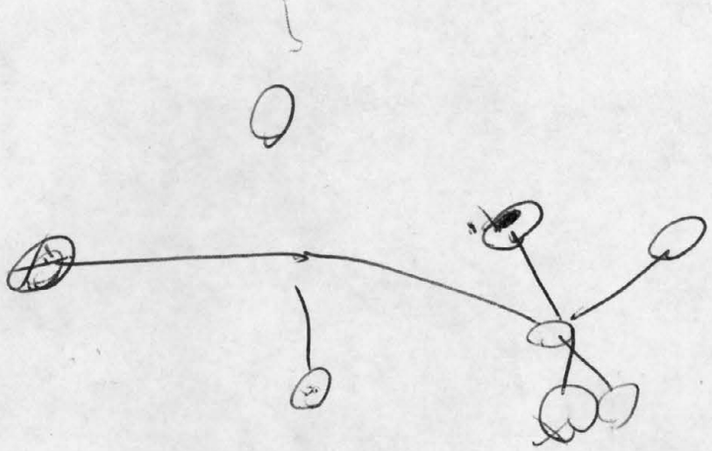
Mr. Drew, with his great sympathy and optimism when times were black as well as the technical help and advice he gave, was the bulwork which held the program together over the long, lean years.

Mr. Merrill made many early contributions and guided and directed the initial stages and established the basis from which later development stemmed.

Many others along the line helped and a sales force and merchandising group worked hard to overcome the lack of qualitites the earlier ribbons possessed. Management continually sustained us through many discouraging failures.

So, basically, product development comes from an organization in which one man can establish the initial direction and incentive and to which an organization can center on management having a focal point to evaluate from, and all other services a source center to make their valuable and necessary contributions.

A. W. Boese



Talk given at Techn Forum Days
October 17, 1960

DEVELOPING NON-WOVEN PRODUCTS

I believe that some 20 years ago when the initial work was started to develop the so called non-woven products that terminology would have seemed surprising.

Actually in the several areas that produced the research from which the present industry stems had specific needs that were not met by products available at that time. That is, something similar to paper but with some characteristics approaching cloth such as strength, suppleness, etc.

Of course, the felt industry had, for centuries, produced "non-woven" products. There were, however, limitations of weight--felt being relatively heavy and also because the process was defined by the characteristics of wool or hair which developed the felting characteristics limited end uses resulted. Some other fibers were introduced in blends in minor proportion and several felt company's produced relatively crude synthetic felts of cotton by bonding carded battings with resins.

They were stiff, crude, and of narrow applications.

With this background then, in which there was no historical direction for the development of non-wovens, how did it come about?

Let us take as an example 3M's participation in this development.

The research started simply enough with a need for a fibrous non-corrosive backing for electrical tape. The initial search of the available fiber field indicated acetate fibers as the raw material with the non-corrosive property needed.

The step of forming and unifying a sheet or paper from acetate fiber started with laboratory paper making equipment.

Immediately it became apparent that this process designed to utilize the cohesive surface of natural cellulose fibers would not produce a bonded or unified product from acetate, which did not develop a latent adhesive surface.

Several dry systems of handling fibers were tried, such as air deposition which seemed cumbersome, and this led to the use of card ng or garnetting equipment. This defined the method of forming the web, but did not offer the solution of bonding or unifying it. A break-thru to the solution of this problem came inadvertently. This was accomplished by passing a small clump of acetate fibers through a small heated rubber calendar.

This did not develop from a theoretical plan, but was playfully done in passing the equipment. However, the result was that the fibers under the heat and pressure unified or bonded and gave lead for a unifying method.

This crude start directed the development of heat bonding.

The next year or two was spent in refining and combining the fiber forming and bonding process.

When we could turn out reasonable sheets of synthetic fibers in blends and of 100% acetate, that fiber having to be in the web as the bonding component, it seemed we had a product that would take huge segments of the textile business.

A year of agonizing product search for markets brought home to us that we had not developed a product, but a relatively crude process of forming new type sheet materials.

The process, as a research tool, was tremendously interesting but we could not, at this stage, point out to a single end use or product.

The original assignment for development had failed. A process was available, but seemed to be directed into a field that 3M Management has always considered a poor business risk; hamely, the textile field.

I believe it was benevolance rather than belief on management's part that allowed a continued search for products in this direction.

New man-made fibers of various characteristics were being introduced in the market and this of course broadened the base for development.

With the conception of ribbon, the first salable non-woven product became a reality.

From the initial process development of carding and unifying, other end uses were searched out and developed mainly by the Pro-Fab group carrying to a conclusion some of the early work and also uses and modifications of the process of their own conception.

Other division's picked up from Pro-fab end products that fit their needs and abilities to market.

Today we have four divisions which are manufacturing and marketing products developed basically from the initial process. These products are as varied as dusting and cleaning materials, filters, scouring pads, and electrical sheetings of various types as well as the ribbon products.

These products have replaced products formerly made of paper, textiles as well as metallic products. The key to these products is that they start from basic fibers and are carried through to the finished component in a single operation.

This is a basic step and a unique development. Hertofore, to manufacture products of this nature the raw materials were put into sheet form either by the textile or paper process and subsequently formed into marketable products.

While this has led to economies of manufacture, this is not the key to these products. The method of producing has given special characteristics that were needed for functional use.

This should be the direction for development of products in this field. Based purely on economics the non-woven development cannot offer satisfactory products or a worthwhile business.

As an illustration, we have developed a medical and nuisance dust maks. This mask will replace many textile masks used today. In some instances, it will be more economical. However, its basic quality is improved filtering and comfort. That was the objective in designing the product and economies were considered secondarily. The acceptance of this mask, I believe, proves the point.

Therefore, I would like to reconsider the title on the program which is "development of non-woven products." I would like to leave instead this thought--the development of products from fibrous materials determined by the end use needs.

Imagination and far-ranging thinking is needed in this field. The concepts of forming the fibers into bats and unifying is available.

The products that can be developed are beyond the scope of textiles or paper conceptions.

BONDED FABRIC DEVELOPMENT

By A. W. Boese

The creation in a broad sense of the non-woven fabric industry has taken place in the last 12 or 15 years.

While it is true that battings or webs of non-felting textile fibers bonded with adhesives have been known and used for many years, these fabrics are not of the type which constitute the products of this new industry. These older materials depended for their characteristics on a heavy proportion of filler material applied in adhesive form, and it is the combined properties of filler material and fibers which constitute the quality of the finished product. The parent natural product which suggested the desired qualities to be striven for in these fiber-adhesive combinations was probably leather.

Therefore, with this background, the suggestion of non-woven fabric development was only remotely connected.

What then is meant by the term, non-woven fabrics?

To reduce it to a broad generality, I believe that a non-woven fabric can be defined as a web or sheet of textile type fibers, bonded together by the application of narrow stripes or patterns of adhesive material, or by autogenously bonding the fibers through activation of the surface, either by chemical action, or heat if thermo-plastic fibers are used.

The main point is that expanses of the web have freedom of fiber movement because the bonding material is in minor proportion to the fiber content, or the adhesion is self-developed from the fibers themselves.

The fibers, by their nature, constitute the quality of a sheet of this type, and the unification material serves only to hold the fibers in place so that advantage can be taken to the fullest extent of the physical properties of the fiber. Webs of this type would have certain physical properties of a textile nature through the use of textile fibers, and would have paper-like properties which are a contribution of the bonding or unifying method and the materials employed. These properties preclude classifying the products so developed as papers or textiles because the unique combination, in a broad sense, of bonding and raw materials used give a sheet material with properties that cannot be exhibited by either of the previously mentioned products.

Methods of Manufacture

I believe it would be well here to summarize briefly the important methods of manufacture, and products developed, which are used commercially in the non-woven fabric field today.

Most of the processes use either garnetts or cards for the production of the fiber bats. Variations of these machines are used in some instances, such as doffing by air or suction, and a new type of bat forming machine designed by Frank Buresh and produced by Curlator Corporation is used in some instances to improve cross strength.

The relationship of strength in the longitudinal to the transverse direction also varies with the arts developed by the manufacturers; however, in the main, the tensile strength is greater in the longitudinal direction.

Generally present day non-woven fabric materials fall into two classes of unification: Class 1, autogenous bonding; and, Class 2, adhesive bonding. There are two types of autogenous bonding: (A) bonding by chemically activating the surface of the fibers to an adhesive state; and (b) activating the surface of thermoplastic fibers through the application of heat.

A means of compressing the fiber webs so activated is necessary for both methods. In the chemical application, one method would be to pass the fiber bats through a sulfuric acid bath of proper concentration and temperature, followed by compressing with a calendar, washing and drying.

By heat bonding, it is possible to use the various thermoplastic fibers produced today, and unification is accomplished with heat and pressure. As an example, "Plas-TECA" brand fibers produced by Tennessee Eastman Corporation can be softened and unified on a hot calendar in one operation. Conditions of temperature and pressure must be closely controlled for satisfactory results.

Wide Variation Possible

By either process, the blending of various types of fibers which will be inert to the process involved opens a wide field for the production of fabrics with greatly differing characteristics.

Adhesive bonding is accomplished by the application of adhesives such as vinyl acetate, etc., in stripes or open patterns. As one example, a diamond shaped pattern could be applied by means of a printing roll.

Proper spacing of the adhesive stripes and design of the pattern are both very important in determining the quality of the finished product, and will determine to a great extent the strength and texture of the sheet, the quality and type of fiber used contributing, as does the flexibility of the resin employed.

The operating speed is in the range of carding or garnett speeds, and is therefore a very important contribution to the realitvely low cost of manufacture. Chemically bonded fabrics made of cellulose fibers have a tendency to be stiff and boardy. While this is true of the heat bonded fabrics also, this stiffness can be reduced considerably and good drape and hand developed by incorporating a percentage of inert fibers, such as viscose or cotton.

Viscose, of course, gives a cleaner web and produces a fabric of much higher quality than is possible with cotton.

However, in some instances cotton would be superior; for example, to give better absorbency or moisture-retaining qualities.

Adhesive-bonded fabrics have a better drape and softer texture than chemically bonded fabrics, but have a tendency to pipe easily in the direction of the bonded stripes.

As you may note from the above brief description, the non-woven field produces numerous varieties of webs and it would not be possible to give technical data on all.

However, some generalizations can be made. Tensile strength is ordinarily in direct relation to the types of fibers used and the weight. The fabrics are much more porous than most woven fabrics of paper, but compared to textiles, the fiber coverage is very good at high porosities. Other qualities needed for specific jobs can be and are incorporated according to the projected use.

Applications Numerous

Non-woven fabrics find applications in many fields today such as reinforcing for plastic laminates, disposable napkins and table cloths, shoe polishing cloths, milk filters, gas and chemical filters, polishing cloths, bandages, applicators for finishes, casket-liners and covers, decorative ribbon fabrics, and many others. Many of these fabrics can be laundered and dry cleaned. Some have to be washed by hand, and others can be washed in normal home washing operations. Ironing can be accomplished if conditions of heat and pressure are carefully controlled. The temperature should be determined by the type of fabric and fiber content, as is the case for textiles today. At present none of the fabrics are used for clothing insofar as the writer is aware, except for baby diapers and costuming. However, it is conceivable that with the use of new high strength fibers and improved spreading of the fibers to increase cross strength, some uses for clothing are possible.

It is interesting to note the wide diversity of interests of the concerns which have entered the non-woven field. Their interests lie in such areas of endeavor as textiles, abrasives, pressure sensitive tapes, sausage casings, and surgical dressings.

What impelled all of these people to set up research facilities to design and manufacture their sheet products?

I believe that primarily it was the fact that new products had been developed or were being considered for development in which paper, felt, or textiles could not answer the needs. This started the search for sheet materials which would have the necessary properties. Some impetus was added, of course, from purely economic reasons, such as utilizing cotton wastes that did not have weaving properties.

This diversity of research and manufacture all acted favorably towards putting the industry on a sound footing in a relatively short period of time.

While it is true that the industry is in a primitive state today as compared with the long-established textile and paper industries, I believe that progress is being made rapidly, and consumers are accepting products developed in this field with the same assurance of quality with which they accept the synthetic fiber products of the textile field today.

Production and Use

The 3M Company has developed and marketed two types of non-woven fabrics, both of which stem from the thermo plastic bonding process. The trade names are "Mistlon" and "Sasheen". I would like to describe briefly their manufacture, characteristics, and uses.

A research project was set up some time before the start of World War II to develop unique types of sheet materials to be used in 3M products. Many methods of forming webs and bonding were tried and discarded.

We finally settled on the thermo-plastic bonding method as being the most versatile and offering the greatest opportunity for developing a wide variety of products. For some time now we have been manufacturing a web which contains approximately 60% "Plas-TECA" (3 denier, 1 1/2" staple) and 40% viscose rayon (1 1/2 denier, 2" staple). The fibers in proper ratio are weighed out in small batches and blended in an ordinary picker. The blend is carded on a garnett machine consisting of two breaker sections, a cross-lapper and two finishing sections. The final finishing section has a double doffer arrangement. Webs of various weights can be made by taping the doffers and collecting several plies of carded fiber on a series of cross-aprons. The final apron, carrying two or more layers of web, feeds the material into a nip roll in contact with an electrically-heated bonding drum. The partially bonded web travels around the drum, and final bonding takes place at a second press roll. The temperature is from 340° to 375° F. Finally, the material is wound into jumbo rolls for further processing. Speed of operation is about 40 feet per minute.

The material has been and is being used for many purposes. In the light-weight web of about four pounds per 100 square yards, it has found ready utility applications, such as lint-free lens tissue, polishing and dust cloths, covering for lawns and seed beds to retain moisture and protect the young plants. Incidentally an interesting characteristic of these fabrics containing acetate is the development of an electrostatic charge through friction when it is used in polishing. The charge has a tendency to pick up and hold small particles and dust on the web.

It can be used for filtering light in photographic work and as a texture screen. Many other uses are indicated and only await further trial and development. This fabric, made as described, has a tensile strength of approximately three pounds in the longitudinal direction and one pound in the transverse. Heavier fabrics have many utility uses such as tape backings, abrasive backings, filters, etc.

Since this sheet is composed of viscose and acetate fibers, any solvents used will have to be governed by cellulose acetate solubility or swelling in the solvent. As these properties are well known, I will not go into detail.

Continuous Dye Method

The major uses for the "Mistlon" brand fabrics have been decorative. To make production economically feasible, a continuous dyeing method was necessary. Our first really successful continuous method of dyeing and finishing this material was to run two or three jumbo rolls at a time, with the webs stacked, through a cold, aqueous dye solution containing a mixture of direct dyes, dispersed acetate dyes, and wetting agents. Excess dye liquor was removed by a set of squeeze rolls and the webs were then run through an enclosed flue with an atmosphere of steam and air at about 180° F. Following the steaming operation, the material was subjected to two washes, a squeeze to remove as much wash water as possible, and drying by means of hot air. During these processes, light to moderate tension was maintained on the webs, and after drying, the layers were separated to produce individual jumbos again. By this process we dyed much of our early "Mistlon" brand ribbon and all of our light-weight window display materials.

As we developed ribbon and display fabrics in the decorative market, a search was

continued for new decorative medias to fulfill the needs. We found that uniquely decorative fabrics could be produced by introducing various materials for colored or metallic flecks directly into the garnett operation, thereby getting relatively even distribution with just enough variation to produce a custom effect.

The fabrics with metallic flecks were made by passing a sheet of light weight aluminum foil into the garnett with the fiber. The garnett broke up and distributed interesting uneven flecks of the foil throughout the web, which, when dyed or left white, gave very interesting effects. Dyed "Mistlon", when passed through the garnett by the same means, distributed oddly shaped colored flecks throughout the web. Color mixtures and mixtures of color and foil were also made as the samples we have here will show. Would not decorative materials of this type, slit into narrow widths, and either twisted or in ribbon form, offer a challenge to textile designers for use in giving both texture and decoration to fabrics?

Effect of Tension

Soon after we started the pad-steam method of dyeing outlined above, it was observed that greater tension applied to the material stretched it in the machine, or longitudinal, direction and at the same time reduced its width. The result was a material of higher weight and greatly improved strength and sheen. Apparently the network of bonded acetate fibers when stretched in length and reduced in width allowed the viscose fibers to slip within the network and become better aligned. This improved alignment of the viscose fibers resulted in the increased strength and better sheen already mentioned. The "tensilized" variety of our "Mistlon" product has been described in Patent Number 2,503,024 (A. W. Boese and E. Michl).

The fabric we marketed as ribbon made by this process weighed approximately 11 pounds per 100 square yards. Tensile strength was 10-13 pounds per 1 inch width, LW. This type of fabric has very good drape and many other interesting properties. If the fabric is pulled in a transverse direction it will stretch some 30-35% without fiber separation.

By applying tension longitudinally, the fibers assume their previous relationship, and the web does not show any disruption. At the present time we are not manufacturing this type of fabric, but we plan to resume activity in marketing these fabrics again in the near future. They have shown desirable qualities for such uses as drapery materials, place mats, napkins, aisle cloths for weddings, display fabrics and many others.

I might add that much of our ribbon material dyed by this method was also made water-resistant by padding with a wax emulsion between the washing and drying stages of the operation. Also some of the display material was made flame-resistant by means of this additional padding station on our dyeing range.

By their very nature, these fabrics are subject to rather high flammability due to the amount of surface area exposed. On the other hand, this property increases the opportunities to coat the fabric with flame resistant materials which, because they can cover substantially all of the individual fiber surface, make them very effective.

Ribbon Data

The ribbon and fabric material we are marketing at the present time under the "Sasheen" brand name is made with a relatively light backing of the bonded garnett material, to one side of which parallel continuous filament-yarns of 150 denier cellulose acetate are heat-bonded.

We consider our "Sasheen" brand ribbon to be a "built" product - that is, we have repeatedly modified the construction in order to get the properties which make it an outstanding gift ribbon. Our three big advantages as a ribbon for the decoration of packages are: 1 - Ease and speed of tieing bows; 2 - crush resistance; 3 - high sheen.

Thus far we are competing only in the gift-wrap field in 7/16", 5/8", 7/8", and 1 1/2" widths and in 14 solid colors. In the near future we are going into wider widths and will actively enter the floral field. Also we have striped, printed, and embossed ribbons in the latter stages of development, some of which may be announced this year.

The ribbon we are manufacturing today has the following physical properties: 1 - An average weight of 15 pounds per 100 square yards or about 2.4 ounces per square yard; 2 - backing constitures about one-quarter of the weight, filaments the balance; 3 - caliper averages 6.5 mils; 4 - tensile strength about 40 pounds in longitudinal direction for a 1 inch sample; 5 - approximately 85 yarns per inch, each yarn 150 denier.

Many additional or different properties can be incorporated into fabrics of this type to meet specific demands and needs.

We have on display a representative group of fabrics and products developed by 3M. I would like to have you make a closer inspection and will try to answer any questions you may ask.

DEVELOPING NON_WOVEN PRODUCTS

I believe that some 20 years ago when the intial work was started to develop the so-called non-woven products that terminology would have seemed surprising.

Actually in the several areas that produced the research from which the present industry stemms had specific needs that were not met by products available at that time. That is, something similar to paper but with some characteristics approaching cloth such as strength, suppleness, etc.

Of course, the felt industry had, for centuries, produced "non-woven" products. There were, however, limitations of weight--felt being relatively heavy and also because the process was defined by the characteristics of;~~woll~~ wool and ~~of~~ hair which developed the felting characteristics limited end used resulted. Some other fibers were introduced in blends in minor proportion and several felt company's produced relatively crude synthetic felts of cotton by bonding carded battings with resins.

They were stiff, crude, and of narrow applications.

With this background then, in which there was no historical direction for the development of non-wovens, how did it come about?

Let us take as an example 3M's participation in this development.

The research started simply enough with a need for a fibrous non-corrosive backing for electrical tape. The initial searach of the available fiber field indicated acetate fibers as the raw material with the non-corrosive property needed.

The step of forming and unifying a sheet or paper from acetate fiber started with laboratory paper making equipment. Immediately it became apparent that this process designed to utilize the cohesive surface of natural cellulose fibers would not produce a bonded or unified product from acetate, which did not develop a latent adhesvie surface.

Several dry systems of handling fibers were tried, such as air deposition which seemed cumbersome, and this led to the use of carding or garnetting equipment. This defined the method of forming the web, but did not offer the solution of bonding or unifying it. A break-thru to the

solution of this problem came inadvertently. This was accomplished by passing a small clump of acetate fibers through a small heated rubber calendar.

This did not develop from a theoretical plan, but was playfully done in passing the equipment. However, the result was that the fibers under the heat and pressure unified or bonded and gave lead for a unifying method. This crude start directed the development of heat bonding. The next year or two was spent in refining and combining the fiber forming and bonding process.

When we could turn out reasonable sheets of synthetic fibers in blends and of 100% acetate, that fiber having to be in the web as the bonding component, it seemed we had a product that would take huge segments of the textile business.

A year of agonizing product search for markets brought home to us that we had not developed a product, but a relatively crude process of forming new type sheet materials.

The process, as a research tool, was tremendously interesting but we could not, at this stage, point out to a single end

use or product.

The original assignment for development had failed. A process was available, but seemed to be directed into a field that 3M Management had always considered a poor business risk; namely, the textile field.

I believe it was benevolance rather than belief on management's part that allowed a continued search for products in this direction.

New man-made fibers of various characteristics were being introduced in the market and thisof course broadened the base for development.

With the conception of ribbon, the first salable non-woven product became a reality.

From the initial process development of carding and unifying, other end uses were searched out and developed mainly by the Pro-fab group carrying to a conclusion some of the early work and also uses and modifications of the process of their own conception.

Other division's picked up from Profab end products that fit their needs and abilities to market.

Today we have four divisions which are manufacturing and marketing products developed basically from the initial process. These products are as varied as dusting and cleaning materials, filters, scouring pads, ~~and~~ electrical sheetings of various types as well as the ribbon products. These products have replaced products formerly made of paper, textiles as well as metallic products. The key to these products is that they start from basic fibers and are carried through to the finished component in a single operation.

This is a basic step and a unique development. Hertofore to manufacture products of this nature the raw materials were put into sheet form either by the textile or paper process and subsequently formed into marketable products. While this has led to economies of manufacture, this is not the key to these products. The method of producing has given special characteristics that were needed for functional use.

This should be the direction for development of products in this field. Based purely on economics the non-woven development cannot offer satisfactory products or a worthwhile business.

As an illustration, we have developed a medical and nuisance ~~dust~~ mask. This mask will replace many textile masks used today. In some instances, it will be more economical. However, its basic quality is improved filtering and comfort. That was the objective in designing the product and economies were considered secondarily. The acceptance of this mask, I believe, proves the point.

Therefore, I would like to reconsider the title on the program which is "Development of non-woven Products."

I would like to leave instead this thought. The development of products from fibrous materials determined by the end use needs.

Imagination and far-ranging thinking is needed in this field. The concepts of forming the fibers into bats and unifying is available.

The products that can be developed are beyond the scope of textiles or paper conceptions.

As I note the list of speakers ;to follow, you will be given in detail a concept of the present process thinking and equipment developments.

Also a phase of the unification of fibers that is bonding materials and techniques will be discussed.

However, the key to the products that can be developed are the fibrous materials themselves. Their physical and chemical properties will determine in large measure the products.

With the basic conceptions you will be given for processes and some background on bondng you are free to develop through imagination end use concepts and exploration of the fibrous raw material field to accomplish the objective of producing new and better products.

CRW/ Corporate Scientist

Long Range Technologies Presentation

To Technical Council

—

February 19th, 1975

Tartan Park

Feb. Tech Council All Day Meeting

Emerging Technologies

Rough Agenda

8:00 - 12:00	Long Range Technologies
12:00 - 1:00	lunch
1:00 - 4:00	New Products & Technologies from 3M Divisions & Depts.

Suggested Format for Long Range Technologies Presentation

(1) Mechanism of LR Planning ~ 15 min

- Why Needed
- Approach
- whats been accomplished
- future action

(2) Highlights of LR Programs by each Task Group ~ 15 min each

— Subject area

— State of the art

Visual aid presentation

— Task group analysis of area

— Highlight proposals

- Specific future action

(3) Critique ?

General Discussion
Panel Discussion
written Response

Proposed Action

Jan 1 - 15 — Task groups meet & formulate presentation

~ Jan 15 — CRL / Corp Sci meeting to firm up presentation - specific outline of each presentation needed

~ Feb 10 — Dry / Dry Runs using visual aids

~ Feb 17 — Dress Rehearsal

Feb 19 — Show

3M technical forum

BOESE ALVIN W
CORP INNOVATIVE LAB
53 5 M-17

SUBJECT: Education Program Spring 1975 Registration

On the following pages are descriptions of six courses being offered this spring by your Technical Forum Education Committee.

A separate registration form is required for each course selected, copies of which are attached. Completed forms are to be mailed to Tech Forum Office, 220-11E.

Since time off the job is involved in these courses, your supervisor must sign each form. One of the courses, "Sales Seminars for the Scientist," is being offered by the Corporate Education and Training Department through a special arrangement with the Technical Forum, and involves a recharge to your department. This course requires approval by your Technical Director.

Registration form(s) should be submitted as soon as possible. We urge that the forms be in by February 25. For further details on any course, contact the course coordinator or Education Committee chairman.

In the event of over-enrollment in any course, priority will be given in order of receipt of registration. Any course may be cancelled at the discretion of the Education Committee if enrollment is not sufficiently large to warrant course presentation.

This year the Technical Forum has eliminated tuition fees for these courses on a trial basis. For this trial to be successful it is important that you register for a course only if you intend to complete it.

In the interest of economy, no further notification of acceptance or course starting time will be mailed. Mark the starting time on your calendar and plan to attend unless you are notified that the class is filled. A summary is on the reverse side of this sheet.

NOTE: A number of these courses could be of interest and use to your technician. Since technicians are not members of Technical Forum, they have not viewed this mailing. I am therefore encouraging you to consider these courses not only for yourself, but as a means to improve the skills of your technician. If you feel a course could be of benefit, please, give a copy of the registration form to your technician, and encourage him to register for the course.

The goal of the Technical Forum Education Committee is to best serve the special educational needs of the Forum membership, and the courses offered this term were chosen because of interest expressed by Tech Forum members. In order to continue offering programs of interest to the membership, we need your input. Please call me with any suggestions for future courses or methods to improve our current programs.

Lester T. Jones, Chairman
Education Committee

EDUCATION COMMITTEE COURSES
SPRING 1975 - 3M TECHNICAL FORUM

I. Information Resources:

Starting Date:	Monday, March 3, 1975
Time:	4:30 - 5:30 P.M.
Location:	Will vary: attendees will be notified prior to each session
Course Coordinator:	Kappy Fitzgerald (3-0391)

II. Research Techniques and Philosophies:

Starting Date:	Monday, March 3, 1975
Time:	12:00 noon - 1:00 P.M.
Location:	Building 201 Auditorium
Course Coordinator:	J. L. Blake (3-5891) and W.J. Schultz (3-9514)

III. Fundamentals of Coatings:

Starting Date:	Friday, March 7, 1975
Time:	12:00 - 1:00 P.M.
Location:	Building 201 Auditorium
Course Coordinator:	J.C. Huang (3-6769)

IV. Sales Seminars for the Scientist:

One-day Seminars:	Friday, March 7, Friday, March 21 Friday, April 4, Friday, April 25, Monday, April 28 Tuesday, April 29 Friday, May 2, Friday, May 9, Thursday, May 15, Friday, May 16, Friday, May 30 Thursday, June 26
Time:	8:00 A.M. - 5:00 P.M.
Location:	Building 220-B, Rm. D
Course Coordinator:	Diane Wilmer (3-8092)

V. Introductory Physiology:

Starting Date:	Wednesday, March 12
Time:	11:30 A.M. - 1:00 P.M.
Location:	Building 230, Rm. S-149
Course Coordinator:	P.W. Willard (3-5241)

VI. Photochemistry of Organic Molecules:

Starting Date:	Thursday, April 3, 1975
Time:	11:30 A.M. - 12:30 P.M.
Location:	Building 201 Auditorium
Course Coordinator:	G.F. Vesley (3-8063)

INFORMATION RESOURCES

Course Objective: To improve utilization of information resources available within the Company.

Pre-requisites: Submission of a general question or subject area to be used for individualized searching during the course sessions. Basic background in the use of libraries and indexes is assumed.

Course Content: Emphasis will be placed on practice rather than theory, with participants using various approaches to obtain both technical and business information in their own selected subject fields. Sessions will cover: technical and business indexes, handbooks, etc. (3/3 and 3/10); patents (3/17); machine searching (3/24); standards and specifications (3/31); government information (4/7); leftovers (4/14).

Enrollment will be limited to 20

225-8701

RESEARCH TECHNIQUES AND PHILOSOPHIES

Course Objective: To introduce technicians or other interested personnel to various techniques useful in conducting industrial research.

Course Content: This course will present research techniques and philosophies by successful 3M'ers. The topics to be covered are:

The Importance of Perception and Observation in Research (Al Boese)
How to Approach a Research Problem (Bryce Clark)
How to Plan a Successful Career (Bill Lundquist)
Time Management (Kathy Lafevere)
The Patent System (Richard Brink)

FUNDAMENTALS OF COATINGS

Course Objective: To introduce the fluid mechanical effects of various coating techniques, including knife, roll, film-forming, saturation, and spray coatings.

Course Content: The course will introduce the relationship between the geometry and fluid mechanics of various coating techniques which will include coatings by knife, roll, film-forming, saturation and spray. The course will stress the explanation of what and how certain parameters, such as surface tension, viscosity, geometry, etc., affect the stability, uniformity and speed of a coating system. An outline of the course is as follows:

Introduction (1 hr)
Knife Coatings (2 hrs)
Roll Coatings (3 hrs)
Film-Forming Coatings (3 hrs)
Withdrawal and Saturation Coatings (1 1/2 hrs)
Spray Coatings (1 1/2 hrs)

SALES SEMINARS FOR THE SCIENTIST

Course Objective: As a member of the technical community, you and a 3M sales representative share a common element in a success formula when negotiating with an end-user. You must sell your ideas to management (technical or otherwise) just as a field sales representative sells the products and services of the 3M Company to our buying public. Before a sale can be made, people must negotiate. Someone buys something. This seminar offeres you an

opportunity to hear, see and become a participant in this vital equation to assist you to sell and communicate your ideas more effectively.

Delivery: Lecture, Discussion and Audio Visual Media

Content: Persuasion
Want-Problem-Solution
Logic-Emotion
Features-Advantages-Benefits
Evidence
Attention
Involvement-Man
Overcoming Objections-Action

These seminars have been specially arranged for the Technical Forum to include all the concepts included in the course for 3M salesmen but they will be condensed into a one-day seminar. There will be a $60 recharge fee to your department for this course.

INTRODUCTORY PHYSIOLOGY

Course Objective: To present introductory information on normal physiology or body function.

Course Content: Organization of the course will be based upon organ systems. Anatomy, pharmacology and abnormal physiology will be brought in where appropriate. The course will be taught at the introductory level over a period of ten weeks. The tentative schedule is:

Skeletal-Muscular
Neural
Sense Organs
Endocrine
Circulatory
Respiratory
Digestive
Urinary

Enrollment will be limited to 60

PHOTOCHEMISTRY OF ORGANIC MOLECULES (An ACS Audio Course)

Course Objective: To present a broad view of organic photochemistry.

Pre-requisite: A basic knowledge of undergraduate level organic and physical chemistry.

Course Content: This is an American Chemical Society Audio Course on cassette tapes. It is taught by Nicholas J. Turro, Professor of Chemistry at Columbia University and 1974 recipient of the ACS Award in Pure Chemistry. At the conclusion of each session a question-answer period will be led by George Vesley. The course deals with mechanisms of electronic excitation and deexcitation; electronic energy transfer; photochemical dynamics; pericyclic reactions; and the photochemistry of alkenes, polyenes, aromatic hydrocarons, conjugated enones, and other compounds.

Textbook: A 300+ page manual integrated with the audio tapes is necessary to follow them. If you wish to have a manual, enclose a check for $5 payable to 3M Technical Forum with your registration. Note: we must have registrations as soon as possible so that manuals can be ordered.

SALES SEMINARS FOR THE SCIENTIST

Registration Form

Please complete registration form and return to Diane Wilmer, Education and Training Department - 220-2E (3-8092).

Seminars will be limited to 15 people each.

Desired day of attendance:

1st Choice _____

2nd Choice _____

Name: _____ Empl. #: _____

Position: _____

Division: _____ Dept. # _____

_____

TECHNICAL DIRECTOR'S APPROVAL
Recharge fee: $60.00

_____

(Print name after signature)

Date: _____ Phone: _____ Location: _____

Registration Form Course Title: _____

Name: _____ Division: _____ Location: _____

Supervisor's Signature: _____ Location: _____

I am: ☐ Exempt ☐ Non-exempt MAIL TO TECH FORUM OFFICE - 220-11E

Registration Form Course Title: _____

Name: _____ Division: _____ Location: _____

Supervisor's Signature: _____ Location: _____

I am: ☐ Exempt ☐ Non-exempt MAIL TO TECH FORUM OFFICE - 220-11E

☐ Enclosed is $5 for a Photochemistry textbook

Registration Form Course Title: _____

Name: _____ Division: _____ Location: _____

Supervisor's Signature: _____ Location: _____

I am: ☐ Exempt ☐ Non-exempt MAIL TO TECH FORUM OFFICE - 220-11E

Topic that you will use for Information Resources Course: _____

_____

_____