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# CONTENTS

## UTILIZATION OF COMPOSITE FABRIC TECHNOLOGY IN FUSIBLE APPLICATION

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ABSTRACT

The term "composite fabric" covers a wide spectrum of fabrics and an even wider spectrum of applications. This paper discusses a range of composite fusible fabrics designed and patented by Crown Textile Company. The fabric consists of a layer of nonwoven fabric, a layer of yarns, stitch yarn knit through both layers to secure them together and a coating of thermoactive adhesive material. The yarns provide strength and resiliency while the nonwoven fabric provides a smooth surface for coating. This concept optimizes the beneficial characteristics of both woven and nonwoven fabrics in fusible application.

### INTRODUCTION

When manufacturing various types of garments, it is the usual practice to attach an ironed-in stiffening insert, usually referred to as an interlining, to the body or base fabric of certain parts of the garment, such as suit, shirt or blouse shoulders, fronts, collars and cuffs. The interlining is normally adhered or fused to the base fabric by a bonding of thermoactive adhesive material applied to one side of the interlining fabric, as by coating, or by printing in spaced deposits of dot patterns. The interlining fabric is then placed adjacent the base fabric with the dot patterns of thermoactive adhesive material in contact with the base fabric and subjected to an ironing or pressing operation so that the thermoactive adhesive material softens and adheres or fuses the interlining fabric to the base fabric.



It is known to produce these interlining fabrics of nonwoven material, knit material, or woven material. The nonwoven interlining fabrics have good cover but do not have the resiliency, drape and the strength properties normally found in knitted and woven interlining fabrics. However, the nonwoven interlining fabrics are sometimes preferred because they have a smooth surface, making it convenient for applying the fusible coating thereto. In many instances, the woven and knitted interlining fabrics are not suitable because they do not have the cover provided by the nonwoven fabrics. While the woven and knitted fabrics have the resiliency and strength, they do not provide the smoothness of surface which is typical of the nonwoven fabrics. Also, the woven and knitted interlining fabrics can present "strikeback" problems. Strikeback is the tendency of the fusible coating material to flow through the interlining fabric and to the opposite side of the interlining fabric to which the fusible coating material is applied. Such strikeback of the thermoactive adhesive material can result in an undesirable bonding between the lining of the garment and the interlining upon the application of heat and pressure. When the lining of the garment is adhered to the interlining, this effects the drape, feel and appearance of the garment as the garment is designed to have the interlining fabric adhere only to the outer or base fabric of the garment and not to the lining.

COMPOSITE FUSIBLE FABRIC

With the forgoing in mind, a composite fusible interlining fabric was developed. The fabric included a layer of nonwoven fabric, a layer of yarns, stitch yarn knit through both layers to secure them together, and a coating of thermoactive adhesive material, which can be activated under heat and pressure to obtain optimum performance in the desired product application.

The embodiment of the composite fusible interlining fabric, illustrated in Figures 1 and 2, includes a relatively thin layer of nonwoven fabric **11**, formed of closely compacted fibers, and a layer of fibrous material, illustrated as inlaid weft yarns **12**, such as spun yarn. Stitch yarn, broadly indicated at **13**, is knit in a warp knit stitch pattern through the layer of nonwoven fabric **11** and incorporates the inlaid weft yarns **12** therein. The stitch yarn **13** forms a plurality of side-by-side walewise extending stitch loop chains **14** on the reverse or back side of the composite fusible interlining fabric and forms diagonally extending laps **15** on the front or face side of the composite fusible interlining fabric. The laps **15** extend in a zig zag path between adjacent wales of stitch loop chains **14**. Thus, the stitch yarn **13** is knit through and connects the layer of nonwoven fabric with the layer of fibrous material [spun yarn **12**] and provides the strength, bulk, drapability and resiliency characteristics of conventional knit or woven interlining fabric. The layer of nonwoven fabric **11** provides the smooth surface characteristics of conventional nonwoven interlining fabric.

A coating of thermoactive adhesive material is illustrated as being applied to the front or face side of the nonwoven fabric **11**; however, it may be applied to the composite interlining fabric. The coating of thermoactive adhesive material may be applied in any desired manner, such as the randomly arranged dots **16** of adhesive material shown in Figure 1. The upper layer of nonwoven fabric **11** provides a relatively smooth surface for the application of the dots **16** of thermoactive adhesive material. The diameter and thickness of the dots **16** of thermoactive adhesive material have been greatly exaggerated in Figures 1 and 2. In the actual fabric, the dots of adhesive material are substantially invisible.

The body or base fabric, indicated at **20**, is fused or bonded to the composite fusible interlining fabric by the application of heat and pressure to soften the dots **16** of adhesive or fusible material and to cause the same to adhere to the inner surface of the garment base fabric **20**. The provision of the layer of nonwoven fabric **11** on the inner surface of the composite interlining fabric provides a barrier or shield of closely compacted fibers to prevent strikeback of the thermoactive adhesive coating material when the composite interlining fabric is fused to the base fabric. The inlaid weft yarn **12** provides the desired resiliency, bulk, hand, body, drape and other characteristics to the fused garment.

As an example, it has been found that a satisfactory composite fusible interlining fabric can be formed by knitting a 40 denier polyester yarn while inlaying a spun [worsted or cotton] yarn in alternate courses, as illustrated in Figure 1. However, it is to be understood that the inlaid weft yarn **12** may be varied to change the above mentioned characteristics of the composite fusible interlining fabric.

GARMENT APPLICATION

Most of the early developmental work was aimed at garment application. Figure 3 shows a pictorial view of a typical coat front of a tailored garment. The coat front is constructed by bonding the outer or shell fabric [**15** in Figure 3] to a thermoplastic adhesive printed fabric [**17** in Figure 3] under heat and pressure. These types of fabrics are identified as fusible interfacings. The adhesive coating is termed as fusible coating. Garments currently produced have woven, weft-inserted knit or nonwoven [dry laid/resin bonded, thermally bonded or spunlaced] fusible interfacings. A composite fusible interfacing such as the one described in TABLE I allows a garment manufacturer to dimensionally stabilize the garment, obtain a desired hand, mold a three dimensional shape to fit a body and offer good aesthetic appearance. By choosing the correct components of the composite fusible interfacing, he can also optimize the overall garment performance during the use of the garment [thru washing and drycleaning treatments]. Composite fusible fabric as described in TABLE I can also be used in the lapel panel, bridle [**16** and **17** in Figure 3], patch pocket, pocket flap, cuff wigan, etc.

Additionally, the upper or breast portion of the coat is provided with one or more separate layers of interlining material, normally referred to as a chest piece [**14** in Figure 3]. Often it is desirable to provide an additional wedge of woven material in the area of the upper extremity of the coat front [**24** in Figure 3] in order to provide additional reinforcement to the shoulder area of the coat. The new composite fusible interfacing described in TABLE II provides good wrinkle resistance, resiliency, is easily moldable, and has good durability for long wear, as well as good appearance, washing and drycleaning performance.

OTHER APPLICATIONS

Other applications for composite fusible fabric concept with variations in the components of the fabric and finishing techniques are highlighted below:

Cap/Hat - The woven buckram used presently is most often imported from the Orient; it has width limitation. Application of glue during the manufacturing of the cap is a very labor intensive, messy operation. A composite fusible fabric described in TABLE III looks extremely promising.

Automotive - Headliners, as well as hoodliners, today are typically nonwoven fabrics. The design capabilities of composite fabric construction will allow one to better control the strength requirements, bulk, resiliency, flame resistance, color matching, etc.

Filtration - Optimally designed composite fabrics with the use of fusible coating could create "gradient" filters for liquid, as well as gaseous compounds. The composite fusible fabrics could be significantly less expensive than felts currently used.

Coating/Laminating - Again, by design parameters, the composite fabrics can be made more or less open. Yarns with PVC coating or thermoplastic fiber can be incorporated to optimize the finished product characteristics.

Contract - Commercial homefurnishing and wall covering use woven fabrics, such as osnaburg and drills. Composite fabric design capability with fusible coating could produce facing, as well as backing fabrics in this market.

Medical - The composite fusible concept could produce durable structures with high degree of stretch and comfort, as well as breathability. Impermeability with drape could be imparted as required by OR gowns using fusible coating to adhere to other substrates.

## SUMMARY AND CONCLUSIONS

The potential for composite fusible fabric concept is enormous. With the proper choice of the various components of the composite fusible fabric, one can optimize the finished product performance whether the finished product be a garment, an automobile, a filter, a wall cover, or an operating gown in the medical field.

## ACKNOWLEDGEMENTS

Acknowledgement is hereby extended to Mr. Paul Atlas and Mr. Ian Stonehouse for their valuable contributions. Appreciation is extended to Carol Weber and Jane Hoover for their assistance. Appreciation to Crown Textile Company for allowing this work to be published is gratefully extended.

## REFERENCES

1. D. V. Kamat, U. S. Patent 4,495,661 [January 29, 1985]
2. D. V. Kamat, U. S. Patent 4,450,196 [May 22, 1984]

**FIGURE 1**

**ELEVATIONAL VIEW OF A GARMENT BASE FABRIC WITH THE COMPOSITE FUSIBLE FABRIC**

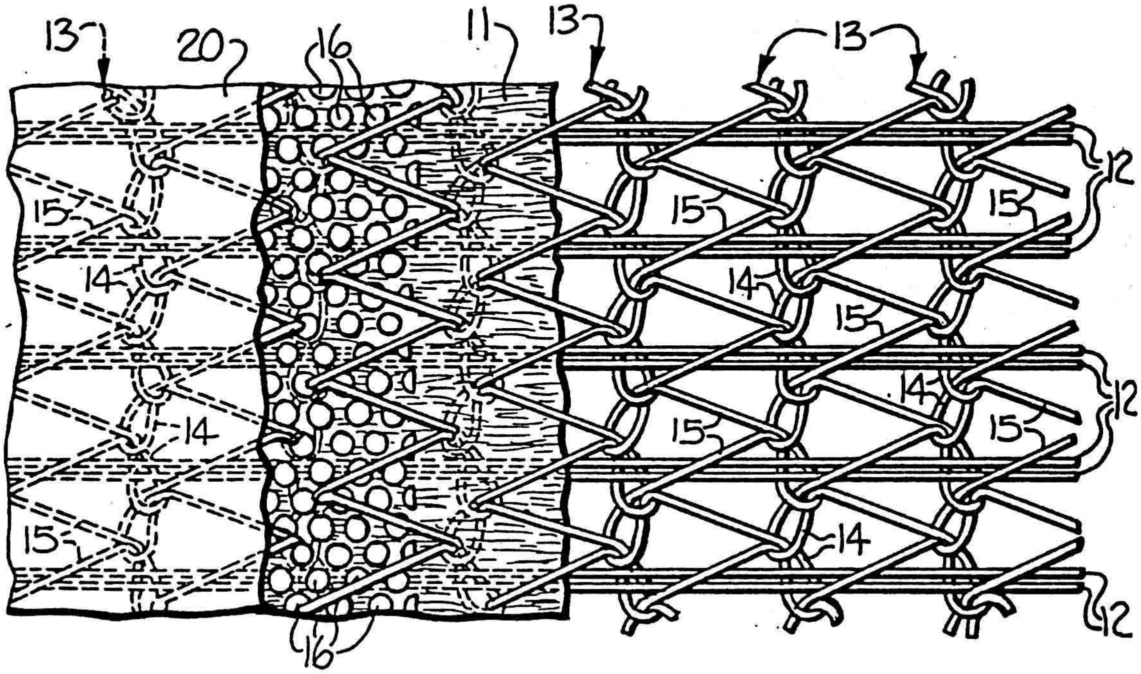
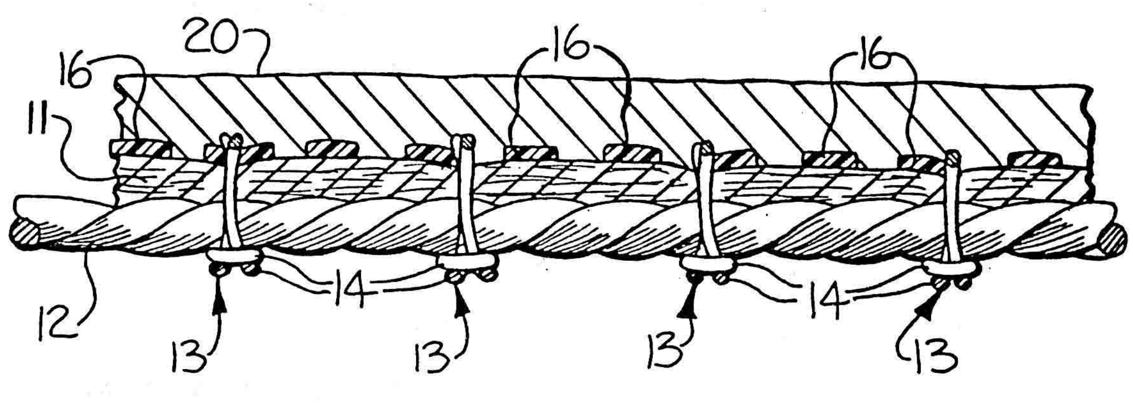


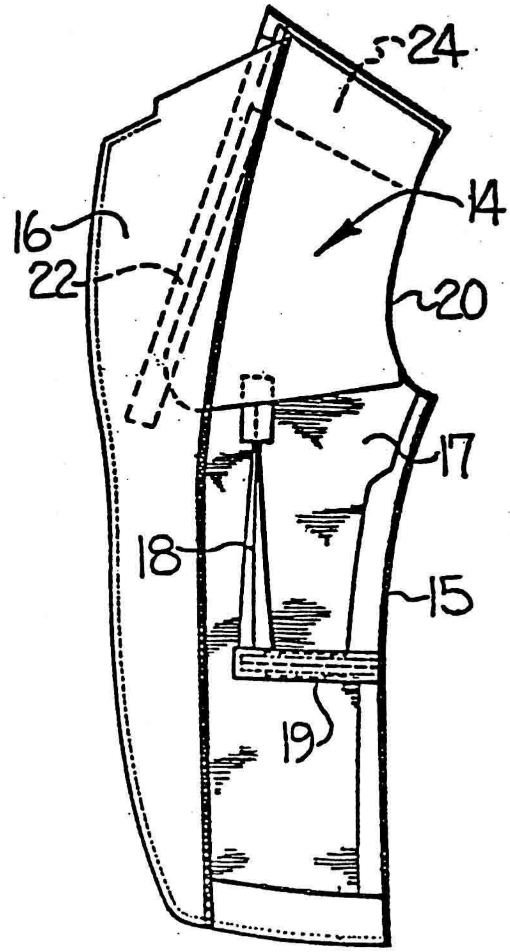

**FIGURE 2**

**ENLARGED SECTIONAL VIEW TAKEN ALONG THE LINE 2-2 IN FIGURE 1**



## FIGURE 3

## A TYPICAL COAT FRONT PANEL OF A CONSTRUCTED GARMENT




14 - Precut Crownflexxx chest piece

15 - Typical suit front panel

16 - Lapel panel with fused interfacing

17 - Front canvas interfacing

18 - Breast darts

19 - Pocket cuts

20 - Arcuate cut edge

22 - Nonwoven fusible bridle

24 - Additional wedge of interfacing material

## TABLE I

## A TYPICAL COMPOSITE FUSIBLE INTERFACING

Stitch yarn - 40 denier multifilament polyester

Stitch type - chain or tricot

Nonwoven layer - 0.8-1.0 ozs./sq. yd.

Fiber type - 100% polyester*

Binder type - soft acrylic

Weft yarn - 2 0/1 cotton spun*

Fiber type - 100% 1.5 denier X 2" polyester*

Picks/Inch - 15*

Fusible coating - 13 or 17 mesh dot pattern

Polymer type - copolyamide/copolyester

Coating add-on - 0.3-0.5 ozs./sq. yd.

*To optimize the hand and other aesthetic properties of the finished garment, one would change the fiber type, blend ratio, yarn size, yarn type - cotton or worsted spun, number of inserts or picks per inch, etc.

## TABLE II

## A TYPICAL COMPOSITE FUSIBLE WEDGE

Stitch yarn - 40 denier multifilament polyester

Stitch type - Chain

Nonwoven layer - 0.8-1.0 ozs./sq. yd.

Fiber blend - polyester/rayon*

Binder type - resilient acrylic

Weft yarn - 330 denier monofilament*

Fiber type - nylon or polyester*

Picks/Inch - 20*

Fusible coating - 13 or 17 mesh dot pattern

Polymer type - copolyamide/copolyester

Coating add-on - 0.3-0.5 ozs./sq. yd.

*To optimize the degree of resiliency, bulk, moldability and other aesthetic properties of the finished garment, one would change the fiber blend, type of monofilament, number of inserts or picks per inch, etc.

## TABLE III

## BUCKRAM ALTERNATIVE IN CAP CONSTRUCTION

Stitch yarn - 40 denier multifilament polyester

Stitch type - chain

Nonwoven layer - 1.0-2.0 ozs./sq.yd.*

Fiber blend - polyester/rayon*

Binder type - resilient acrylic

Weft yarn - 10/1 cotton spun*

Fiber type - polyester and/or rayon

Picks/Inch - 12-15

Finish - Special resilient finishes to impart bounce as well as stiffness without cracking

Fusible coating - 13 or 17 mesh dot pattern

Polymer type - special thermoplastic for easy bonding during cap manufacturing

Coating add-on - 0.3-0.5 ozs./sq. yd.

*To optimize the degree of resiliency, bounce, moldability and other aesthetic properties of the finished cap, one would change the weight of and fiber blend in the nonwoven layer, size of the yarn, type of yarn, number of inserts or picks per inch, etc.

# PERMANENTLY HYDROPHILIC POLYMER FIBERS, FABRICS, AND WEBS

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For several years this company has been licensing technology to process synthetic fabrics and nonwoven webs to render them permanently and irreversibly hydrophilic and soil releasing. The original work was on fabrics used in apparel. Within the past year and a half we have expanded the technology to include needlepunch, spunbonded, melt blown, and stitchbonded webs. And most recently we have developed the technology to treat staple fibers before they are incorporated into a wet lay slurry or a dry lay mat.

These fibers or fabrications may be of most polymers except PTFE and those polymers that dissolve in hot aqueous solutions (Polyacrylates for example). The use of Polypropylene, Polyethylene, Nylon and Polyester are the most common. Inter-polymer blends are possible and later in this paper we will discuss the polymer-cotton blends.

Web density, fiber length and denier size are not restricted as long as it is possible to pump or force the processing liquid through the fabrication. In wet lay most of our work has been with 1.5 to 10 denier Polypropylene and Polyester of one quarter inch to two inch lengths. We chose these sizes because they are commonly used in the industry. In dry lay we have employed the longer filament lengths in a wide range of denier. Work at The University of Tennessee at Knoxville on melt blown nonwovens has demonstrated that these webs are capable of accepting the process. Open fabrications such as needlepunch and spunlace are easily treated.

Basically the process involves a permanent molecular change on to the surface of the polymer. This change is chemically achieved in a process similar to a dyeing operation, and in fact dyeing equipment is most generally employed in processing. This technology is presently the subject of several patents pending and at present we are constrained from being more specific about the chemicals or the mechanics. This information is available to companies that work with us under appropriate Secrecy Agreements.

In wet lay the use of polymer fibers to augment a cellulose web is certainly not new. Natural webs can be considerably strengthened by polymer fibers. In addition, expanded texturizing properties can be added to the wet lay web, and the particulate drop off can be reduced. Nor is the application of a surfactant to the polymer fibers novel. In the slurry, water-friendly fibers are less likely to exhibit many of the classical clumping and dumbbell effects that are associated with untreated polymer fibers.

But Surfactant treated fibers have some drawbacks because the surfactant in part or in total is removed in the wet lay process.First, if some of the surfactant is retained, it may be a contaminant depending on the end use of the wet lay. Where low level extractables are essential, this retained surfactant which leaches out will probably render the final web unsuitable for any use in clean room or high tech environments and suspect in medical applications. The second drawback occurs when the surfactant is entirely removed in the wet lay process. Then the polymer fibers no longer have any hydrophilicity, and the wet lay as a whole is only as absorbent as its other constituents. Balancing these needs of strength, low extractables, low particulates, and absorbency is nearly impossible in a surfactant polymer - cellulosic system.

By creating a permanently hydrophilic staple fiber that requires no surfactants to improve its performance in the slurry, you can eliminate many of the above problems. And because the fibers in the formed web have an absorbency similar to the cellulosics, the choice of the ratio of fiber types is determined by both the projected end use of the wet lay and the engineering constraints of the web forming machinery. Webs from a 90:10 cellulose:polymer ratio have nearly the same absorbency as a 10:90 ratio. And 100% absorbent polymer webs
are achievable.

In case this picture appears too rosy, there is a drawback. The treated fibers must be carded before they are put into the wet lay slurry otherwise they too tend to clump together.

Let us turn our attention to dry lay. Once they are carded, the processed fibers behave exactly like their untreated counterparts in the web forming process. The differences become apparent only after the web is formed. In most cases it is more economical and practical to treat the dry lay after it has been formed. However, where the web is especially fragile or where a high loft must be maintained, then best results are achieved by treating the fibers before the web is made.

To date most of the interest in these dry lay webs is in the filtration field where there is a need for webs that are permanently wettable, inert, and durable. In many applications polymer webs have added to them clay, resins, leachable surfactants, and other agents to make the webs water-friendly. These agents have only a limited life span and generally are washed off long before the web looses its innate structure. The functional life span of these filters is all too often determined not by the polymer fabrication but by the additives. However, by using a filter that is itself water-friendly, the life span of the filter is greatly extended because it is now a function of the polymer itself. This type of treated web is less expensive than a web that has had resin or clay added.

Treated webs demonstrate a unique ability to break oil-water emulsions. This effect is probably the result of a momentary hold up of the water phase on the fibers. This property appears to have some interesting applications in industrial filtration of cleaning fluids and oils.

Small pore size synthetic filters that are subject to back pressures in water-based solutions often experience a decrease in that back pressure due to a reduction in hydrophobicity. Generally, the smaller the pore size, the more pronounced is the effect. It should be noted that we encounter this feature more in our work with membranes and solid plastic filters than we do in nonwoven constructions.

The treated fibers are irreversibly hydrophilic. The process can only be removed by melting the fiber. Fabrications made from 100% treated fibers can be expected to adsorb approximately four times their weight in water or water based solutions of any pH, salinity, or protein content. After washing and drying they will again adsorb the same volume of liquid. Although this liquid pick up is somewhat less than cellulosic fibers, these hydrophilic synthetic fibers dry in less than half the time and have functional life span many times longer than natural materials. In addition, treated fibers or webs have unmatched soil release properties where washing and reuse is required.

Needlepunch and related webs that are used as scrims or reinforcements in emulsion asphalt or rubber products have an improved adhesion to the solids and incorporate more easily into the matrix. You can visibly watch the liquid phase pass through a treated web where usually it would remain on the surface or have only limited penetration.

Similarly, nonwovens made from treated Polypropylene have some unique bonding characteristics. The problems of using adhesives with Polypropylene are well known. Treated fibers, however, exhibit markedly improved adhesion characteristics as a consequence of the change in surface tension. The lamination of foams and fabrics to a treated Polypropylene web , or to a web containing a proportion of treated fibers, is facilitated. The attachment of one Polypropylene fabrication to another is greatly improved.

Polymers that are normally oleophilic retain this capacity after processing while adding a hydrophilic characteristic as well. These capacities exist in ratios that vary with the exact polymer type and the degree of treatment although the oil absorbency is usually not diminished.

There are minimal extractables from treated fabrics and webs over a range of tested pH values from 2 to 11, and in methanol. Extractable results for Sodium, Calcium, Magnesium, and Potassium are all in the low ppm range. In addition, figures for Total Organic Carbon extractables fall into the same range.

A major U.S. testing company using AATCC 90-1974 tested treated Polyester material for activity against Klebsiella, Staphlococcus, and MIL-STD-810C Fungus. The test reports support claims regarding the fabric's resistance to bacterial and fungal degradation, and suggest inhibition of odor production. Testing using the Bauer-Kirby procedure produced no zone of inhibition as was

expected, since the INTERA treatment works by effecting a molecular change in the polymer rather than adding a moiety that can be released or extracted.

The process will work in polymer-cotton and polymer-cellulose blends. In polymer-cotton blends, the process affects only the polymer; the cotton remains unchanged. In polymer-cellulose blends there is some improved absorbtion with the cellulose. However, there is no technical advantage to maintaining the natural fibers in the fabric since mechanically blended fibers detract from machine efficiency as compared to 100% polymers. And the INTERA processed synthetic fibers now absorb and wick like natural fibers with far superior strength and durability. Needlepunch nonwovens of 100% polyester are the basis of a whole new generation of hospital incontinent products that far outperform cotton in wearability, looks and cost per use.

Discussion of specific end uses is probably more appropriate for the October INDA show and we will present them there.

The process discusssed in this paper is currently the subject of several patents pending owned by the Intera Company, Ltd. of Cleveland, Tennessee, a joint venture between the Lubrizol Corporation and the Intera Corporation.

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April, 1986.

ABSTRACT:

A new process for making various polymer fibers and webs permanently and irreversibly hydrophilic (water-friendly) is described. Application to wet-lay, dry-lay, needlepunch and welt blown are addressed. The properties of the treated fibers are detailed along with suggested practical uses.

# USE OF SOME FIBERWEBS AS NOISE INSULATION MATERIALS: AN ASSESSMENT

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## INTRODUCTION

Noise is a common nuisance, sometimes causing an incurable damage to the inner ear. Figure 1[1] displays response of the human ear to sound. The lower curve represents the hearing threshold, the upper curve represents the threshold of pain. Exposure to a sound level exceeding this threshold can cause partial to total deafness. Noise control is, therefore, a problem of considerable technological importance.

Besides its ability for noise control, the choice of a particular insulating material, for a given application, is determined by some of its other desirable characteristics. These include cost, specific weight, thickness, fire resistance, etc. For example, to insulate against the noise in an aircraft, specific weight and thickness of the insulating material should be as low as possible. As a result, the technically well known noise insulating materials, such as glass powder or "rock wool", are inappropriate for use in aircrafts.

Fiberwebs are much lighter and can be cheaper than the conventional noise insulating materials. In order to evaluate their potential as noise insulators, their insulating characteristics must be explored. This constitutes the objective of the research reported in this paper. It describes the results of some experiments conducted to determine the sound transmission and/or absorption characteristics of some fiberwebs and relate them to the physical picture that emerges from the theoretical analyses of the absorption and transmission of sound waves through porous media[2,3].

## EXPERIMENTAL DESIGN AND PROCEDURES

The experiments to be described were performed in a specially designed acoustic laboratory. In the design of experiments two cases have been considered. In the first case, the listener and the noise source are supposed to be in the same room, and the noise reduction is achieved by covering the walls of the room with a noise absorbing medium. In the second case, the listener and the noise source are separated by a barrier, and the noise control is achieved by the attenuation of the sound waves passing through the insulating barrier.

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*Y.S. dedicates this paper to the late Ms. Revital Seri, his niece.