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PRODUCTION OF NON-WOVEN FIBROUS STRUCTURES

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This invention relates to the production of non-woven fibrous structures and provides a rapid process for obtaining thin homogeneous non-woven fibrous sheets made of fibres of fine count.

In the known processes for the preparation of non-woven fibrous structures it is necessary to form the fibres used by extrusion. In one such method, the continuous filaments thus obtained are cut, and then converted into a sheet either by carding or by passing them through an apparatus of the "Rando-Webber" (registered trademark) type. However, such processes, which are relatively long and costly, do not give completely satisfactory thin structures with fibres of fine count.

A process has recently been proposed for obtaining a fibrous structure directly after extrusion of the continuous filaments, but this process, which is difficult to perform, again involves extrusion.

This invention provides a rapid and economical process for directly obtaining a fibrous structure without using a conventional extruding operation.

The process of the invention comprises forming a layer of a solution of a fibre-forming polymer on the surface of a temporary support containing perforations corresponding to the size of the fibres desired, forcing the said solution through the said perforations with a fluid which precipitates the polymer from the solution, and separating the non-woven fibrous polymer structure thus formed from the support.

By the new process it is possible to obtain rapidly and economically, and if desired continuously, thin fibrous structures which consist essentially of fibres of fine count.

The "temporary support" may be any surface having orifices of fibre-forming dimensions, i.e. of size such that by passing a polymer solution therethrough and precipitating the polymer, fibres are formed. It will be understood that the said support must have orifices small enough to retain the deposited solution by surface tension. Preferably, a metal cloth or plate is employed having orifices whose density and dimensions depend upon the articles which it is desired to produce. A metal cloth e.g. of stainless steel, corresponding to a sieve size from 0.1 mm. to 2 mm. (AFNOR Standard 21 to AFNOR Standard 34) is preferred for most purposes.

In the new process any fibre-forming polymer may be used in solution in a suitable solvent, for example polyamides of type 6 or 6.6 (i.e. polycaprolactam or polyhexamethylene adipamide), polyesters, e.g. poly(ethylene terephthalate), polyacrylonitrile and its copolymers, polyolefines, cellulose mono- and tri-acetate, regenerated cellulose, and mixtures thereof.

The polymer solutions may also comprise auxiliary agents such as pigments or dyestuffs, so that coloured fibrous structures dyed in the mass are obtained.

The polymer solutions may be deposited on the temporary support by any known methods, e.g. with a lightly touching roller, or a doctor. Preferably, excess solution is avoided by passing the support through a scraping device.

Depending upon the nature of the polymer solution, the arrangement and the dimensions of the orifices in the support, the quantity of coating deposited varies. Gen-

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erally speaking, good results are obtained by depositing 200 to 400 or even 500 g./m.² of solution. The solution itself will ordinarily contain from at least 5% by weight of polymer up to the saturation concentration of the polymer in the particular solvent used.

Depending upon the viscosity of the polymer solution, the shape of the support and the method of deposition, the deposited coating will be on only one face of this support or on both faces and may even, by capillary action, fill the orifices in the support.

In order to convert the layer deposited on the support into filaments, the polymer is precipitated from its solution by the action of a fluid, generally a non-solvent from the polymer in question. For reasons of convenience and economy, water is preferably employed whenever possible, and in some cases alcohols of low molecular weight, e.g. methyl alcohol, as such or as an aqueous solution.

As stated in the foregoing, an essential requirement is that the precipitating fluid should force the polymer solution through the orifices in the support. To do this, the precipitating fluid is preferably directed substantially perpendicularly at the coated surface of the support. For this purpose, either the coated support may be immersed in the precipitating fluid and moved therein in the direction in which it offers the maximum resistance to its advance, or a jet of the precipitating fluid may be passed through the said coated support. Ordinarily the precipitating fluid will move at a speed of 0.25 to 2 m./sec. with respect to the support in a direction perpendicular to the surface of the support.

Depending on the dimensions of the orifices in the temporary support, on the nature of the precipitating fluid and the speed at which the precipitating fluid travels through the coated support, or at which the said support travels through the precipitating fluid, fibrous structures of varying fineness are obtained. More particularly, by employing relatively low speeds of travel, structures are made in which the fibres are bonded together.

The structures produced may be finished in various ways, depending on their desired use. For example, the structures formed may be isolated by collecting them in a water bath, so as to eliminate the included precipitating fluid, and, after drying either used directly or subjected to a calendering, optionally after impregnation with a conventional binder.

The fibrous structures prepared in accordance with the invention can be employed in all conventional applications of non-woven fabric of small thickness and good porosity, for example professional clothing, laminate supports, surfaces for laminates, insulating tapes, synthetic leathers, papers and linings.

The invention is illustrated by the following examples.

Example 1

There is prepared in the cold a solution of 30 g. of polyhexamethylene adipamide in 170 g. of 89% formic acid. This solution is deposited by a lightly contacting roller on an endless stainless steel belt having a mesh aperture corresponding to AFNOR Standard 29. This coating is reduced to 400 g. of solution per square metre by passing it over a doctor.

A current of water having a speed of travel through the said belt of 1 m./sec. is perpendicularly directed at the belt thus charged. The sheet is then detached from the belt, neutralised with a 10% sodium carbonate solution, washed, and dried.

After impregnation of the said sheet with a tetrahydrofuran solution containing 1% by weight of a linear polyurethane, it is passed through a pair of rollers, dried and then calendered under a pressure of 50 kg./cm.², by passage between two rolls heated at 130° C. There is thus obtained a sheet in which the mean diameter of the com-

ponent fibres is 10μ , and which has the appearance of leather and a "goat handle." It weighs 60 g./m.² and has good resistance to abrasion.

Example 2

A solution containing 20 g. of poly(ethylene terephthalate) in 180 g. of a mixture in equal parts by weight of phenol and 1,2-dichloroethane is prepared at 50° C. with stirring. A frame carrying a stainless steel metal cloth having a mesh aperture corresponding to AFNOR Standard 25 is immersed in this solution. The frame is withdrawn and the excess solution is then removed by passing it over a doctor.

The frame is then moved, perpendicularly to its plane, through a tank containing methyl alcohol, at a speed of 0.75 m./s. It is left in the said tank for one hour and the fibrous structure is then separated, dried and calendered under a pressure of 150 kg./cm.² by passing it between two rolls heated at 100° C. A sheet weighing 45 g./m.² is obtained, in which the mean diameter of the component fibres is 20μ .

Example 3

A solution containing 8% by weight of cellulose triacetate in a mixture of 4 parts of methylene chloride by weight and one part of ethanol by weight is prepared, and deposited, as in Example 1, on a stainless steel belt, AFNOR Standard 29, at a rate of 450 g. per square metre.

The belt is then moved perpendicularly to its plane through a tank containing methyl alcohol at a speed of 0.50 m./s.

The fibrous mat is left in the said tank for 10 minutes and then separated and dried at 80° C. A sheet is obtained which weighs 36 g./m.² and in which the mean diameter of the component fibres is about 20μ .

I claim:

1. Process for the production of a non-woven fibrous structure which comprises forming a layer of a solution of a fibre-forming polymer on the surface of a temporary support containing perforations corresponding to the size of the fibres desired, forcing the said solution through the said perforations with a fluid which precipitates the polymer from the solution, and separating the non-woven fibrous polymer structure thus formed from the support.

2. Process according to claim 1, wherein the fibre-forming polymer is a polyamide.

3. Process according to claim 2, wherein the polyamide is used in solution in formic acid, and the said fluid is water.

4. Process according to claim 1, wherein the fibre-forming polymer is a poly(ethylene terephthalate).

5. Process according to claim 4, wherein the poly(ethylene terephthalate) is used in solution in a mixture of phenol and 1,2-dichloroethane in equal parts by weight and the said fluid is methyl alcohol.

6. Process according to claim 1, wherein the fibre-forming polymer is cellulose triacetate.

7. Process according to claim 6, wherein the cellulose triacetate is used in solution in a mixture of 4 parts by weight of methylene chloride and 1 part by weight of ethyl alcohol, and the said fluid is methyl alcohol.

8. Process according to claim 1, wherein the temporary support is a metal cloth of mesh size 0.1 mm. to 2 mm.

9. Process according to claim 8, wherein the said fluid

moves at a speed of 0.25 to 2 m./sec. with respect to the support carrying the layer of the polymer solution in a direction perpendicular to the surface of the support.

10. Process for the production of a non-woven fibrous structure which comprises forming a layer of a solution of a synthetic linear polyamide on the surface of a metal cloth of mesh size 0.1 mm. to 2 mm., forcing the said solution through the perforations in the metal cloth with a fluid which precipitates the polyamide from the solution, and separating the non-woven fibrous polyamide structure thus formed from the cloth.

11. Process for the production of a non-woven fibrous structure which comprises forming a layer of a solution of a poly(ethylene terephthalate) on the surface of a metal cloth of mesh size 0.1 mm. to 2 mm., forcing the said solution through the perforations in the metal cloth with a fluid which precipitates the poly(ethylene terephthalate) from the solution, and separating the nonwoven fibrous poly(ethylene terephthalate) structure thus form the cloth.

12. Process for the production of a non-woven fibrous structure which comprises forming a layer of a solution of a cellulose triacetate on the surface of a metal cloth of mesh size 0.1 mm. to 2 mm., forcing the said solution through the perforations in the metal cloth with a fluid which precipitates the cellulose triacetate from the solution, and separating the non-woven fibrous cellulose triacetate structure thus formed from the cloth.

13. Process for the production of a non-woven fibrous structure which comprises forming a layer of a solution of a synthetic linear fibre-forming polyamide in formic acid on the surface of a metal cloth of mesh size 0.1 mm. to 2 mm., forcing the said solution through the metal cloth with water moving at a speed of 0.25 to 2 m./sec. in a direction perpendicular to the surface of the support so as to precipitate the polyamide, and separating the non-woven fibrous polyamide structure thus formed from the cloth.

14. Process for the production of a non-woven fibrous structure which comprises forming a layer of a solution of a poly(ethylene terephthalate) in a mixture in equal weights of phenol and 1,2-dichloroethane on the surface of a metal cloth of mesh size 0.1 mm. to 2 mm., forcing the said solution through the metal cloth with methyl alcohol moving at a speed of 0.25 to 2 m./sec. in a direction perpendicular to the surface of the support so as to precipitate the poly(ethylene terephthalate), and separating the non-woven fibrous poly(ethylene terephthalate) structure thus formed from the cloth.

15. Process for the production of a non-woven fibrous structure which comprises forming a layer of a solution of cellulose triacetate in a mixture of 4 parts by weight of methylene chloride to 1 part by weight of ethyl alcohol on the surface of a metal cloth of mesh size 0.1 mm. to 2 mm., forcing the said solution through the metal cloth with methyl alcohol moving at a speed of 0.25 to 2 m./sec. in a direction perpendicular to the surface of the support so as to precipitate the cellulose triacetate, and separating the non-woven fibrous cellulose triacetate structure thus formed from the cloth.

No references cited.

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