

**A PROCESS FOR PREPARING A NON-WOVEN
CELLULOSIC STRUCTURE AND THE NON-WOVEN
CELLULOSIC STRUCTURE PREPARED THEREFROM**

5 RELATED APPLICATIONS

This Application claims priority to Indian Application No. 999/MUM/2004 dated 17.09.2004.

10 BACKGROUND OF INVENTION

The present invention relates to a process for preparing a non-woven cellulosic structure and the non-woven cellulosic structure prepared therefrom. Particularly, the present invention relates to a process for preparing a consolidated multiple / single layer, absorbent, durable or disposable composite non-woven
15 cellulosic structure comprising of at least one layer that is made from bio-degradable, continuous cellulosic material.

More particularly, the present invention relates to a process for preparing a non-woven cellulosic structure comprising of continuous, randomized cellulosic
20 fibers and the composite non-woven cellulosic structure prepared therefrom.

Introduction

Consolidated non-woven structure may comprise of Viscose Fibers, Lyocell Fibers, Cellulose acetate, and / or its blends with synthetic fibers. Lyocell
25 fiber is a man made fiber based on dissolving non-derivatized cellulose directly in an organic solvent. Lyocell fibers are produced by regeneration of cellulosic fiber from a solution of cellulose in an organic solvent like N Methyl Morpholine N Oxide.

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Prior art

The process of manufacturing cellulosic fibers is known in the prior art. U.S. Patent 3600379 discloses a process of manufacturing Viscose fibers wherein
5 the wood pulp is utilized as a raw material. It is steeped either as sheets or slurry with 17 – 22 percent NaOH solution. The excess steeping liquor is removed by pressing. The alkali cellulose is shredded and aged. The aged alkali cellulose is xanthated with an amount of carbon disulphide. The xanthate is dissolved in NaOH solution forming Viscose solution. The viscose is ripened and filtered once or
10 several times either during or after ripening. The viscose solution can then be spun through fine orifices in acidic spin bath to form regenerated cellulosic filaments / fibers / tow. Viscose / Rayon spinning is almost 100 years old technology and hence described in brief only. Similarly preparation of non-derivatized cellulose solution through solvent spinning route is also known.

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Indian Patent No. 189773 mentions a process of preparing cellulose solution for spinning fibers / films. The process includes introducing cellulose material into an aqueous solution of tertiary amine oxide to prepare a suspension. Later the suspension is subjected to high shear equipment heating under reduced
20 pressure.

US Patent 4,144,080 and 4,246,221 disclose a method of preparation of amine oxide solution by extruding ground tertiary Amine Oxide solution and Cellulose. Also disclosed is the method of producing fibers by spinning the
25 solution through fine orifices in air, orienting the same by mechanical stretching and regenerating the cellulose from the solution by allowing the spun filaments to pass through a bath of a nonsolvent.

Once filaments are formed either through Viscose process or by any other
30 process, the tow is washed and fibers cut into staple length. Conventionally the staple fibres are dried and baled (if non-wovens are prepared at different location). The dried staple fiber bale is opened, blended if required and carded to form a

fibrous mat. This mat is directly or after cross lapping bonded to form a non-woven material.

Methods cited in US Patents 3,833,438 and 3,906,130 explain a process to
5 make non-woven and perforated textile fabrics from continuous cupramonium
rayon, viscose rayon and the like fiber filaments. In this process primarily the
continuous filaments are cast on a conveyor, which is caused to oscillate laterally
along with forward motion. The spinning units describe respective parallel and
sinusoidal curves. Later, consolidation is achieved by water jets. Cupramonium
10 rayon is an expensive method to produce absorbent cellulosic non-woven. Method
involves mechanical moving parts like cam/crank mechanisms, which are prone to
breakdown/maintenance. The limiting oscillation speed (cycles/min) limits the
filament feed velocity and hence the production rate.

15 US Patents 3,620,903 and 4,069,563 disclose a method to produce light
weight, non patterned non-woven fabrics by treating fibrous sheet of materials with
fine, essentially one or more columnar streams of liquid jetted from orifices, under
high pressure. A layer of fiber web is supported on a surface and traversed with the
streams to entangle the fibers in a manner which imparts strength and stability
20 without the need for binder.

The aforesaid patents describe the processes wherein the cellulosic solution
is spun using a solvent spun method. The cellulosic fibers are spun and cut into
staple lengths. Subsequently, they are treated with water and/or other chemicals.
25 These wet fibers are then dried. In order to manufacture a non-woven product, the
mat is opened by use of an opener, carded and then hydro entangled to obtain a
spun laced product. The said product is re-dried to achieve a cellulosic non-woven
fiber. This is a conventional and well-accepted method to produce cellulosic non-
woven fiber. However, the process involves drying the said fiber twice, thereby
30 increasing the costs. Also strength of the said non-woven fiber is not high since it
comprises of short (staple) length fibers.

Summary of present invention

The present invention discloses a process of manufacturing continuous cellulosic filaments obviating the aforesaid drawbacks.

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The present invention relates to a process for preparing a non-woven cellulosic structure comprising the steps of extruding filaments from a cellulosic solution; passing the extruded filaments through a regenerating liquid to attenuate the filaments and laying the attenuated filaments into a web and to the non-woven
10 cellulosic structure prepared therefrom.

Detailed description of the preferred embodiment

The present invention will now be described with reference to the figures
15 accompanying the specification, wherein the same numerals denote the same parts and wherein:

Figure 1 shows the isometric view of the assembly for spinning the non-woven cellulosic material.

Figure 2 shows the exploded isometric view of the spinning box as
20 shown in Figure 2.

Figure 3 shows the isometric view of the set up showing the laying of the curtain.

Figure 4(a) to 4(e) show various options for preparation of a composite structure.

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Referring to Figures 1 and 2, the cellulose solution at required temperature and constant flow rate is fed into a spinneret assembly (7), preferably a rectangular assembly. A spinning box (3) is kept below the rectangular spinneret assembly. The spinning box (3) is used to attenuate the filaments and also to randomly lay
30 down the filaments, thereby maintaining the rectangular configuration of the web. The regeneration liquid is fed with the help of a regeneration liquid feed pipe (4). The location of the regeneration liquid feed pipe can be either from the top or from

the bottom of the spinning box. The spinning box (3) comprises of a funnel shaped sides which form a funnel shape till a certain length, the rest of the portion remaining straight. The funnel is meant to allow the regeneration liquid to pass from top to bottom. Top part of the funnel (5) may have perforations in the side plate so that as the regeneration liquid starts filling up the spinning box (3), the fluid comes out from the perforations and passes through the funnel. Flow from the regeneration liquid feed pipe (4) is regulated to maintain a constant level of the liquid. The height of the water column in the spinning box makes the liquid flow from the funnel (5) at a high speed, due to gravitational acceleration. High speed fluid imparts a drag to the filaments fed from the spinneret assembly and get attenuated. Stretched filaments are allowed to fall by way of its own energy gained by the fluid flow on to a collection belt conveyor (8). Since the collection belt (8) moves at a slower speed as compared to the filament drop down speed, the filaments lay down randomly on the belt forming a fairly entangled non-woven web. The entire conveyor is placed within a regeneration liquid collection tank (9). The regeneration liquid by gravity flows out of this tank to the recovery section and the recycle section. Laying is attained by a vacuum system (10), which is provided below the collection belt just under the filament outlet. Vacuum allows the filaments to retain its random orientation on the belt, thereby reducing the effect of water force.

Figure 3 shows one of the preferred laying options. Curtain (11) formed by the aforescribed method is brought to the feeding box (12). The feeding box may have a mechanically driven twin roll arrangement to draw the curtain and feed it below. The feeding box (12) is pivoted by a swing arrangement, which lays down the curtain in folds (13) on to the moving collecting belt (14). Depending upon the coverage required, the speed of the swing, the drop down rate and the belt conveyor speed can be adjusted. Similarly, one or more feeding boxes (12) in combination with collecting belt (14) may operate such that web structure like that of a cross lapper is obtained. A cross lapped web may have a higher coverage and

better tensile strength in cross direction (CD) as compared to the CD tensile strength of the web made as shown in Figure 3.

Figure 4(a) shows a typical un-consolidated laid mat made from Viscose
5 continuous filaments (1) randomized by fluid assisted randomizer. Figure 4(b) shows a typical un-consolidated laid mat made from Lyocell continuous filaments (2) randomized by fluid assisted randomizer. The above two structures may be consolidated by known methods described. Figure 4(c) is a representative sketch of a non-woven composite structure prepared by the aforesaid process prior to
10 consolidation. In this case the bottom layer is cellulosic non-woven Viscose or Lyocell or the like (1) or (2) prepared by the process described above, while the top layer may be either cellulosic non-woven or synthetic non-woven web (x). The structure may be consolidated by known methods described above to form a consolidated structure. Figure 4(d) is a representative sketch of a non-woven
15 composite structure prepared by the process described above prior to consolidation. In this case the bottom layer may be either cellulosic non-woven or synthetic non-woven web (x), while the top layer is cellulosic non-woven Viscose or Lyocell or the like (1) or (2) prepared by the process described above. The structure may be consolidated by known methods. Figure 4(e) represents a composite structure with
20 multiple layers of either cellulosic or synthetic non-wovens (x1, x2...) with at least one layer of cellulosic non-woven Viscose or Lyocell or the like (1) or (2) prepared by the process described above. Presence or absence of either of the layers (1) or (2) may be decided upon the desired performance of the composite structure. The structure may then be consolidated by known methods.

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Solvent Spinning Route (Lyocell):

Pulp preferred for use for making the solution is soft wood pulp having high alpha cellulose content (89-93%) and low hemi-cellulose content. DP (Degree of
30 Polymerization) of the pulp is in the range of 600 to 1100, preferred range would be 700 to 1000. Cellulose concentration to achieve a spin able solution can be in

the range of 5% to 28%. Preferably 7% to 20%, most preferred values of the cellulose concentration are 10% to 15%. NMMO (N-Methyl Morpholine N-Oxide) as available in the market is of 50% concentration has to be pre-concentrated to 77% prior to dissolution of cellulose by conventional distillation process. Blending
5 of small pieces of pulp with pre-concentrated solvent is carried out at about 100°C in a double blade sigma mixer where in vacuum of 400 mm Hg is applied. After duration of 1.5 hours a homogeneous solution is obtained, which is allowed to cool down to solid condition. Other methods available for making cellulose solutions on a continuous basis are available like use of high shear blender, thin film device or a
10 devolatilizing type counter rotating twin screw extruders. A method described in Indian Patent No. 189773 may also be followed.

A spinning die with multiple holes arranged in a rectangular configuration having aspect ratio of length to breadth around 1.2 to 200, which has spinning hole
15 diameters ranging from 50 micron to 150 micron, preferably 55 to 100 microns, is utilized to extrude filaments. The above given aspect ratio allows for providing 10 to 60 rows of holes.

During spinning of Lyocell polymer at 90 to 110 deg C, adequate air gap
20 and air flow in cross direction is provided. Depending upon the size of the spinneret and the stretch ratio, filaments from sub denier to 5 deniers can be spun.

Filaments coming out in the form of a curtain retain their rectangular configuration by the virtue of a special device, which contains the regeneration
25 bath. Central portion of the box has a funnel type arrangement. The funnel may be perforated from the top and plain below a certain distance. Internals are so arranged such that a slit is provided at the bottom of the funnel, which serves as an outlet for the regeneration solution as well as outlet for spun filament. The funnel is sealed and isolated from the sides so that the regeneration liquid from the bottom
30 of the box cannot enter the funnel. The inlet of the regeneration liquid is provided at the bottom. As the liquid fills the box and level is raised beyond the plain

portion of the funnel, the liquid reaches to the perforated portion of the funnel. Liquid enters the funnel. Flow in the box is so adjusted that the outlet level matches with the inlet and always keeps the regeneration box full up to the brim. The velocity of the extruded filaments is 8m/min to 80m/min.

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Flow of liquid inside a small width accelerates the filaments from the spinneret. The regeneration liquid is sent for solvent recovery process.

Velocity of the regeneration liquid attained at the outlet of the spinning box is governed by the relation:

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$$V^2 = 2 \times g \times h$$

Where g – force of gravitational acceleration in m/sec^2

15 h - height of regeneration liquid from funnel bottom opening in m

V - velocity of regeneration liquid in m/sec .

The velocity of the regenerating liquid is kept between 50m/min to 250m/min, preferably between 100m/min to 200m/min.

20 Flow rate of regeneration liquid required to maintain the level in the spinning box is governed by the relation:

$$Q = L \times W \times V$$

Where L - Length of the funnel measured at the bottom in m

25 W – Opening of the funnel bottom in m

Q – Quantity of regeneration liquid required to maintain the level in m^3/Hr .

From the above relations it can be observed that for a given width of spinneret, water flow depends mainly on 2 parameters, viz. the height and the funnel bottom opening. Trials conducted on various funnels showed that higher the liquid height, higher is the flow rate and higher is the drag (stretch) imparted to the

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filaments. On the other side of it, higher the water flow rate means higher water energy at the funnel outlet position. Higher the water energy higher is the disturbance imparted to filaments. Therefore while designing a spinning box funnel one should keep both these factors into consideration. Examples cited show
5 different funnel configurations.

When the extruded filaments are passed through the regenerating liquid, the filaments are attenuated.

10 The said filaments formed by the method described above are brought to the belt conveyor where filaments may get additionally randomized due to flow of regenerating liquid. As an alternative for belt conveyor, collection of web may be done on a rotary vacuum drum system. The feeding box may have a mechanically driven twin roll arrangement to draw the web and feed it below. The feeding box
15 has a variable speed drive and is pivoted by a swing arrangement which lays down the web in folds on to the moving collecting belt. Step less adjustment of the swing amplitude and the swing speed can also be provided. Depending upon the coverage required the speed of the swing, the amplitude of the swing, the drop down rate and belt conveyor speed can be adjusted so as to get webs with coverage from 10 to
20 600 gsm. Filament mat can also be formed without swinging the feeding box also. Then the only variables would be the conveyor and the curtain drop down speed.

Yet another laying option is cross lapping. The method is similar to the one shown in Figure 3. However, there are one or more than one boxes feeding the belt
25 conveyor in cross direction. Swing boxes lay down the web along the width of the conveyor giving a cross lapping type laying, as well as they may lay it along the direction of the moving belt conveyor as shown in Figure 3 if required, such a web may have higher coverage and better tensile strength in cross direction as compared to the CD tensile strength shown in Figure 3. The laying options cited
30 above are especially beneficial when cellulosic fibers are to be mixed with other fibers. When a composite structure is required, web of 1 or more fiber is brought in

to form a multi layer structure. The resultant web would be a composite structure of cellulosic and the other fibers.

5 The un-bonded web then passes through consolidation step, which may include hydro-entanglement, chemical bonding, needle punching system, etc., which consolidates the mat fibers together to produce a bonded consolidated non-woven material.

10 Wet non-woven bonded material is thereafter treated for, bleaching, further washing, dyeing, soft finishing, etc. and then passed through a dryer that expels excess moisture. Subsequently the web is collected on the winder and rolled. The said web has a soft handle and good strength and may be used for many different applications of semi-durable or disposable segment.

15 Viscose Spinning Route:

Properly aged, filtered, ripened and deaerated viscose is fed at right temperature to the spinning machine. Spinneret holder may remain same or needs to be modified suitable to the cluster plate which has circular precious metal eyes fitted and arranged in the form of a rectangular shape. Each eye is drilled with required number of spinning orifices following the conventional triangular pitch and configuration.

25 Spinneret is dipped in the spin bath maintained at desired temperature and concentration level in the bottom down position, i.e. the spinning orifices face downwards. The only difference between Lyocell route and Viscose route is that in Lyocell route, an air gap is maintained between the regeneration liquid and spinneret, while in case of Viscose route, spinneret is immersed in the regeneration bath, since Viscose spinning is a wet spinning process. Thus a viscose web is formed. Cross section of the cellulosic fibers may be altered by using different spinnerets to obtain tri-lobal, Y-shaped, or other shapes to impart specific

properties to the structure. Subsequent steps are same as mentioned above for the solvent spinning route for the formation of a non-woven material. Only the hydro entanglement / consolidation operating parameters might differ for Viscose.

5 Understanding the filament behavior when they are laid down is necessary. Hence an analogy of a thread is considered. When a thread is laid down perpendicularly on to a moving belt, the laid down form taken by the thread is determined by the filament properties (linear density, bending rigidity and torsional rigidity, height of the feed point and feed to belt speed ratio). Further, important
10 variables apart from the filament properties in the process of lay down are filament velocity, belt speed, water velocity, height of the spinning box from the belt, vacuum below the collecting belt and design of the spinning box.

15 Consolidation:

 Once the curtain of randomized / laid continuous cellulosic filaments is obtained, next process is to consolidate the curtain into a non-woven web. There are numerous options available (as shown in figures 4(a) to 4(e)) to the non-woven
20 manufacturer once a curtain of randomized / laid continuous cellulosic filaments is obtained. Layer / Layers of melt blown or spun bonded, mono / bi-component melt spin able thermoplastic polymers like Polyethylene, polypropylene, ethyl vinyl acetate, polyester, polyurethane, ethylene methyl acrylate, nylon or the like may be used. Depending upon the desired end product performance characteristics
25 the layer / layers are selected. One may also use a carded staple fiber mat formed out of viscose, Lyocell or other melt spin able thermoplastic polymers as mentioned above to form a part of the non-woven structure along with at least one layer of the curtain produced by method disclosed in this invention. After laying all the layers in the desired positions, the un-bonded non-woven structure is
30 consolidated using various processes known to those skilled in the art. Process may include hydro entanglement, needle punching, thermal bonding, spot bonding, melt

stabilization, latex or chemical bonding. Type of bonding / consolidation process used may be decided based on the desired end product / product characteristics.

Testing:

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Test procedures used to determine the properties of the consolidated non-woven structure and products made by the disclosed process are known to those well versed in the non-woven field.

10 Tensile tests:

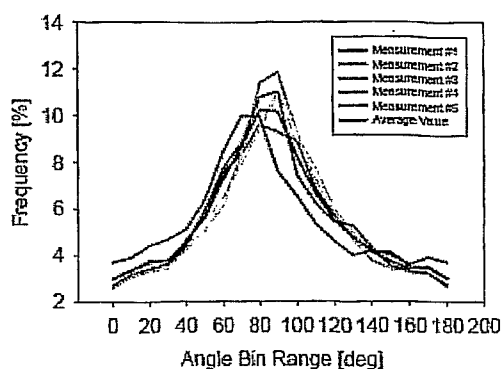
A sample of 200 mm length and 2.5cm wide can be stretched in an Instron equipment at a rate of 100 mm/min obtains the point at which the structure yields. This figure when represented in N/2.5cm value describes the value of tensile strength of a non-woven. Values obtained are shown in the table No 1.

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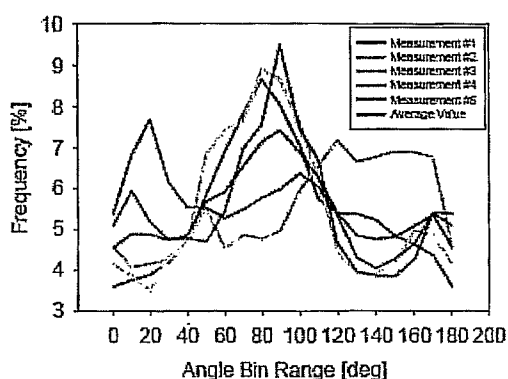
Fiber Orientation distribution:

This test is a measure of randomization of filaments in a non-woven structure. Two example graphs as shown below: Graph: 1 represents a non-woven structure which has more number of filaments in a particular direction – representing a low degree of randomization, while Graph: 2 shows a non-woven structure with a higher degree of randomization. One can thus determine the amount of randomization of the web structure.

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Graph : 1



Graph : 2

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Other tests which are essential to understand the performance of the product are: Basis weight, Elongation at break, tear strength, web abrasion resistance test, drop absorbency test, absorbent capacity test, vertical wicking rate, drip capacity test, dry lint release test. Procedure for these tests can be obtained from any non-woven handbook.

Examples:

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Example 1: 12% cellulose Lyocell polymer solution was fed at the rate of 0.06 grams/hole/min through a rectangular spinneret having 20 rows of 80 micron

- diameter holes, giving an extrusion speed of 10 m/min. Below the spinneret the spinning box maintaining a regeneration liquid column of 510 mm was installed in such a way that the gap between top most water surface and spinneret bottom is between 15 to 25 mm. 5 mm gap was provided in the funnel bottom portion.
- 5 Regeneration liquid flow rate of 10 to 15 m³/hr was sufficient to maintain full level in spinning box. The velocity of the liquid is kept at 190 m/min. Although the water velocity at the outlet of the funnel is much higher, the drag imparted to the filaments made them to attenuate at 40 to 60 m/min speed, thus giving a draw ratio of 4 to 6. (Draw ratio is the ratio of filament speed to extrusion speed.) Collection
- 10 belt operating at 10m/min below the spinning box maintained a distance of 120 mm between the spinning box. Vacuum of 400mm of water column was provided below the laying portion. Web obtained on the belt was washed clear off the solvent and sent to multi layering device and then for bonding. Different samples were prepared by varying the number of layers to get non-woven samples of
- 15 different coverage. Non-wovens obtained had good strength, were soft and absorbent. Samples were tested for coverage in grams/square metre (gsm), water absorbency measured in gram/gram and tensile tests as described above in machine direction (MD) and in cross direction (CD) both in dry and wet condition. Key test results are tabulated below:

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TABLE No. 1

Parameter	PRESENT INVENTION			CONVENTIONAL PROCESS	
	Sample # 1	Sample # 2	Sample # 3	100% Viscose staple fibre	60/40 V/P staple fibre
Filament Denier	1.5	1.2	2	1.5	1.51
Nonwoven coverage – gsm	111.6	82.8	100	112.9	80
Tensile strength In the direction of laying (N/2.5cm)	145.6	118.8	270.7	71.2	70.58
Water absorbency	7.46	8.32	4.94	5.58	7.5

(gm/gm)					
Bonding method adopted	Hydro entanglement	Hydro entanglement	Chemical bonding	Hydro entanglement	Hydro entanglement

Example 2: 11% cellulose Lyocell polymer solution was fed at the rate of 0.01 grams/hole/min through a rectangular spinneret having 20 rows of 80 micron diameter holes, giving an extrusion speed of 1.72 m/min. Spinning box was maintained at regeneration liquid column of 170 mm. 4 mm gap was provided in the funnel bottom portion. Regeneration liquid flow rate of 7 m³/hr was sufficient to maintain full level in spinning box. The velocity of the liquid is kept at 109 m/min. Although the water velocity at the outlet of the funnel is much higher, the drag imparted to the filaments made them to attenuate at 8 m/min speed, thus giving a draw ratio of 4.6. Web laying speed was kept at 1 to 3 m/min to obtain a uniform non-woven. Vacuum of 255 mm of water column was provided below the laying portion. Web obtained on the belt was washed clear off the solvent and sent to multi layering device and then for bonding. Different samples were prepared by varying the number of layers to get non-woven samples of different coverage. Results obtained were very similar to those disclosed above.

The present invention can also be worked on viscose to achieve similar comparative results.

Benefits of this invention:

- a) For the same coverage, strength of the cellulosic non-woven fabric is higher by a factor of 1.5 to 2 as compared to staple fiber carded spun laced fabric and substantially higher as compared to Lyocell melt blown fabric. This means, keeping the material input same one can get a stronger fabric or for the same strength lower usage of material can serve the same purpose.

- b) Process does not involve use of expensive high temperature air for spinning as done in Lyocell melt blowing. Entire process operates on lower temperatures, thus reduction in total energy consumed per Kg of fabric.
- 5 c) Attenuation of filaments does not need expensive high pressure air.
- d) Randomization of filaments does not need injection of high pressure fluid and large vacuum levels. It uses low quantity and velocity of recyclable fluid.
- 10 e) Process from Viscose to Web or from Lyocell dope to Web involves only one step of drying (in the final stage after spun lacing), thus saving one complete step of drying as compared to non-woven webs made through staple fiber – carded spun laced route. This process also eliminates tow cutting, fiber opening and carding steps.
- 15 f) Once a randomized mat is produced, one can adopt other processes to consolidate the web, viz. needle punching, using binders, etc. without the use of additional equipments like cross lappers, etc.
- g) Process uses only continuous fibers, hence no chances of short fibers resulting into linting, ideal for producing wipes for clean room application.

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AMENDED CLAIMS

**[received by the International Bureau on 21 April 2006 (21.04.06);
originals claims 1-17 replaced by news claims 1-19 (2 pages)]**

1. A process for preparing a non-woven cellulosic structure comprising the steps of:
 - a) extruding filaments from a cellulosic solution;
 - b) passing said extruded filaments through a regenerating liquid, to attenuate and randomize said filaments; and
 - c) laying said attenuated and randomized filaments into a web;
2. A process as claimed in Claim 1, wherein said filaments are continuous.
3. A process as claimed in Claim 2, wherein said structure is uniform.
4. A process as claimed in Claim 3, wherein said non-woven cellulosic structure is consolidated using known methods.
5. A process as claimed in any of the Claims 1 to 3, wherein said regenerating liquid and said extruded filament are passed through a gap of 3 mm to 7 mm.
6. A process as claimed in any of the Claim 5, wherein said regenerating liquid and said extruded filament are passed through a gap of 4 mm to 6 mm.
7. A process as claimed in any of the aforesaid claims, wherein said regenerating liquid is having a velocity of 150 m/min to 330 m/min.
8. A process as claimed in Claim 7, wherein said regenerating liquid is having a velocity of 200 m/min to 216 m/min.
9. A process as claimed in any of the Claims 7 or 8, wherein said velocity is attained by a gravitational force.
10. A process as claimed in any of the aforesaid Claims, wherein said filament is of 1 to 5 denier.

11. A process as claimed in any of the aforesaid claims, wherein the velocity of said extruded filament when it exits from said regenerating liquid is 8 m/min to 80 m/min.
12. A process as claimed in any of the aforesaid claims, wherein the velocity of the said extruded filament provides a draw ratio of utmost 6.
13. A process as claimed in any of the aforesaid Claims, wherein said laying is carried out by a vacuum assisted process.
14. A process as claimed in Claim 13, wherein said vacuum assisted process is achieved by a rotary vacuum drum system.
15. A non-woven cellulosic structure prepared from the process as claimed in any of the aforesaid claims.
16. A non-woven cellulosic structure as claimed in Claim 15, wherein said non-woven structure is either of lyocell, viscose or a combination of either of them.
17. A non-woven consolidated structure comprising of at least one layer of non-woven cellulosic structure claimed in Claim 15 or 16.
18. A process for preparing a non-woven cellulosic structure substantially as herein described with reference to the examples and figures accompanying the specification.
19. A non-woven cellulosic structure substantially as herein described with reference to the examples and figures accompanying the specification.