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ACID BONDING NONWOVEN FABRICS

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ABSTRACT OF THE DISCLOSURE

A process for making a bonded nonwoven fabric from a blend of nylon fibers and fibers of another kind of material. The fibers are formed into a web which is treated with a concentrated solution of a strong acid which affects the nylon but does not substantially affect the other material. The nylon is softened and swollen by the concentrated acid. Then, the web is contacted with water which dilutes the concentrated acid and coagulates the nylon. Subsequently, the web is subjected to pressure. The acid treatment makes the nylon more susceptible to pressure but does not have this effect on the fibers of the other material. When pressure is applied, the nylon flows and causes the other fibers to be bonded to each other.

The present invention relates to the manufacture of a bonded nonwoven fabric and more specifically to fabrics useful as a substrate for artificial leather. In accordance with the present invention, a nonwoven fiber web composed of unbonded fibers including nylon fibers and others is treated with strong acid to selectively affect the nylon fibers, and the web can then be calendered to cause the nylon fibers to further bond the web into a more cohesive fabric.

Leather is composed of a plurality of collagen fibers bound together by reticular tissue which forms a network between the collagen fibers. Therefore, in the manufacture of artificial leather, an effort has been made to substitute textile fibers for the collagen fibers and a synthetic polymer for the reticular tissues.

There are certain characteristics of leather which must be reproduced in a leather replacement material. For shoe uppers, which consume more than half of the hides used in the U.S., these characteristics include optimum values of density, relative density, uniformity of density, permeability, roll, break, piping, crease resistance, suppleness, formability (lastability) and dimensional stability to low order stress and strain.

Density is the weight of a given volume of a material and is expressed in grams per cubic centimeter according to the equation.

$$\text{Density (gm./cc.)} = \frac{\text{Weight (ounces per square yard)} \times 1.33}{\text{Thickness (mils)}}$$

Leather is a dense but supple fibrous material and it has long been recognized that synthetic leather materials also should be dense and supple. A suitable density is 5.5 to .70 g./cc.

Relative density is the volume of solid mass in a porous material in relation to the total volume the material occupies. Thus a relative density of one (1) is the highest obtainable and indicates a solid non-porous mass of any material or combination of materials. It is computed using the equation.

$$\text{(Relative Density)} = \frac{\text{Weight (ounces per square yard)} \times 1.33}{\text{Average specific gravity of components} \times \text{thickness (mils)}}$$

A relative density, for example, of .51 indicates a pore space or porosity of .49 (49%). Porosity is the proportion of the volume of a material occupied by interstices.

Relative density, together with density, characterizes the degree of compactness of a fibrous sheet structure.

Density uniformity or uniform density.—This property relates to the evenness of interstice and fiber distribution within the structure. A method of measuring this property is described in U.S. Pat. 2,958,113. In that method a fiber web is placed between a light source moving in a four-inch line and pulsed at 60 cycles per second and a photocell which feeds its pulsed input into a display cathode ray oscilloscope. The projection of the oscilloscope represents the varying intensity of light as it passes through the batt along its path. The top peaks represents areas of no light transmission through the batt. The bottom peaks denote light transmission through the batt. Non-uniform nature of the batt will be represented by wide fluctuations, particularly in the bottom peaks and widespread between top and bottom peaks. Relatively uniform fluctuations between top and bottom peaks demonstrate uniformity of the product. Relatively narrow spread between top and bottom peaks indicates high covering power.

Another means to determine density uniformity is examination of cross sections of the fibrous sheet under a microscope at about 30 magnifications.

Preferably a flexible film is coated or laminated to the surface of a fibrous sheet material and the texture and appearance of the coating upon stretching is examined as to the development of irregularities produced by nonuniform density of the fibrous sheet substrate.

Permeability is the ability to allow vapors and liquids to pass through the interstices or pores. It denotes that the interstices of a material are interconnected and are not isolated and sealed off one from the other as in buoyant foamed polystyrene. Fibrous sheet materials of up to .75 relative density, i.e. 25% pore space, are extremely permeable to vapors and liquids, provided they are unsaturated or uncoated and possess uniform density. A preferred test method for permeability is described in U.S. Pat. 2,723,935.

Roll as related to a flexible sheet material, is the character of its resistance to the rolling or flexure of a rear flat bend or crease. It is tested by producing a sharp (small radii) bend of 180° and subsequent flexure of the near flat bend or crease by moving the faces of the folded sheet across one another back and forth in a direction normal to the bend or crease line. Sheet materials with good roll offer even and uniform resistance to the rolling or flexure of a sharp bend or near flat crease. This is most practically evaluated by folding a small sheet of the material between the extended fingers of both hands and then moving the hands back and forth as when rubbing the palms of the hands together.

Break, as related to a flexible sheet material, is the continuity of structure and appearance of the material on the concave and convex side of a sharp (small radii) bend as it is subjected to flexure as described above when testing or examining for roll characteristics. A marked change in continuity of structure and appearance upon roll testing is considered poor break. When one breaks in a pair of shoes, the appearance of the creases and folds at the instep allows one to judge the break characteristics of the leather or flexible sheet material of the shoe upper.

Piping is a descriptive term also used to denote the degree of structure and appearance of change along the concave line of a sharp (small radii) bend or fold of leather or a flexible sheet material. This is observed when testing for roll and break. The structure of a flexible sheet material is subjected to considerable compressive forces on the concave side of a shape (small radii) bend or fold. If the structure collapses, deep creases develop in conjunction with pipelike protrusions of the structure

between creases. This is excessive piping and indicates poor roll and break.

Crease resistance is the ability of a flexible sheet material or leather not to collapse or develop deep creases when subjected to the considerable compressive forces of a sharp (small radii) bend or fold.

Suppleness is principally considered to be softness or lack of stiffness. Stiffness (or softness) may be tested on a Tinius-Olesen machine in accordance with ASTM 1388–55T.

Formability or lastability is the ability of a leather or sheet material to be forcibly drawn or stretched into a new configuration without exhibiting the memory or desire to return to its original configuration as is characteristic of elastic sheet material. An example is the forming of a shoe upper toe from a flat sheet. In order for a material to be formable it must possess a very uniform structure and its components must be able to slip upon each other and assume a stable new configuration.

Dimensional stability to low order stress and strain is the ability of the fibrous sheet material to be rolled and unrolled, saturated with aqueous or solvent saturant systems, heated, coated etc. without excessive elongation, stretching or necking down upon being subjected to the normal tensions of such handling.

Sheet materials ideally suited for shoe upper leather, suede leather, wearing apparel and the like, must possess properties of suppleness, and good roll, and break. Therefore, many solid compositions of rubber and plastic sheets have been considered as artificial leather because they possess the correct properties of suppleness and drape, roll and break. However, they are not well suited for use as shoe uppers, wearing apparel and the like because they do not normally possess the properties of leather-like feel, permeability, porosity and the ability to draw, last, or be formed without memory or desire to return to their original dimension. Non-solid all fibrous sheet materials like felts or other needle-punched and shrunk materials also have been considered because they possess many of the desirable properties referred to above. They are not suitable themselves, however. Consequently, it has been suggested that they be subjected to saturation or impregnation by a rubber or plastic material, with or without adhesion of the impregnant to the fibrous sheet, in order to obtain all of the properties desired in a shoe upper, suede leather or wearing apparel material.

For some types of artificial leather, e.g. intended to be used as shoe uppers, it has been found that porosity and gas permeability are not essential characteristics. In such cases, it has become common to utilize the artificial leather material made by coating a plastic, such as polyvinyl chloride, onto a woven fabric. The present invention is concerned with the manufacture of a nonwoven fabric which is useful as a substrate for making artificial leather of this type.

In accordance with the present invention, a nonwoven fabric is made from a fiber blend of which a portion of the fibers comprise nylon. The blended fibers are formed into a web which preferably is needle punched and the web is then immersed in strong, concentrated acid. This tends to soften and flow the nylon fibers, and the web is then immersed in water which coagulates the nylon. The web is bonded at this point but not as well or tightly as it is after also calendering. Next the web is neutralized with an alkali, or the nylon can be coagulated and neutralized simultaneously by passing the web from the acid bath directly into the alkali bath, followed by washing and, if necessary, drying. The web can then be calendered or compressed while hot enough to cause the treated nylon to flow. The acid treatment reduces the temperature at which the nylon flows under pressure whereas the other fibers in the blend are not affected by the acid. Therefore, at the temperature applied when the fibers are pressed, the nylon is selectively flowable while the other fibers remain essentially unaffected so that the nylon becomes a more efficient bonding agent which holds the other fibers together.

The nylon fibers which are used in the present invention are fibers of polyamides which are condensation products containing recurring amide groups as integral parts of the main polymer chains. They are made by condensation of amino acids or lactams derived from them, or from diamines and dibasic acids, or salts or the like made from them. The polyamides are fiber-forming which means that they are of relatively high molecular weight. The invention is particularly concerned with the use of nylon 6 and/or nylon 6,6. It also may be used with nylon 6,10, although this polymer requires stronger treatment. Nylon 6 is a polyamide derived by polycondensation of 6-amino-caproic acid or a polyamide forming derivative thereof such as caprolactam. Nylon 6,6 is the polycondensate of adipic acid and hexamethylene diamine, or polyamide derivatives thereof, particularly the salt formed by reaction of hexamethylene diamine and adipic acid. Nylon 6,10 is a polyamide derived by polycondensation of hexamethylene diamine and sebacic acid or polyamide forming derivatives thereof. Copolyamides especially of the aforesaid amide forming materials also may be used.

As fibers useful for blending with the nylon fibers, there may be mentioned polyester, polyolefin, e.g. polypropylene, glass, cellulose fibers such as cotton and rayon, polyvinyl chloride, Saran and the like. Wool might be used if the acid is, say, sulfuric acid which does not affect it, even though it is a kind of polyamide. The criteria for selection of other fibers is that they be relatively unaffected by the acid treatment (and that they preferably have a softening point higher than the nylon after the nylon has been treated with acid).

The fibers utilized in accordance with the invention may be oriented or unoriented, although it is normally preferred that at least the non-nylon fibers be oriented to increase their tensile strength. The fibers ordinarily will be 1.0 to 15 denier and about 1½ inches long. In the blend, the nylon may constitute about 20–80 percent by weight. The fibers may be blended together using any conventional fiber blending technique.

The fibers in the blend are formed into a nonwoven fiber web. This term is used to describe a web such as a batting or similar material comprising fibers arranged at random but not bonded to each other. A web may be formed, for example, by driving the fibers, preferably while dry, onto a moving screen with air blowing the fibers along and/or with suction applied through the screen. A web also may be formed using a card which tends to produce a higher degree of alignment of the fibers in the machine direction.

The web may be built up to greater thickness than originally formed as described above, by placing successive layers of the web on top of each other, for instance in a cross laying machine; the cross laying of several layers tends to cancel out some of the nonuniformities in individual layers. It also is preferred to combine the nonwoven fiber web by needle punching with a carrier layer which is a sheet material having greater dimensional stability than the nonwoven fiber web itself. This holds the web together during subsequent treatment. Almost any kind of carrier material may be used in this embodiment. For instance, it may be a woven scrim, i.e. an open mesh plain woven fabric of cotton in various weights and constructions. The carrier layer also may be a sheet material of any type, for example, a plastic film, a plastic foam, such as polyurethane, or a ligated or previously bonded nonwoven web. Typically, the carrier will have a weight of 0.5–3.0 ounces per square yard. It is possible that the carrier layer may be composed of nylon, for instance a nylon scrim of film, which is affected by the acid bonding treatment in accordance with the present invention, increasing the bond strength of the fabric and

permitting the acid treatment to eliminate orange peel which otherwise might be caused by the carrier layer.

In lieu of a reinforcing carrier, the web may be bonded lightly by conventional techniques, For example, the web can be impregnated with a relatively dilute latex of binder, such as cross-linkable thermoplastic acrylic polymer or rubber, and the binder may be cross-linked by heating. Preferably the amount of binder is relatively small, up to about 5% by weight of the fibers, and insufficient to coat the nylon fibers substantially.

The nonwoven fiber web. preferably laminated to the carrier layer, is first subjected to needle punching. This is a process whereby a plurality of needles, ordinarily having barbs projecting from them, are pushed into the fabric and withdrawn repeatedly. Needle punching tends to densify the web, and also may cause some shortening of the fibers and redistribution of the fibers among themselves, increasing the internal strength of the web. The needle punch density used in accordance with the present invention will range from 1000–20,000 punches per square inch, preferably about 3000 punches per square inch. In terms of leather-like properties, needle punching increases density, improves roll and break, and possibly other properties as well. However, needle punching tends to form pock-marks on the surface of the web, which show through a superimposed polymer coating when the product is used in artificial leather. One of the advantages of the subsequent treatments in accordance with the present invention is that they remove these marks.

The needle punched nonwoven fiber web then is contacted with strong acid. Contact may be accomplished in many ways such as spraying the acid onto the web, padding or simply immersing the web into the acid.

A variety of acids may be used for the treatment. The acid should be a strong one, that is having a dissociation constant in water at 20° C. of 10^{-5} or greater. The acid should be water soluble, and preferably has a dissociation constant of 10^{-4} or greater. Formic acid has been used, but still stronger acids are preferred, notably sulfuric, nitric, phosphoric, hydrochloric and fluoboric acids. These acids are applied to the fabric from an aqueous solution, usually containing about 25–75% by weight of acid, the balance being water. The exact concentration varies, depending upon the strength of the acid. In general, the weaker acids are used in higher concentration and the stronger acids in lower concentration. For instance, sulfuric acid may be used at as low a concentration as 30%, whereas formic acid requires a concentration of the order of 75% or more. The exact concentration to be used can be determined by a simple test. Samples of a particular acid in water at different concentrations are made up and samples of nonwoven fiber web containing nylon fibers are immersed in the solutions. The samples, after immersion for 10–20 seconds, are withdrawn, immersed in water at room temperature, dried and tested for stiffness. The concentration of acid which gives the desired degree of stiffness in the fabric is the concentration to be used. If the stiffness is not increased, the concentration is too low. On the other hand, if the stiffness is increased excessively, the concentration is too high. The acid treatment also produces a change in the fabric which can be seen by holding the fabric up to light, i.e. a change in its optical density. Thus, the minimum concentration which produces the visible change can be taken as the minimum concentration to be used.

The acid treatment need be continued only for a few seconds. In general, a contact time sufficient for the acid to fully penetrate the web is desired, but long contact time is not necessary. The effect of the acid treatment depends primarily on the strength and concentration of acid, rather than the duration of the treatment. 3–5 seconds contact times have been sufficient, and little is gained by continuing the treatment for more than about 10 seconds, unless extremely heavy fabrics are being treated.

After the acid treatment, the fabric is contacted with water which immediately dilutes the acid. During the acid treatment, the nylon fibers are swollen, distended, and become very tacky, but the nylon coagulates immediately on contacting the water and the fibers in contact with the nylon become bonded thereto. The fabric may be padded with the acid, to a controlled pick up and then immersed in water so that the concentration of acid is reduced well below the minimum acid solvation concentration described above. It is not necessary to wash all the acid from the fabric, and successive washings are not required.

A small quantity of nylon may become dislodged from the fabric in the acid and especially in the water bath where it appears as finely dispersed particles. In general the weight loss does not exceed about 5% by weight of the nylon. In addition, some nylon which becomes solubilized or dislodged by the acid, redeposits in the acid bath and serves as binder.

The washed fabric is treated next with an aqueous solution of alkali to neutralize any remaining acid. This is not an essential step, but is useful because it prevents any further action by acid on the nylon as the fabric is dried. During drying, as water evaporates, the acid residue becomes more concentrated in the unevaporated water, ultimately reaching a concentration sufficient to swell the nylon. By neutralization, this effect is avoided.

The choice of alkali to be used in the aqueous solution is not critical, but common alkali metal hydroxides and carbonates, or ammonium hydroxide, carbonate or bicarbonate may be used. The concentration of alkali is related to the speed of the fabric and pick up level, but preferably these are correlated to achieve approximate neutrality as the fabric proceeds to the next stage which is a further wash to remove salts and any excess alkali.

At this stage, the nylon fibers may appear somewhat swollen and coagulated nylon particles can be seen. Their flowability and deformability have been increased substantially, but melting point does not appear to be affected appreciably. The acid treatment itself reduces the strength of the nylon fibers to an enormous degree, but the fabric is held together by the entangled web of unaffected fibers. The strength of the web is substantially restored during coagulation in water.

Following these liquid treatments, the fabric can be calendered or otherwise compressed with or without intermediate drying. During compression, the fabric is heated to a temperature sufficient to further increase the flowability of the nylon, generally to about 300° F., but the temperature is insufficient to cause the other fibers in the blend to flow under the applied pressure. The pressure applied depends upon the thickness of the fabric and its density but will ordinarily be about 10 to 1000 p.s.i., preferably 10 to 500 p.s.i. Preferably the temperature does not exceed 400° F.

The temperatures and pressures used in the acid and alkali treatment stages, and preferably also coagulation, are conveniently room temperature. While heating the liquids might accelerate the process, so little time is required that the advantage does not justify the additional cost. Heating might also reduce the required acid concentration, but any savings would be consumed by the cost of heating. The liquids also can be cooled, but this might slow down the process or require higher concentrations and is not desirable. Therefore, while any temperature between the freezing and boiling points of the liquids might be used, it is preferred to allow the liquids to remain in equilibrium with the ambient temperature environment. However, during wash stages, especially after the alkali treatment, it is preferable to heat the wash water to increase efficiency.

After the fabric is compressed, it is quite sturdy and uniform. In particular, a rather thick fabric can be split into two or more thinner layers which are substantially

equivalent to each other, a clear indication of the removal of nonuniformities of structure.

The following examples illustrate the invention, all parts and percentages being by weight.

Example I

A needled bat weighing about 18 ounces per square yard composed of 42% nylon 66 fibers (3 denier x 1½" long), 23% polyester fibers (2¼ denier x 1½" long) and 35% polypropylene fibers (1.8 denier x 1½" long) is made using conventional carding and needleloom equipment. A preformed bonded nonwoven carrier composed of 3.0 ounce per square yard nylon 66 fibers (3 denier x 1½" long), 0.5 ounce per square yard polypropylene fibers (1.8 denier x 1½" long) and 1.0 ounce per square yard natural rubber binder is centered within the structure by needle punching the batt uniformly through the carrier.

The fabric is needled to a density of approximately 3000 punches per square inch using conventional 36 barb needles. Surface tufts are readily visible on the needled batt and the diameters of the tufts when viewed in cross section are undesirably large for certain end uses where density uniformity is necessary.

After needling, the batt is dipped in a room temperature solution, which contains 40% by weight of 66° (96%) sulfuric acid (33° Bé.), at room temperature. The excess solution is squeezed out. The fabric is now weak because of the partial dissolving of the nylon fibers but sufficiently strong to be pulled under light tension without undue distortion because of the presence of unaffected fibers. Dwell time in the 33° acid is 4 seconds, although varying the dwell time does not appreciably affect the final properties. Upon leaving the acid, the fabric is immersed immediately in a water bath at room temperature which congeals or coagulates the partially dissolved nylon. Most of the acid is removed at the same time. The strength of the fabric increases again. Next the fabric is immersed in a 10% by weight solution of ammonium hydroxide in water for neutralization of the last traces of acid remaining. Ammonium sulfate is formed as a by-product. The fabric is next given a final wash, preferably in hot water, to remove the ammonium sulfate and excess ammonium hydroxide. The fabric is then dried. Shrinkage of about 5–10% occurs fillingwise when the fabric is dried under tensionless conditions, such as on dry cans.

At this stage, the flow and deformation properties of the nylon are dramatically altered, although its melting point is not materially affected. The nylon fibers are adhered to each other and to some of the unaffected polyester and polypropylene fibers by the process. The nylon fibers also have a swollen appearance. The fabric is now strongly and uniformly bonded, and stiffer than the original batt, but not excessively stiff.

Example II

The fabric produced in Example I is compacted to the desired gauge by hot pressing on a flat bed press. Temperature is about 250° F. and pressure required about 10 pounds per square inch. The fabric after pressing is very smooth and dense but not stiff. Surface tufts have been eliminated. Cross section tufts also are barely discernable.

Tensile properties except elongation and tear remain virtually unchanged during the bonding and subsequent densification. Elongation is reduced by 50% as is tongue tear. However, gauge, weight and stiffness are affected. Leatherlike properties are greatly accentuated as a result of the processing.

Microscopic examination shows that the nylon fibers have been deformed considerably and bond the unaffected fibers.

Example III

A batt of 60% polyester fibers (1½ denier x 1½ inches long) 40% nylon, 66 fibers (1½ denier x 1½ inches long) is needled about 4000 punches per square inch using conventional needling equipment. Total weight is about 10 ounces per square yard.

The fabric is then passed through an acid bonding-neutralization-wash line using an acid solution containing 35% of 66° (96%) sulfuric acid in water and the neutralization is effected with aqueous ammonia in the bath immediately following the acid bath.

After bonding the fabric is pressed to about 25 mils on a flat bed press at 275° F. for one minute. The resulting fabric is smooth and well bonded. Needle marks are barely discernible and the fabric is suitable as a substrate for vinyl or urethane coating to make shoe upper and similar materials.

Example IV

A carded and crosslaid web weighing 4 ounces per square yard composed of 60% polyester fibers (1½ denier x 1½ inches long) and 40% nylon 66 fibers (1½ denier x 1½ inches long) is needled into each side of a 1.0 ounce per square yard polyester scrim. The fabric is reneedled about 2500 punches per square inch using conventional needling equipment.

The fabric is next passed through the acid bonding-wash-neutralization-wash line described in Example I except that the acid tank contains 35% fluoboric acid in water, and the last rinse tank contains hot water at about 150° F.

After the pass through the acid bonding line, the fabric is hot calendered at 300° F. and adequate pressure to cause the coagulated nylon to flow and bond to adjacent polyester fibers. A smooth well bonded, strong but not excessively stiff fabric results which is suitable for vinyl coating.

Example V

A lightly bonded nonwoven fabric is made of 60% polypropylene and 40% nylon 66 fibers of 1½ denier and 1½ inch in length. The total weight is about 5 ounces per square yard, of which about 5% is cross-linked acrylic polymer binder.

The fabric is passed through the acid bonding-wash-neutralization-wash line described in Example I except that the acid bath is composed of 50% phosphoric acid and water.

The fabric then is pressed on a hot head press at 250° F., 10 p.s.i. for one minute. A smooth tough but not undesirably stiff fabric results.

Example VI

A carded and crosslaid web weighing 4 ounces per square yard composed of 60% polyester fibers (2¼ denier x 1½ inches long) and 40% polypropylene fibers (1.8 denier x 1½ inches long) is needled into each side of 1½ mil (.015") nylon film. The fabric is reneedled to a density of 3,000 punches per square inch.

The fabric is then passed through the acid bonding-wash-neutralization-wash line described in Example I with 38% aqueous sulfuric acid (specific gravity=1.28) at room temperature in the acid tank.

The fabric then is calendered at 300° F. and adequate pressure to cause the coagulated nylon to flow and further bond to adjacent unaffected fibers. A smooth, well-bonded strong but not excessively stiff fabric results, which is suitable for vinyl coating.

Example VII

A carded and crosslaid web weighing 4 ounces per square yard composed of 75% polyester fibers (3 denier x 1¼ inches long) and 25% nylon fibers (2¼ denier x 1¼ inches long) is needled into each side of nylon film (1½ mil thickness). The fabric is reneedled to a density of 3,000 punches per square inch.

The fabric is then passed through the acid bonding-wash-neutralization-wash line described in Example I

with 38% sulfuric acid (specific gravity=1.28) at room temperature in the acid tank.

After acid bonding, the fabric is calendered at 300° F. and adequate pressure to cause the coagulated nylon to flow and further bond to adjacent unaffected fibers. A smooth, well-bonded strong but not excessively stiff fabric results which is suitable for vinyl coating.

Example VIII

Three 3.5 ounces per square yard webs composed of 75% polyester fibers (3 denier x 1¼ inches long) and 25% nylon fibers (2¼ denier x 1¼ inches long) made on conventional carding and crosslaying machinery and lightly needled are needled together (combined) in one pass through a needle loom. The fabric is then reneedled to a density of 3,000 punches per square inch.

The needled fabric is passed through an acid bonding-wash-neutralization-wash line as described in Example I except with 38% aqueous sulfuric acid (specific gravity=1.28) at room temperature in the acid tank.

After acid bonding, the fabric is calendered at 300° F. and adequate pressure to cause the coagulated nylon to flow and further bond to the adjacent polyester fibers. A smooth, well-bonded strong but not excessively stiff fabric results which is suitable for vinyl coating.

I claim:

1. A process for the manufacture of a bonded nonwoven fabric comprising contacting, with an aqueous solution containing at least 25% by weight of a strong acid, a nonwoven fiber web which comprises a blend of nylon staple fibers and staple fibers of another material which is substantially unaffected by said acid contacting said web with water to dilute the acid and coagulate the nylon, thereby increasing the flowability of the nylon fibers, and compressing said web so that the nylon bonds the fibers of said other material to each other.

2. A process as set forth in claim 1 in which the nylon is selected from the group consisting of nylon 6 and nylon 66.

3. A process as set forth in claim 1 in which the other material is selected from the group consisting of polyethylene terephthalate, polyolefin, glass, cellulose, polyvinyl chloride and Saran.

4. A process as set forth in claim 1 in which the strong acid has a dissociation constant in water at 20° C. of at least 10^{-5}.

5. A process as set forth in claim 4 in which the dissociation constant in water at 20° C. is at least 10^{-4}.

6. A process as set forth in claim 4 in which the strong acid is selected from the group consisting of sulfuric acid, nitric acid, phosphoric acid, hydrochloric acid and fluoboric acid.

7. A process as set forth in claim 6 in which the strong acid is sulfuric acid and the concentration is 30 to 50% by weight.

8. A process as set forth in claim 6 in which the strong acid is formic acid and the concentration is at least 75% by weight.

9. A process as set forth in claim 6 in which the strong acid is fluoboric acid and the concentration is about 35% by weight.

10. A process as set forth in claim 6 in which the strong acid is phosphoric acid and the concentration is about 50% by weight.

11. A process as set forth in claim 6 in which the strong acid is glacial acetic acid.

12. A process as set forth in claim 1 in which the water contacted with the nonwoven web is in the form of an alkaline solution which dilutes the acid and coagulates the nylon and also neutralizes the acid.

13. A process as set forth in claim 1 including the further step of treating the water-washed web with alkali to neutralize residual acid.

14. A process as set forth in claim 13 in which the alkali treatment is carried out by contacting the fabric with an aqueous solution of a water soluble alkali.

15. A process as set forth in claim 13 including the step of contacting the web with water after neutralization to remove residual alkali and salts.

16. A process as set forth in claim 15 in which the water wash after neutralization is carried out with hot water.

17. A process as set forth in claim 16 in which the temperature of the hot water is at least about 150° F.

18. A process as set forth in claim 1 in which the nonwoven fiber web is needle punched prior to contact with said aqueous solution, the needle punching creating surface irregularities which are removed in the acid treatment.

19. A process as set forth in claim 18 in which said needle punching is 1000 to 20,000 punches per square inch.

20. A process as set forth in claim 1 in which the pressure is 10 to 1000 p.s.i.

21. A process as set forth in claim 1 in which pressure is applied by calendering.

22. A process as set forth in claim 1 in which the nonwoven fiber web is a laminate of at least one batting layer and a sheet-like carrier layer.

23. A process as set forth in claim 22 in which the carrier layer is a scrim.

24. A process as set forth in claim 22 in which the carrier layer is a plastic film.

25. A process as set forth in claim 24 in which the plastic film is nylon which also is treated with said strong acid.

26. A process as set forth in claim 1 in which said strong acid is at room temperature when contacting said web.

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