NON-WOVEN FABRICS AND METHOD FOR PRODUCING THEM

Inventors: Robert Groten, Sundhofen (FR); Christoph Josefiak, Rimbach (DE); Georges Riboulet, Colmar (DE); Peter Dengel, Kaiserslautern (DE)

Assignee: CARL FREUDENBERG KG, Weinheim (DE)

Correspondence Address:
GROSSMAN, TUCKER, PERREaulT & PFLeger, PLLC
55 SOUTH COMMERCIAL STREET
MANCHESTER, NH 03101 (US)

Abstract
The invention relates to non-woven fabrics comprising threads not produced with the spun-bonding method, for example made of non-melt spinable thread-forming materials. The use of these fibers, optionally in combination with filaments produced using the spun-bonding method, allows the production of novel non-woven fabrics with novel property combinations. The production can be carried on conventional spun-bonding equipment, wherein part of the extruding devices are used as conveyors for the threads not produced with the spun-bonding method.
NON-WOVEN FABRICS AND METHOD FOR PRODUCING THEM


[0002] Textile surface structures have been known for quite some time. The techniques for producing these surface structures are subject to continuous improvements.

[0003] For example, the loom is one of the oldest machines worldwide, yet to this day it is constantly being improved. While weaving speeds have been increased, among other things due to higher weft speeds, the process still means that the weft thread has to be lowered to a speed of zero on both sides of the textile fabric before it can resume its path in the opposite direction.

[0004] Knitting is also a very old structure-forming technique, which can be carried out automatically. Knitting is a process of arranging each individual thread while being guided, or in the case of modern circular knitting machines also in a warp.

[0005] Both methods described above share the fact that they use continuous threads as a semi-finished product.

[0006] Further textile surface structures include felt and loden. Felt is obtained by fulling or needling several superimposed layers, particularly wool threads. A felt can also be considered as a fibrous web made of wool. Loden is initially woven from wool yarns, and the resultant wool fabric is then felted by means of fulling into the so-called loden material. Frequently, this involves the (often unintentional) tangling of the wool fibers due to straightening up scales.

[0007] A further group of textile surface structures includes the non-wovens. These can be produced by wet or dry methods.

[0008] During the production of wet non-wovens, short fibers are stirred in water that is heavily diluted and are separated from the water by a screen, whereupon they are mutually bonded chemically or thermally to form a non-woven fabric. A high dilution level in the water and a short fiber length ensure that the fibers of various origins neither become entangled nor can agglomerate with each other. This way, a very uniform distribution of the fibers across the surface can be achieved. The resultant surface structures, however, cannot withstand high mechanical loads.

[0009] During the production of dry non-wovens, fibers with finite lengths are opened from the fiber bale that was prepared in a prior manufacturing stage, are likewise mixed with other types of fibers and are “combed” in a carding device in a preferred orientation, thus creating a card web. Several layers of this card web are placed on top of each other (stacked), wherein as a result of the depositing movements limited preferred orientations of the fibers are created and these layers are then converted into a non-woven vertically to the web plane by arbitrary bonding. This technique guarantees a high productivity as well as a high level of uniformity of the fiber deposition. By mixing the fibers, they can be adapted to desired surface structure properties within a broad range. In order to increase the mechanical stability, such as pilling or washing resistance, a high percentage of the intersecting points that are in contact with each other have to be chemically or thermally bonded into bonding sites. This increases the bending tensile strength, and the surface structure loses its draping ability.

[0010] For the production of spunbond non-wovens, granules of one or more melt-spinnable polymers are melted in an extruder, pressed through a spinneret, mechanically or pneumatically extruded and placed on a belt. The non-bonded non-woven fabric is then mechanically stabilized analog to the aforementioned non-woven production methods.

[0011] Until a few years ago, this method was used to produce surface structures, which were intended, for example, for applications as supports for sheet roofing or as supports for carpet fibers, and which were typically not subject to any demands in terms of textile drapability. Unlike other non-wovens, spunbond non-wovens are characterized by a comparatively poor uniformity and the comparatively high mechanical loads they can be subjected to.

[0012] Spun-bond equipment is characterized by a high productivity compared to other surface structure forming machines. This productivity, however, requires high investment costs and very high changeover times and cost when switching the polymers used. As a result of these factors, equipment of this type has to be operated with a certain lack of flexibility and has to be operated continuously.

[0013] All non-woven fabrics share the common fact that the fibers forming their structure are stacked in several layers (placed in the x-y plane) and that the resulting mechanically unstable non-woven fabric then has to be consolidated in the z-direction. The chemical or thermal bonding method results in decreased drapability.

[0014] Compared to other textile surface structures, non-woven fabrics offer the advantage that the polymer granules or the fibers can be converted directly into the finished surface structure. When weaving or knitting, on the other hand, the yarns first have to be converted in the textile structure by a complex surface forming process.

[0015] According to the related art, it has already been proposed to wind filaments after the production thereof and then introduce these products in a surface forming process.

[0016] U.S. Pat. No. 3,921,265 and U.S. Pat. No. 3,885,279, for example describe a method for producing a non-woven fabric and a suitable device, wherein threads are deposited by several guide arms. They describe the directed depositing of the threads and not a non-woven forming process, which, as is known, is characterized by random deposition. In addition, they include no information as to the nature of the guided threads.

[0017] DE patent 816 215 describes a device for producing fibrous mats or webs made of glass fibers or similar fibers. Several fibers are combined in a mechanical feeding means and placed on a surface in the form of coiled strands to form a web. The strands are fed by being transported by means of a blower. Depending on the adjustment of the blower, the feeding can be varied. Further details, particularly a random feeding of the strands, are not disclosed in this publication. The strands are maintained in the non-woven web.

[0018] DE-A 30 12 806 describes a tufted carpet comprising a second backing made of continuous filament non-woven with a plurality of layers of randomly laid threads
made of polyester, which are disposed in a cross-over parallel texture. The nonwovens can also be produced in groups or by unwinding or removing polyester filaments and placing them jointly into a non-woven with a cross-over parallel texture. The use of non-melt spinnable fibers is not included in this document.

DE-A 36 30 392 describes a method for producing consolidated nonwoven fabrics to absorb water and/or substances with oleophilic and/or lipophilic properties. The nonwoven is produced by direct blow-spinning on a device.

EP-A 281,865 describes bound sheet-like structures made from organic fibers, such as water glass fibers or silicic acid fibers. The structure is obtained by directly processing the spun fibers by dry or wet techniques. The fibers are bonded by a heat treatment at temperatures above 50°C. Due to the comparatively low bonding temperatures, the resultant fibers have to be processed promptly.

From U.S. Pat. No. 5,660,910 nonwoven fabrics with improved tear resistance are known. Apart from the matrix filaments, the nonwoven fabrics include reinforcement filaments with high titers. In addition to the production of spun-bond non-wovens, the patent also discloses the processing of previously spun and stored filaments into non-wovens. They are placed directly on a conveyor belt by means of a suction device. A random feeding of the stored filaments is not disclosed. The uniformity of the resultant non-woven fabrics is also limited due to the use of coarse filaments.

DE-A 41 15 190 discloses nonwovens from filaments, which have a very uniform mass distribution, while at the same time achieving a high basis weight of more than 250 g/m². For the production of these nonwovens, filaments (filament bundles) made of various materials are opened by air jets into single filaments, deposited very uniformly on to a moving surface and then bonded in the familiar fashion. Nonwovens with a low basis weight and uniform mass distribution are not disclosed there. Particularly these nonwoven fabrics are difficult to produce since in the case of non-woven fabrics with high basis weights and a correspondingly high number of fibers per unit of volume, the developing irregularities are averaged out. Finally, exclusively thermoplastic spinnable materials are disclosed as fiber materials.

Proceeding from the related art, it is the object of the present invention to provide non-woven fabrics with a very high level of uniformity.

A subgroup of the novel non-woven fabrics relates to products, which comprises continuous threads that have not been able to be processed into non-woven fabrics so far. This way, the range of possible non-woven fabrics as well as the property profiles thereof and applications can be expanded.

The present invention relates to non-woven fabrics with a basis weight of up to 250 g/m² and a high level of uniformity, expressed by a mass coefficient of variance of the basis weight distribution CV of less than 10%, which fabrics comprise randomly deposited threads not produced with the spun-bonding method.

In a further embodiment, the invention relates to non-woven fabrics comprising randomly deposited threads made of non-melt spinnable materials.

Within the framework of this description, the term “thread” or “threads” shall mean a structure made of fibers or filaments, wherein a dimension referred to as “length” exceeds the two remaining dimensions relating to the cross-section of the thread by several orders of magnitude and the titer of which ranges between 0.1 dtex and 100 tex. Typical thread lengths range from several meters to several thousand kilometers.

Within the framework of this description, the term “fiber” or “fibers” shall mean a structure with finite length, wherein a dimension referred to as “length” exceeds the two remaining dimensions relating to the cross-section of the thread by several orders of magnitude and the titer of which ranges between 0.1 dtex and 100 tex. Typical fiber lengths range from one millimeter to several centimeters.

Threads as defined by this description can be filament yarns, fiber yarns, monofilaments (wires) as well as double twists.

Thread-forming materials, which create the threads used according to the invention, are not subject to any limitations. A great variety of materials or material mixtures can be used. Examples include threads made of synthetic and/or natural thread-forming materials, such as thermoplastic polymers, natural materials such as cellulose, modified cellulose or proteins, or inorganic materials such as carbon, metals or glass, or fibers that may be obtained by peeling processes, such as polytetrafluoroethylene threads. In addition to homofilaments or homofibers, also multi-component filaments or fibers may be used.

Within the framework of the invention, “non-woven fabric from randomly deposited fibers” shall mean a non-woven fabric, which is produced by depositing fibers on a moving transport device, wherein the fibers are deposited on the transport device in several steps, and the threads are not deposited towards a previously defined location and therefore extend independently from each other in the individual layers. The fibers can be deposited in a defined location with or without orientation, wherein the exact location is not precisely defined due to the deposition process.

The non-woven fabric according to the invention may comprise a plurality of different materials and material combinations.

One characteristics of the non-woven fabric according to the invention is that at least a portion of the threads has not been produced using the spun-bonding process. Unlike conventional spun-bonding methods, in which the production of filaments is directly coupled to the formation of the textile surface structure, here at least a portion of the threads is produced in one or several prior steps, is placed in intermediate storage or not produced in the spun-bonding equipment, but in a different spinning equipment disposed upstream and is then used for the production of the non-woven fabric. This means that threads are used, which
were not produced on a non-woven production equipment. A group of these threads may comprise fibers or filaments made of materials that cannot be produced in the conventional spun-bonding process. This procedure allows the production of non-woven fabrics from novel materials (material combinations). A second group of these threads may comprise fibers or filaments made of melt-spinable materials, which cannot be produced with the spun-bonding method or only at great cost and which therefore suitably have been produced in a system disposed upstream of the non-woven production system.

[0035] One example for the first group of materials are threads made of non-melt spinnable materials, such as cellulose fibers.

[0036] Examples for the second group are threads comprising fibers or filaments of the POY ("partially-oriented yarn") type, or threads comprising fibers or filaments of the FOY ("fully-oriented yarn") type, or threads comprising fibers or filaments with an additive, which cannot be spun using the spun-bonding process or only with great difficulty, or threads comprising high-strength fibers or filaments, which were produced by extrusion after spinning.

[0037] The threads used according to the invention and not produced with the spun-bonding method may be completely made of non-melt spinnable materials; it is also conceivable, however, that they are made of combinations of these fibers or filaments with other fibers or filaments made of thermoplastic spinnable materials; and/or they may be made of thermoplastic spinnable materials containing additives; and/or they may be made of thermoplastic spinnable materials that have been treated subsequent to spinning in a manner that is typically not possible on spun-bonding systems, such as multiple extrusion with very high draw ratios, optionally followed by a relaxation step.

[0038] The type of thread-forming technique is not important for the production of threads made of non-thermoplastic spinnable materials or thermoplastic spinnable materials. It is possible to use continuous filaments obtained with the wet spinning method, the dry spinning method, the wet-dry spinning method, the gel spinning method, the peeling method or the matrix spinning method, which filaments cannot be produced with the spun-bonding method or only with difficulty, or staple yarns may be used, which were produced with a secondary spinning method.

[0039] The non-woven fabrics according to the invention are characterized by a very high level of uniformity. This becomes evident from a mass coefficient of variation of the basis weight distribution CV of less than 10%, preferably less than 7%.

[0040] The mass coefficient of variation of the basis weight distribution is determined with the following method:

[0041] Across the width of the surface structure panel, 2 rows with 19 samples measuring 5x5 cm² are stamped out per each meter of length, the second row being offset from the first by half a sample.

[0042] Across the length of the surface structure panel, 60 samples measuring 5x5 cm² are stamped in one row successively in the machine direction.

[0043] The basis weight \( x_i \) of each sample \( i \) is converted into g/m². Since every sample has a surface of 0.0025 m², the basis weight has to be multiplied by 400 to arrive at a basis weight of g/m² in relation to 1 m².

[0044] The coefficient of variation is determined as follows:

\[
CV = \frac{S_{X_{i}}}{X_{i}^{100}}\times(\%
\]

wherein

\[
S_{X_{i}} = \left(\sum_{i=1}^{n} (x_i - \mu)^2 / n\right)^{1/2}, \quad X_{i} = \left(\sum_{i=1}^{n} x_i^2 / n\right)
\]

and

\[
\mu = \text{mean basis weight of the non-woven fabric in g/m²}
\]

[0045] \( \mu \) = weight of the sample \( i \) in g/0.0025 m²

[0046] \( n \) = number of samples

[0047] The shape of the threads used for producing the non-woven fabric according to the invention can be selected arbitrarily. In addition to mono- and multifilaments, it is also possible to use staple fiber yarns or double twists.

[0049] Preferred are non-woven fabrics made completely of threads comprising fibers or filaments of non-thermoplastic spinnable thread-forming materials.

[0050] Further preferred non-woven fabrics are made of or comprise threads made of fibers or filaments from melt-spinable thread-forming materials, in addition to fibers or filaments made of non-thermoplastic spinnable thread-forming materials.

[0051] Further preferred non-woven fabrics comprise threads of POY fibers or POY filaments and/or FOY fibers or FOY filaments. These POY fibers or POY filaments and/or FOY fibers or FOY filaments are produced on spinning devices with very high pull-off speeds and are subsequently likewise extruded. As a result, fibers or filaments with very high strength are obtained, which are difficult to produce on the present spun-bonding equipment.

[0052] Further preferred non-woven fabrics comprise threads made of high-strength polymer fibers or high-strength polymer filaments, particularly polyester. These fibers or filaments are produced by means of melt or solvent spinning and are subsequently extruded to a high degree. As a result, fibers or filaments with very high strength are obtained, which are likewise difficult to produce on the present spun-bonding equipment.

[0053] Further preferred non-woven fabrics comprise threads made of metal or metal alloys.

[0054] Further preferred non-woven fabrics comprise threads made of polymers with additives, particularly preferred of spin-dyed and/or flame-protected polymers.

[0055] These fibers or filaments are produced by means of solvent or melt spinning masses with additives and are subsequently extruded. This way, fibers or filaments with additives are created, which cannot be produced on conventional spun-bonding equipment.

[0056] Preferred examples for non-melt spinnable thread-forming materials are cotton, wool, cellulose and cellulose derivatives (such as rayon, modal, copper rayon, cellulose acetate, semi-acetate or triacetate), polyacryl nitrile, aromatic polyamides (aramides), non-thermoplastic polyure-
thane, non-melt spinnable halogenated polyolefins, such as polytetrafluoroethylene, polyvinylchloride or polyvinylidene chloride, as well as rubbers, polyvinyl alcohol or carbon.

[0057] Cellulose fibers or filaments are preferably the rayon fibers or filaments obtained with the rayon method. Furthermore, it can be fibers or filaments obtained with the solvent spinning method, such as \( \text{\textregistered} \) Lyocell fibers or \( \text{\textregistered} \) Lycell filaments.

[0058] Cellulose derivative fibers or filaments shall be understood as fibers or filaments derived from chemically modified cellulose, for example from cellulose acetate or cellulose semi-acetate.

[0059] Preferred examples of melt-spinnable thread-forming materials are melt-spinnable thermoplastic polycondensates, for example polyester, such as polyethylene terephthalate, polybutylene terephthalate or polylactic acid, or aliphatic or aliphatic-aromatic polyamides, such as polyamide 6, polyamide 6,6, or polyether ketones, polyarylene sulfides, polyarylene ethersulfones, polycarbonate, or proteins and protein derivatives, such as gelatins, chitin or alginates, as well as melt-spinnable thermoplastic polyesters, such as polyolefins, particularly polypropylene, polyethylene or the copolymers thereof, or the thermoplastic polyurethanes, including the thermoplastic polyurethane elastomers, as well as other melt-spinnable materials such as glass or metals, including metal alloys.

[0060] Particularly preferred, melt-spinnable thermoplastic polycondensates or melt-spinnable thermoplastic polyesters are used as the melt-spinnable thread-forming materials.

[0061] In another preferred embodiment of the invention, the non-woven fabrics additionally comprise randomly deposited filaments produced with the spun-bonding method, particularly multi-component filaments in the form of separable filaments comprising at least two clavable, melt-spinnable and thread-forming polymers that are not mutually compatible, preferably separably filaments from the combinations polyester/polyamide, polyester/polyolefin, polyamide/polyolefin, polyolefin/polyolefin, polyester/polyurethane, polyamide/polyurethane, polyolefin/polyurethane.

[0062] Separable filaments of this type and non-woven fabrics produced thereof are known, for example from U.S. Pat. No. 5,970,583.

[0063] Particularly preferred are non-woven fabrics, the threads of which are made exclusively of filaments and/or staple yarns from non-melt spinnable thread-forming materials.

[0064] One embodiment of the non-woven fabrics according to the invention may have arbitrary basis weights that are adapted to the respective application.

[0065] Examples of the basis weights are 15 to 1000 g/m\(^2\), preferably 50 to 600 g/m\(^2\), particularly 50 to 250 g/m\(^2\).

[0066] Another embodiment of the non-woven fabrics according to the invention has basis weights up to 250 g/m\(^2\), preferably 15 to 250 g/m\(^2\), particularly 20 to 150 g/m\(^2\).

[0067] The filaments and/or staple yarns used in the non-woven fabrics according to the invention can have arbitrary titers that are adapted to the respective application. Examples for these filament numbers are 0.05 to 200 dtex, preferably 0.15 to 150 dtex.

[0068] In addition to filaments and/or staple yarns made of homofoil fibers, it is also possible to use those of heterofil fibers, for example made of bicomponent fibers, in curled or uncurred shape, or of mixtures of a plurality of fiber types.

[0069] In the non-woven fabric according to the invention, the threads are typically not deposited in any preferred orientation, meaning isotropically. The non-woven fabric may be made of identical or different filament numbers of the same threads. The threads in the non-woven fabric may comprise a variety of filaments and/or fibers, for example homofoil fibers or filaments, but also 100% bicomponent fibers or filaments, or a blend of bicomponent fibers or filaments and homofoil fibers or filaments. It is also possible to use mixtures of threads made of synthetic fibers or filaments with natural fibers.

[0070] By including thread materials that have not been used in spun-bond non-wovens in the past, optionally combined with thread materials used in conventional spun-bond non-wovens, novel non-woven fabrics with novel property combinations can be produced. For example, by depositing metal threads, non-woven fabrics with electrical and thermal conductivity may be produced, or by depositing threads to which appropriate additives were admixed to the spinning mass, spin-dyed or flame-resistant non-woven fabrics can be produced, or by depositing high-strength threads, non-woven fabrics with particularly high strength properties can be produced.

[0071] The method described above can be used to manufacture textile surface structures, which correspond to fabrics in terms of the variety of their properties, however which contrary to them comprise randomly deposited threads. Furthermore, textile surface structures can be produced, wherein fiber mixtures such as in staple fiber fabrics are possible, yet with significantly higher and more durable resistance properties since in the non-woven fabrics according to the invention—similar to the fabrics—the threads are incorporated in the structure. For a number of properties, such as the maximum tensile load, washability, resistance to tear propagation and pilling behavior (abrasion), this results in significantly better values.

[0072] After being deposited on the transport device, the non-woven fabrics according to the invention can be mechanically stabilized in the conventional manner and be processed further.

[0073] Directly after they are deposited in several layers, a mechanical, unstable and non-bonded non-woven is created, which cannot be handled and has to be stabilized by interlacing the individual layers. This is achieved by using mechanical, hydromechanical, pneumatic and/or thermal methods and/or by using chemical binding agents.

[0074] It is particularly preferred if the non-woven fabric is bonded by using mechanical, hydromechanical and/or thermal method, particularly by using embroidering looms or water jets.

[0075] The non-woven fabrics according to the invention may comprise further additives, which are typically used in non-woven fabrics. Examples of such additives are glazes,
brighteners, antistatic agents, biocides, antioxidants, additives conveying electrical conductivity, adsorption agents or fillers.

[0076] The present invention provides a novel and simple method for producing non-woven fabrics, which is characterized by high productivity and flexibility. Furthermore, the method allows the production of non-woven fabrics from materials, which so far were difficult to process into continuous threads comprising non-woven fabrics, or could not be processed at all.

[0077] The invention also relates to a method for producing non-woven fabrics that includes the following measures:

[0078] i) feeding threads to several supply devices A, particularly threads comprising fibers or filaments made of non-melt spinnable materials,

[0079] ii) optionally feeding threads to further supply devices B, which threads differ from the threads located in the supply devices A,

[0080] iii) pulling the threads off the supply devices A by means of at least one conveying device, preferably several conveying devices,

[0081] iv) random depositing of the threads pulled off in step iii) in the form of a non-bonded non-woven onto a transport device in multiple layers,

[0082] v) optionally pulling the threads off the supply devices B by means of at least one conveying device, preferably several conveying devices,

[0083] vi) optionally random depositing of the threads pulled off in step v) in the form of a non-bonded non-woven onto a transport device in multiple layers,

[0084] vii) bonding the obtained non-bonded non-woven by using familiar mechanical, hydromechanical, pneumatic and/or thermal methods and/or by using chemical binding agents.

[0085] In another embodiment, the invention relates to a method for producing non-woven fabrics, in which method at least a portion of the threads is fed directly to the non-woven production equipment from another production system. This method comprises the following method:

[0086] viii) feeding threads comprising fibers or filaments made of non-melt spinnable materials originating from a production system A' used for these threads and pulling these threads off with at least one conveying device,

[0087] i) optionally feeding threads to several supply devices A, particularly threads comprising fibers or filaments made of non-melt spinnable materials,

[0088] ii) optionally feeding threads to further supply devices B, which threads differ from the threads located in the supply devices A,

[0089] iii) optionally pulling the threads off the supply devices A by means of at least one conveying device,

[0090] ix) random depositing of the threads pulled off in step i) in the form of a non-bonded non-woven onto a transport device in multiple layers,

[0091] iv) random depositing of the threads pulled off in step iii) in the form of a non-bonded non-woven onto a transport device in multiple layers,

[0092] v) optionally pulling the threads off the supply devices B by means of at least one conveying device,

[0093] vi) optionally random depositing of the threads pulled off in step v) in the form of a non-bonded non-woven onto a transport device in multiple layers, and

[0094] vii) bonding the obtained non-bonded non-woven by using familiar mechanical, hydromechanical, pneumatic and/or thermal methods and/or by using chemical binding agents.

[0095] The method can be carried out on a conventional spin-bonding equipment. The available extruding devices are used at least in part as conveying devices or as devices for pulling the threads off the supply devices.

[0096] These threads are produced in one or more prior steps and are added to the supply devices or feed into the non-woven forming device directly from a manufacturing equipment. These threads are used for further processing in the spin-bonding equipment.

[0097] In addition to the non-woven fabrics according to the invention described above, the method according to the invention may also be used to produce conventional spun-bond non-wovens. In the latter embodiment of the method, threads are fed to the supply devices, which threads are made of fibers or filaments that can be produced with the spin-bonding method. The non-woven forming process is carried out such that non-woven fabrics are obtained that have the desired mass coefficient of variation of the basis weight distribution CV. In principle, it is desirable to feed the maximum number of layers with the lowest possible basis weight. It is preferred, if the non-woven fabrics according to the invention are produced with the method according to the invention.

[0098] Familiar devices, such as reels or cans, can be used as the supply devices. The individual supply devices A and B may contain identical or also different threads.

[0099] Wet or dry spinning systems may be used as different production systems A', as can be secondary spinning systems.

[0100] Familiar devices may be used as the conveying devices, particularly aerodynamically operating devices, such as pneumatic conveying devices.

[0101] It is preferred if the threads from the supply devices A and/or B or from the different production system are guided by thread guides prior to entering the conveying devices, which guides are disposed at the inlet openings of the conveying device. This embodiment of the method allows the production of non-woven fabrics with a particularly low mass coefficient of variation of the basis weight distribution CV.

[0102] The threads A, A' and B originating from the supply devices A and optionally B or from the different production system as well as the further filaments C are optionally in the spin-bonding equipment are deposited randomly in the conventional manner, not towards a previously defined location and are distributed in several layers on top of each other on a moving transport device, preferably a belt, which may optionally comprise openings.

[0103] For the random deposition, the familiar depositing devices may be used. Examples include deflecting devices,
which deflect the bundle of threads after leaving the mechanical conveyor and randomly change the course of the individual threads. Examples of deflecting devices include baffles or other mechanically operating deflectors, aerodynamically operating devices or tubular collectors, which move back and forth longitudinally and/or transversely to the movement of the transport device. The objective of these devices is to ensure that the threads are not placed uniformly on the transport device.

[0104] So as to achieve the high level of uniformity, the threads are deposited on the transport device in several layers. The number of layers is adjusted as a function of the desired productivity (= speed of the transport device) such that the desired uniformity is maintained.

[0105] In the event that the individual layers are deposited by means of deflecting devices, typically at least ten, preferably at least twelve of these are used, in order to achieve the required number of individual layers.

[0106] In the event of panel spinning systems, it is best to use two, preferably four systems arranged in series, in order to achieve the required number of individual layers.

[0107] The invention therefore relates to a continuous manufacturing process for textile surface structure (also referred to as non-woven fabric) such that means of mechanical, hydromechanical or pneumatic equipment continuous, thread-like solid bodies of various origin, such as metallic, mineral, natural or synthetic, which cannot be processed by melt-spinning, are randomly, meaning not directed towards a previously defined location, distributed in several layers on top of each other on a transport device, for example an advancing belt, and subsequently the thread-like solid bodies are bonded mechanically, hydromechanically, pneumatically, thermally or chemically with each other across these layers, as are the thread-like solid bodies inside each layer.

[0108] During the production of the non-woven fabrics according to the invention, the equipment technology of a spun-bonding equipment may be utilized.

[0109] It may be equipment, the spinning and extruding units of which correspond to the width of the entire product width (panel spinning systems).

[0110] It may also be equipment, wherein the spinning and extruding units represent individual round spinpaks producing initially finished extruded filaments, which are then fed to the belt with a transport system and for which the product width can be adjusted via this transport system.

[0111] With the method according to the invention, however, the portion of the spun-bonding equipment that serves the melting and extruding of thermoplastic polymers is not used or only partially. At least a portion of the extruding devices provided in the spun-bonding equipment serves the feeding and transporting of previously produced threads from supply devices and/or from other production systems onto the transport device.

[0112] In a preferred embodiment, the spun-bonding equipment comprises an arrangement of pipes similar to that of organ pipes, which pipes guarantee the pneumatic transport of at least one continuous thread (bundle of threads) to the continuously advancing belt, from the pipe outlet of which the random distribution of the thread occurs by means of a transport pipe system randomly vibrating longitudinally and transversely to the running direction of the belt, by means of deposition system randomly vibrating longitudinally and transversely to the running direction of the belt, or by randomly moving the air between the pipe ends and the belt.

[0113] In a preferred embodiment of the method according to the invention, the random deposition of the threads is achieved by the random movement of the depositing units, by the random movement of the belt, the random movement of the air between the depositing unit and the belt, or by a combination of two or three of these measures.

[0114] In a further preferred embodiment of the method according to the invention, the threads deposited on the transport device are retained thereon by a vacuum (suction).

[0115] It is particularly preferred to use a method, wherein filaments C are additionally deposited with the threads A and/or A' and optionally the threads B, which filaments have been produced on the same equipment by melt spinning thread-forming materials and which following the passage through an extruding device are deposited with the threads A and/or A' and optionally with the threads B on the transport device.

[0116] Another preferred embodiment of the method according to the invention comprises the production of filaments C in the spun-bonding equipment, multi-component filaments made of at least two separable, melt-spinning and thread-forming polymers that are not compatible with each other, and the cleaving of these multi-component filaments in step vii) by means of water jet treatment.

[0117] After deposition the threads on the transport device, they are fed to one or more successive bonding steps.

[0118] The bonding of the obtained non-bonded non-woven can be achieved by using familiar mechanical, hydromechanical, pneumatic and/or thermal methods and/or by using chemical binding agents.

[0119] Examples include the use of embroiling looms, fluid jets or air jets, calendars or thermally cross-linking binding agents or binding fibers as well as of auto-crosslinking binding agents. It is also conceivable to use combinations of these methods.

[0120] The preferred bonding technique in the production of the non-woven fabrics according to the invention is the bonding with water jets.

[0121] The non-woven fabrics according to the invention can be used in various applications. Examples include textile and particularly technical applications. The non-woven fabrics according to the invention may be used in applications that today are reserved for fabrics or other surface structures. Examples include the application as textiles such as clothing materials, home textiles or industrial textiles, or the application as technical tissues, particularly as high-strength materials for use as textile surface structures in architectural designs, or the application as carriers for coated or impregnated non-woven fabrics, or also in the filtration of fluid flows or fluids.

[0122] These uses are also the object of the present invention.
The non-woven fabrics described here may be used in fuel cells, which produce electrical energy from chemical energy sources. From literature, for example, hydrogen-oxygen fuel cells are known. In fuel cells, membranes are disposed between electrodes. These membranes can be associated with gas diffusion layers, which must not damage the membranes if possible. The non-woven fabrics described here are particularly suited as gas diffusion layers or as parts of gas diffusion layers, since the risk that the membranes will becoming damage by the fiber ends of the non-woven fabrics is nearly non-existent. This is due to the structural configuration of the non-woven fabrics, which are composed of fibers or continuous fibers.

In addition to high stability, this structure has a surface with few fiber ends.

The following examples will explain the invention in more detail, without limiting it.

**EXAMPLE 1**

10 cops (bobbins) of rayon filament yarn from ENKA, type 84fB1, not spirally twisted, with a single filament titer of 2.7 dtex, were hung on a board provided with retainers, directed from there via the narrow side of the conical cop into a venturi nozzle, which normally in a spun-bonding equipment serves as an extruding unit for the freshly spun filaments, and pulled off the cops pneumatically. The yarns were fed into a pipe system transitioning into a so-called traveler system, which consists of a telescoping pipe, on the end of which a head pivoting in the equipment direction and at the same time transversely to the equipment direction randomly distributes the emerging filaments onto a deposition belt running in the equipment direction.

With a pressure of 3.2 bar, which is typical for the extrusion of freshly spun polyester filament, at nearly 3000 rpm about 200 g/min rayon filament yarn was deposited in a homogeneous, yet disassymetrical spot measuring about 500 mm in diameter on the belt.

The loose card web was sprayed with wood glue diluted 1:30 with water (Ponal, Henkel), the water was evaporated in a calendar step, the slightly bonded nonwoven was pre-bonded in a first step by means of an embossing loom (the spray-on adhesive sites largely burst open), and in a second step it was fully bonded with four water jet passages at 230 bar and about 10 m/min into a rayon continuous filament non-woven. A basis weight of 122 g/m² was obtained with a mass coefficient of variation CV of 7.6.

**EXAMPLE 2**

Analog to Example 1, 10 cops of rayon filament yarn from ENKA, type 84fB0, not spirally twisted, with a single filament titer of 1.4 dtex, was fed into the extruding unit of the spun-bonding test system described in Example 1. A spot measuring about 55 cm in diameter was deposited at a throughput of about 220 g/min and one spinning site. Then the traveler system was turned on and the deposition width was adjusted in relation to the belt speed such that the deposited spot moving in zigzag form transversely to the advancing belt largely overlapped.

The chemical bond, commercially available wood glue was diluted 1:30 with water, sprayed evenly on the slowly advancing card web with a manual spraying apparatus (flower sprayer) and the solvent (water) was evaporated in the heated calendar. The slightly mutually adhering rayon filament yarn threads obtained this way were fed to an embroidering loom and pre-bonded with about 60 punctures per cm² such that the product was able to be rolled up.

The product was unrolled in front of a water jet bonding system, fed into this system and bonded by means of water jets at 4×230 bar at about 10 m/min and subsequently dried in a floating drier. The result was a roughly 40 cm wide, non-thermoplastic non-woven fabric with a basis weight of 115 g/m² with a mass coefficient of variation CV of 6.1%.

**EXAMPLE 3**

Analog to Example 1, 10 cops of rayon filament yarn from ENKA, type 167f42, not spirally twisted, with a single filament titer of 3.9 dtex, was fed into the extruding unit of the spun-bonding test system described in Example 1. At a transport speed of about 2400 rpm, a throughput of 330 g/min and a spot of about 45 cm were achieved. A basis weight of 152 g/m² was obtained with a mass coefficient of variation CV of 8.2%.

**EXAMPLE 4**

Analog to Example 3, 10 cops of rayon filament yarn from ENKA, type 84fB0, not spirally twisted, was fed into the extruding unit of the spun-bonding test system described in Example 1. A spot with a basis weight of 234 g/m² was obtained, with a mass coefficient of variation CV of 9.8%.

**EXAMPLE 5**

In a spun-bonding equipment as described in EP-A-814,188 and used for producing microfilament spun-bond non-wovens, a rayon filament yarn from Example 3 was fed to the extruding units, meaning the venturi nozzles, during the ongoing process for the extrusion of freshly spun polyester-polyamide bicomponent filaments undergoing the extruding step at a spinning speed of about 4500 rpm, was deposited and bonded by water jet bonding, while the bicomponent filaments were separated and bonded.

Surprisingly, at about 3.5 bar extrusion air pressure and the significantly higher spinning speed of the bicomponent filaments compared to the rayon filament yarn speeds of 1500 rpm described in Example 1-1, no malfunctions were observed. Neither any clogging within the 7-10 m long traveler system (telescoping pipes) nor knotting during the depositing step were detected. This way, a significantly improved specific resistance to tear propagation of the microfilament non-woven was achieved.

**EXAMPLE 6**

During additional testing analog to Example 5, FOYPET multifilament yarns from SETILA, filament type 100/88 were added to the freshly spun bicomponent filaments located in the extrusion phase and the bonding conditions were selected such that in turn good pilling resistance was achieved. Due to the added multifilament yarns, the resistance to tear propagation of the resultant product was drastically increased. Although the bicompo-
nant filaments moved in the pipe system at typical speeds for the process of 4500 rpm, while at the same time an unwinding speed of only 1500 m/min was reached, no problems occurred during the process. At the same time, very good basis weight uniformity was achieved.

[0137] The produced non-woven fabrics had the following values:

[0138] basis weights of 100 to 107 g/m²; CV values of 5.2-7.2
[0139] basis weights of 127 to 133 g/m²; CV values of 5.2-6.4
[0140] basis weights of 164 to 168 g/m²; CV values of 4.8-5.4

EXAMPLE 7

[0141] The procedure from Example 5 was repeated. Since rayon requires different coloring than polyester and polyamide, the test was repeated with a polyester filament yarn made of high-strength (POY) polyester (polyethylene terephthalate=PET). In the spun-bonding system described in Example 5, a POY-PET filament yarn from SETLIA, item no. 12058, type 100/88 with an individual filament titer of 1.14 dtex was fed to the extruding units, meaning the venturi nozzles, during the ongoing process for extruding freshly spun polyester-polyamide bicomponent filaments located in the extruding step at a spinning speed of about 4500 rpm, was deposited and bonded by water jet bonding, while the bicomponent filaments were separated and bonded.

EXAMPLE 8

[0142] In a panel spun-bonding equipment with rectangular set-up (spinpack across the entire width of the equipment), the melt-spinning part of the equipment was not activated.

[0143] By means of two spool carriers for 20 thread spools each, 40 polyurethane filament yarns from Elastogran, type Elastollan IREL 22 dtex, which were held by means of a comb-like device at a width of 80 cm with even spacing, were fed from the wide side into the rectangular terry air duct and supplied to the depositing belt.

[0144] A basis weight of 100 g/m² was obtained, with a mass coefficient of variation CV of 6%.

What is claimed is:

1. A non-woven fabric with a basis weight of up to 250 g/m² and a high level of uniformity, expressed by a mass coefficient of variance of the basis weight distribution CV of less than 10%, as determined by samples measuring 55×5 cm², comprising randomly deposited threads not produced with a spun-bonding method.


3. A non-woven fabric according to claim 1, characterized in that it comprises threads made of fibers or filaments.

4. A non-woven fabric according to claim 1, characterized in that it has a level of uniformity, expressed by a mass coefficient of variation of the basis weight distribution CV of less than 7%.

5. A non-woven fabric according to claim 1, characterized in that it comprises threads made of high-strength polymer fibers or high-strength polymer filaments.

6. A non-woven fabric according to claim 1, characterized in that it comprises threads made of metal or metal alloys.

7. A non-woven fabric according to claim 1, characterized in that it comprises threads made of polymers with additives, preferably spin-dyed and/or flame-protected polymers.

8. A non-woven fabric according to claim 1, characterized in that it additionally comprises randomly deposited filaments produced with the spun-bonding method.

9. A non-woven fabric according to claim 8, characterized in that the filaments produced with the spun-bonding method are separable filaments derived from multi-component filaments, comprising at least two separable, melt-spinable and thread-forming polymers that are not mutually compatible, preferably separable filaments from the combinations polyester/polyamide, polyester/polyolefin, polyamide/polyolefin, polyester/polyurethane, polyamide/polyurethane, polyolefin/polyurethane.

10. A non-woven fabric according to claim 2, characterized in that it is made exclusively of filaments and/or staple yarns of non-melt spinnable thread-forming materials.

11. A non-woven fabric according to claim 10, characterized in that the non-melt spinnable material is selected from the group comprising cotton, wool, cellulose and cellulose derivatives, particularly rayon, modal, copper rayon, cellulose acetate, semi-acetate or triacetate, polycryl nitrite, aromatic polyamides (aramides), non-thermoplastic polyurethanes, non-melt spinnable halogenated polyolefins, such as polytetrafluoroethylene, polyvinylchloride or polyvinylidene chloride, as well as rubbers, polyvinyl alcohol or carbon.

12. A non-woven fabric according to claim 2, characterized in that the non-melt spinnable material is a thread-forming polymer or a polymer that can be spun with a peeling process.

13. A non-woven fabric according to claim 12, characterized in that the filaments produced with the spun-bonding method are derived from melt-spinable thermoplastic polycondensates, selected from the group comprising polyesters, polyamides, polyether ketones, polyarylene sulfides, polyarylene ether sulfones, polycarbonate, proteins and protein derivatives, or which are derived from melt-spinable thermoplastic polymerides selected from the group comprising polyolefins and polyurethanes, or which are derived from other melt-spinable polyurethanes selected from the group comprising metals and glass or from a combination of two or more of these polycondensates, polymerides or other materials.

14. A non-woven fabric according to claim 1, characterized in that it has been bonded by using mechanical, hydromechanical and/or thermal methods, particularly by using embroidering looms or water jets.

15. A method for producing non-woven fabrics comprising the following measures:

i) feeding threads to several supply devices A, particularly threads comprising fibers or filaments made of non-melt spinnable materials,

ii) optionally feeding threads to further supply devices B, which threads differ from the threads located in the supply devices A,

iii) pulling the threads off the supply devices A by means of at least one conveying device,
iv) random depositing of the threads pulled off in step iii) in the form of a non-bonded non-woven onto a transport device in multiple layers,
v) optionally pulling the threads off the supply devices B by means of at least one conveying device,
vi) optionally random depositing of the threads pulled off in step v) in the form of a non-bonded non-woven onto a transport device in multiple layers, and
vii) bonding the obtained non-bonded non-woven by using familiar mechanical, hydromechanical, pneumatic and/or thermal methods and/or by using chemical binding agents.

16. A method for producing non-woven fabrics comprising the following measures:
i) feeding threads comprising fibers or filaments made of non-melt spinnable materials originating from a production system A' used for these threads and pulling these threads off with at least one conveying device,
ii) optionally feeding threads to several supply devices A, particularly threads comprising fibers or filaments made of non-melt spinnable materials,
iii) optionally feeding threads to further supply devices B, which threads differ from the threads located in the supply devices A,
iv) optionally pulling the threads off the supply devices A by means of at least one conveying device,
v) random depositing of the threads pulled off in step i) in the form of a non-bonded non-woven onto a transport device in multiple layers,
vii) random depositing of the threads pulled off in step iv) in the form of a non-bonded non-woven onto a transport device in multiple layers,
vi) optionally pulling the threads off the supply devices B by means of at least one conveying device,
viii) optionally random depositing of the threads pulled off in step vii) in the form of a non-bonded non-woven onto a transport device in multiple layers, and
ix) bonding the obtained non-bonded non-woven by using familiar mechanical, hydromechanical, pneumatic and/or thermal methods and/or by using chemical binding agents.

17. A method according to claim 15, characterized in that reels or cans are used as the supply devices.
18. A method according to claim 16, characterized in that wet or dry spinning systems or systems for secondary spinning are used as the different production systems A'.
19. A method according to claim 15, characterized in that pneumatic conveying devices are used as the conveying devices.

20. A method according to claim 15, characterized in that the threads are guided by thread guides from the supply devices A and/or B and/or from the different production system A' prior to entering the conveying devices, which guides are provided on the inlet openings of the conveying devices.
21. A method according to claim 15, characterized in that the method is carried out on spun-bonding equipment, in which the spinning and extruding units are disposed along the entire product width.
22. A method according to claim 15, characterized in that the method is carried out on spun-bonding equipment on which individual round spinnacks are provided as spinning and extruding units to produce finished extruded filaments and which comprises a transport system, which is used to feed the filaments to a belt, the product width being adjustable via the transport system.
23. A method according to claim 15, characterized in that the threads A and/or threads A' and optionally the threads B are deposited randomly and not towards a previously defined location and are distributed in several layers on top of each other on an advancing belt.
24. A method according to claim 15, characterized in that in addition to the threads A and/or threads A' and optionally the threads B filaments C are deposited, which have been produced in the same system by melt-spinning thread-forming materials and that following passage through an extruding device they are deposited together with the threads A and/or threads A' and optionally the threads B on the transport device.
25. A method according to claim 24, characterized in that the filaments C are multi-component filaments, which are made of at least two separable, melt-spinnable and thread-forming polymers that are not compatible with each other, which are separated by means of water jet treatment.
26. A method according to claim 15, characterized in that the random deposition of the threads is achieved by the random movement of the depositing units, by the random movement of the belt, the random movement of the air between the depositing unit and the belt, or by a combination of two or three of these measures.
27. A method according to claim 15, characterized in that the threads deposited on the transport device are retained there by a vacuum.
28. A method according to claim 15, characterized in that the bonding is carried out by means of water jets.
29. The use of the non-woven fabrics according to claim 1 as textiles, as clothing materials, as home textiles or as industrial textiles, as technical tissues or as carriers for coated or impregnated non-wovens, or they are used in the filtration of fluid flows or fluids.
30. The use of a non-woven fabric according to claim 1 in a fuel cell.

* * * * *