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BULKED NONWOVENS

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No Drawing. Continuation-in-part of application Ser. No. 558,177, Mar. 15, 1966, which is a division of application Ser. No. 266,123, Feb. 20, 1963, which in turn is a division of application Ser. No. 778,248, Dec. 4, 1958, now Patent No. 3,100,328, dated Aug. 13, 1963. This application Oct. 10, 1969, Ser. No. 870,385

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4 Claims

ABSTRACT OF THE DISCLOSURE

A process which comprises extruding a solution of a lower alkanolic acid ester of cellulose to form filaments, moving the filaments about while in a mutually adhesive condition to cause them to become randomly directed and bonded to one another at spaced points, collecting them in a form of a bonded non-woven web and contacting the non-woven web with steam to thereby improve the physical properties of the web, i.e., covering power, resilience, insulation, strength, density and hand.

This application is a continuation-in-part of copending application Ser. No. 558,177, filed Mar. 15, 1966 now abandoned, which is a division of application Ser. No. 266,123, filed Feb. 20, 1963 now abandoned, which in turn is a division of application Ser. No. 778,248, filed Dec. 4, 1958, now U.S. Pat. 3,100,328 issued Aug. 13, 1963.

The present invention relates to novel nonwoven articles characterized by high bulk and a soft hand.

It is an object of the invention to provide nonwoven filamentary materials of increased covering power, resilience, insulation and strength as well as of softer hand.

Other objects and advantages of the invention will become apparent from the following detailed description and claims.

In accordance with one aspect of the present invention, a nonwoven article comprising organic acid ester of cellulose filaments bonded to one another at spaced locations is subjected to steaming whereby the physical properties of the article are changed, viz. the covering power is increased along with the resilience, insulation and strength while the density is decreased and the hand is improved.

The steaming is advantageously carried out at a temperature ranging from about 95 to 180° C. and preferably 110 to 125° C. The pressure is generally superatmospheric but atmospheric or even reduced pressure may prevail.

The duration of the steam treatment will depend upon the temperature and upon the thickness and construction of the article being treated. Generally it will be at least about 1 minute to produce a substantial improvement and it may be as long as 10 minutes or more. At the preferred temperatures the duration of steaming is preferably about 1 to 5 minutes.

The nonwoven article may comprise a web, fleece or sheet material composed of staple length fibers either randomly disposed or oriented to a greater or lesser degree as by carding, the fibers being bonded to one another at spaced points.

In accordance with another aspect of the invention, the nonwoven article comprises a web, fleece or sheet material composed of substantially randomly directed substantially

continuous filaments bonded to one another at spaced points of contact. Advantageously such webs may be formed as described in detail in application Ser. No. 744,844 filed June 26, 1958, now U.S. Pat. 3,148,101 issued July 16, 1964.

Briefly, filament-forming material in liquid phase is extruded through a plurality of orifices to form continuous filaments which may be agitated, such as by blasting with air, while still mutually adhesive, to cause them to swirl about and coalesce randomly. The filaments are continuously drawn away from the extrusion location in the form of a nonwoven web or fleece. As the web dries, the filaments become bonded to one another. The web so produced can be directly steamed or it may be subjected to intermediate treatments such as hot calendaring to increase the number of points of fusion and the density. Various adsorbents, pigments, etc. can be incorporated in the nonwoven either by being added to the dope which is being spun or by being deposited on the web as formed.

The denier of the individual filaments of the nonwoven may vary within wide limits, e.g., from less than 1 up to 20 or more, although preferably it ranges from about 2 to 16. The weight per square yard of the nonwoven can also vary widely, depending upon its thickness, density, etc.

The filamentary material may comprise an organic acid ester of cellulose such as cellulose acetate, cellulose propionate, cellulose butyrate, cellulose acetate propionate, cellulose acetate butyrate, or the like. The esters may be triesters, i.e. esters containing fewer than about 0.29 free hydroxyl groups per anhydroglucose unit of the cellulose molecule, or they may be conventional secondary or ripened esters containing about 0.6 free hydroxyl groups per anhydroglucose unit. The nonwoven articles may comprise mixtures of these filamentary materials with each other or with other filamentary materials either natural or synthetic, e.g., cotton, wool, silk, rayon, nylon, polyethylene terephthalate, acrylics, polyolefins, polymers of halo-olefins such as vinyl chloride or vinylidene chloride, etc.

In accordance with another aspect of the invention, the non-woven article may comprise a mixture of continuous filaments of a cellulose triester and of a secondary cellulose ester, e.g., cellulose triacetate and conventional cellulose acetate. This can be formed by simultaneously extruding a solution of cellulose triacetate in methylene chloride through one set of orifices and extruding a solution of conventional cellulose acetate through a second set of orifices. The filaments formed by such extrusions are positioned near each other and a blast of air causes them all to swirl and entangle with one another, becoming fused at spaced points as the web dries. Steaming produces exceptionally high bulk because of the effect on the filaments individually as well as because of the differences in the thermal characteristics of the different types of filaments.

While not wishing to be bound thereby, the change in physical properties upon steaming is believed due to the following effects: Upon drying of freshly formed cellulose ester filaments, especially of substantially continuous filament nonwovens wherein the filaments are fused at spaced points of contact, the filaments undergo compression or other stresses between fusion or weld points. During subsequent steaming the stresses are released and the filaments become distorted into sinusoidal, helical or other three-dimensional crimp-like configurations between the welds. In addition, the filaments are somewhat softened and make additional bonds with adjacent filaments as the expansion creates new points of contact. The movement of the filaments increases the interlocking of filaments so that the final structure is stronger, in addition to being

less dense as a result of the three-dimensional bulking. At the same time there is an improvement in the hand of the nonwoven, i.e., it becomes softer.

In the event that the filamentary material of the nonwoven is initially more or less oriented and the nonwoven accordingly much stronger in one direction than another, the steaming decreases the orientation and reduces the differential strength.

In spite of their increased strength and abrasion resistance, the products may be completely free of extraneous binders and/or plasticizers.

The steaming treatment can be effected with the nonwoven starting material in sheet form either flat or wound in a roll loosely about a shaft. Alternatively the nonwoven may be in a form approximating that required for an end use, e.g., it may be wound about a perforated cylindrical core in a form suitable for use as a cylindrical oil filter cartridge. The non-woven may be incorporated as an interlining or filling material between layers of fabric or the like and the composite article may be subjected to steaming. In general, the product will be useful wherever nonwovens have heretofore found application.

A first solution of filament-forming material, e.g., conventional cellulose acetate in acetone, is extruded as a plurality of filaments through a spinnerette; a second solution of filament-forming material, e.g., cellulose triacetate in methylene chloride, is extruded through a spinnerette. Blasts of air are directed at the two sets of filaments through nozzles, causing the filaments to swirl about and to contact one another while still wet with solvent and in mutually adhesive condition. As the filaments dry they fuse or form welds at their contact points and deposit on a screen as a randomly directed fleece which leaves the cabinet through an opening defined by a pair of rolls, which prevent excess leakage of solvent vapors from the cabinet. The fleece is taken up loosely on a roll simultaneously with a separating web such as paper unrolled from a supply package. When the roll reaches a predetermined size the fleece and web supplying the roll are cut, the roll is removed and a new roll is started.

The roll of predetermined size is placed in an enclosure and steam is admitted. After a predetermined time the line is closed to terminate steaming and relatively cool air is forced in to purge the steam and to cool the roll. The roll is then removed and can be used in conventional manner, stripping the paper separator as the roll is unwound.

A nonwoven sheet material composed of substantially continuous filaments of relatively high denier is very flat and has a high gloss and stiff hand, the filaments having a plastic rather than a textile appearance. After steaming, the sheet is about twice as thick, the luster is reduced considerably and, while still somewhat stiff, the feel is similar to that of a starched natural fiber web rather than a plastic. In addition, the individual filaments are characterized by numerous crimps extending in three dimensions which increase the covering power of the article.

With initially more dense nonwovens the same differences will result, but the individual filaments are not as readily identifiable, except on closer observation.

The following example is given to illustrate the invention further:

EXAMPLE

A heated dope of cellulose acetate in acetone is extruded through a spinnerette provided with 60 circular orifices each 126 microns in diameter. The linear speed of extrusion through the orifices is 3750 meters per minute, and the speed of screen 12 is 75 meters per minute. The denier of the filaments of the nonwoven ranges from about

2 to 7 and its weight is 2 ounces per square yard. After autoclaving for 8 minutes with steam at 121° C. and 15 p.s.i.g., the nonwoven shrinks in width from an initial value of 4.5 inches down to 4.3 inches. The sheet weighs about 2.1 ounces per square yard and its thickness has increased from about 0.02 to 0.06 inch.

It is to be understood that the foregoing detailed description is given merely by way of illustration and that many variations may be made herein without departing from the spirit of our invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. The process which comprises extruding a solution of a lower alkanolic acid ester of cellulose to form continuous filaments, moving said continuous filaments about while in mutually adhesive condition to cause them to become randomly directed and to bond to one another at spaced points as the filaments dry and collecting them in the form of a dry, bonded nonwoven web, and contacting said bonded nonwoven web with steam at a temperature of from about 95 to 180° C.

2. The process which comprises extruding a solution of a lower alkanolic acid ester of cellulose through a plurality of orifices to form substantially parallel continuous filaments, agitating said filaments while in mutually adhesive condition whereby they become randomly directed and bonded to one another at spaced points as the filaments dry, collecting said filaments in the form of a dry, bonded nonwoven web in which the filaments are substantially continuous, and contacting said bonded nonwoven web with steam at a temperature ranging from about 95 to 180° C.

3. The process which comprises extruding a solution of cellulose acetate in a volatile solvent into an evaporative atmosphere through a plurality of orifices to form substantially parallel continuous filaments, agitating said filaments with air while in mutually adhesive condition to cause them to swirl about and entangle, whereby they become randomly directed and bonded to one another at spaced points as the filaments dry, collecting said filaments in the form of a dry, bonded nonwoven web in which the filaments are substantially continuous, and contacting said bonded nonwoven web with steam at a temperature ranging from about 95 to 180° C. for at least about 1 minute.

4. The process which comprises extruding through one set of orifices a solution of secondary cellulose acetate to form substantially parallel continuous filaments, extruding through another set of orifices a solution of cellulose triacetate to form substantially parallel continuous filaments, agitating said filaments while in mutually adhesive condition to cause them to swirl about and entangle, whereby they become randomly directed and bonded to one another at spaced points as the filaments dry, collecting said filaments in the form of a dry, bonded nonwoven web in which the filaments are substantially continuous and contacting said bonded nonwoven web with steam at a temperature ranging from about 95 to 180° C.

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