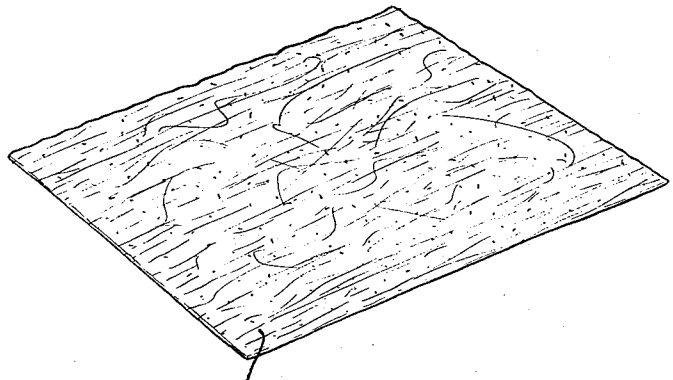
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RESILIENT NON-WOVEN TEXTILE MATERIALS

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Non-Woven textile material bonded with thermosetting resin and thermoplastic tripolymeric binder

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RESILIENT NON-WOVEN TEXTILE MATERIALS

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The present invention relates to the production of non-woven textile materials and more particularly to the production of non-woven textile materials which are resilient, dimensionally stable and relatively unaffected structurally by laundering or dry cleaning. Another aspect of the present invention relates to the improved resilient, dimensionally and structurally stable non-woven textile materials themselves and to the textile uses of the same.

Non-woven fabrics of various types have become increasingly important in the textile field, primarily because of their low cost of manufacture, as compared to the cost of fabrics formed by weaving or knitting spun fibers. Such non-woven fabrics have also been found particularly suitable for applications where launderability is not a prerequisite, especially in the case of finished products that are used once and then discarded, as for example, sanitary napkins, surgical dressings, casket liners, table napkins, shoe-shine cloths, dusting cloths, hand towels, diapers, drapery fabrics, and the like.

Non-woven fabrics are conventionally manufactured at the present time by several different methods. One of the more commonly used methods comprises producing a more or less tenuous web of loosely associated carded textile fibers, followed by the lamination of several of these card webs together to form a somewhat more self-sustaining sheet weighing from about 100 to about 4000 grains or more per square yard. This essentially two-dimensional web or sheet of fibers has its fibers substantially parallelized or oriented in the "machine direction," i.e., the direction in which the product moves continuously from the sheet-forming machine. In such a web, the degree of fiber orientation may range from about 70% to about 90%, with the remainder of the fibers being "non-oriented" or more or less randomly disposed in overlapping intersecting arrangement.

Other methods of preparing non-woven webs of corresponding weights suitable for conversion into fabrics applicable to the present invention comprise the use of fluids such as air or water to deposit the fibers and form a web wherein the fibers are in a haphazard intersecting arrangement. Such may be accomplished by processing techniques such as described in U.S. Patents 2,676,363 and 2,676,364. Such non-woven fabrics are substantially isotropic and possess like physical properties in all directions.

The conventional fibrous materials for such non-woven webs are usually cellulosic and comprise any of the common textile-length or staple fibers, such as cotton, viscose or cuprammonium rayon, cellulose acetate, or mixtures thereof. These fibers vary from approximately one-half inch to about three inches in length, with the denier of the rayon and acetate fibers being in the range of from about 1½ to about 15.

These non-woven webs, unfortunately, regardless of how they are formed, are not basically self-sustaining as they are intially formed by the textile equipment and lack dimensional and structural stability. Such inherent disadvantages have been overcome to a considerable extent by subjecting the non-woven web to various subsequent bonding operations wherein impregnation with binder agents in overall fashion or in patterns of spots, lines, dots or annuli have increased the dimensional and structural stability thereof.

Additionally, the non-woven webs, as originally manufactured, are limp and flaccid and yield to pressure all too readily and without resistance, resilience, bounce, or "spring-back." Applications of binder materials have also changed this to some extent but in many cases have resulted either in fabrics which are lightly impregnated and incapable of withstanding laundering and washing, or fabrics which are more heavily impregnated but which are undesirably stiff and boardy.

Another objection to many of the prior art non-woven fabrics manufactured from such webs is the lack of color-fastness and poorness of resistance to gas fading.

It is therefore a principal purpose of the present invention to provide a non-woven fabric which is not limp or flaccid but is desirably resilient without being undesirably stiff or boardy.

It is a further principal purpose of the present invention to provide a non-woven fabric which is dimensionally and structurally stable whereby it can be successfully and repeatedly washed or laundered without falling apart or disintegrating.

It is another principal purpose of the present invention to provide a non-woven fabric which is color-fast and non-gas fading.

Such purposes may be accomplished in these non-woven webs by employing more resilient fibers such as wool, nylon and other fibrous synthetic non-cellulosic fibers in place of all or a part of the less resilient cellulosic fibers previously used and by coating or impregnating the resulting non-woven web with a mixture containing a thermosetting synthetic resin and a thermoplastic tripolymeric binding agent.

The present invention wil be illustrated and described with reference to the drawing wherein the figure is a fragmentary perspective showing of a portion of a non-woven textile material bonded with a thermosetting synthetic resin and a thermoplastic synthetic tripolymeric binder agent.

Although wool and nylon have been referred to in the preceding paragraph as examples of the more resilient fibers which are used in the production of the non-woven webs of the present invention, it is to be observed that other fibrous synthetic materials are also of use provided they possess more resilience than the cellulosic fibers referred to herein. Representative of such other synthetic fibrous materials are zein ("Vicara"), polytetrafluoroethylene ("Teflon"), polyester ("Dacron"), vinyl chloride-vinyl acetate ("Vinyon"), vinylidene chloride ("Saran" and "Velon"), polyethylene, and vinyl-acrylics "Dynel" and "Vinyon N"), the acrylics ("Orlon," "Acrylan," "Creslan" and "Acrylast"), glass ("Fiberglas"), and the like. The denier of these synthetic fibers is on the order of from 1¼ to about 15 and preferably from about 3 to about 6, with their lengths varying from about ½ inch to about 3 inches, and preferably from about 1 inch to about 2 inches.

With regard to the term "resilience" as used in this specification, such a term relates to that property of a material which enables it to do work against restraining forces during return from a deformed state. More specifically, it is a term relating to the hand or the crease and wrinkle resistance of fabrics, and refers to their ability to recover from deformation. Resilience may be flexural, compressional, extensional or torsional and evaluations thereof range from springy (high) to limp (low). The resilience of fibers may be evaluated in many ways, none of which has been found to be very precise or highly accurate, the most common being by determining their recovery and permanent set from a deforming strain.

The following table sets forth the comparative prop-

erties of various fibers with regard to their immediate elastic recovery, their delayed recovery after one hour and any permanent set created therein after a 5% elongation has been imposed thereon.

TABLE I

Fiber	Immediate Elastic Recovery	Delayed Recovery	Permanent Set
Viscose	40	49	11
Cotton 50/1	44	46	10
Cotton 12/1	40	50	10
Polyester	42	51	7
"Vinyon"	42	52	6
Zein	59	37	4
"Orlon"	40	59	1
Casein	41	59	0
"Saran"	49	51	0
Human Hair	60	40	0
Nylon	51	49	0
Wool	40	60	0

From Table I, it is to be noted that the less resilient cellulosic fibers fall into a group wherein the permanent set after a 5% strain is 10% or more. The more resilient non-cellulosic fibers are to be noted as having permanent sets after 5% strain of 7% or less, and in most cases, substantially zero permanent set, the latter characteristic being particularly applicable to the nitrogen-containing fibers such as casein, human hair, nylon and wool, possessing negligible permanent sets.

Another method has employed a 2% elongation basis wherein the values for elastic recovery are obtained at 20° C. and 65% relative humidity, with the rate of loading being 10 grams per denier per minute, the duration of action of load being 30 seconds and the recovery time 60 seconds. Table II sets forth the fibers tested and their elastic recoveries.

TABLE II

2 percent strain (elongation)

Material:	Recovery, percent
Cotton	74
Viscose rayon—regular	82
Viscose rayon—medium tenacity	82
Viscose rayon—high tenacity	82
Saponified acetate rayon	82
Cellulose acetate	94
"Creslan" acrylic	95
"Orlon" acrylic	97
"Dacron" polyester	97
"Vinyon" regular	99
Wool	99
Zein	100
Nylon regular	100
Glass	100

From Table II, it is to be noted that the less resilient cellulosic fibers fall into a group wherein the percent recovery after a 2% strain is 94% or less of the original length. The more resilient non-cellulosic fibers are to be noted as having percent recovery after a 2% strain of 95% or more of the original length.

The non-woven textile webs of the present invention normally comprise mixtures of the desired fibers in a range of from about 25% to about 100% by weight of the more resilient non-cellulosic fibers and from about 75% to a negligible amount or even 0% by weight of the less resilient cellulosic fibers. Within the more commercial aspects of the present invention, the non-cellulosic fibers are present in the mixture in an amount of from about 35% to about 90% by weight and the cellulosic fibers are present in an amount of from about 65% to about 10% by weight. Mixtures of 50%–50% proportions have been found to be generally desirable on an over-all basis. Substantially any more resilient non-cellulosic fiber may be selected for the mixture, providing it creates the resiliency characteristics desired in the product.

Nylon is an excellent example of such a synthetic more resilient non-cellulosic fiber and it is to be noted that the term "nylon" is intended to cover all polymeric polyamides produced by any of the known processes known to the industry. Among the more common of these polyamides are nylon-6/6 (hexamethylenediamine-adipic acid), nylon-6/10 (hexamethylenediamine-sebacic acid), nylon-6 (polycaprolactam) and nylon-11 (castor oil derivative, 11-amino undecanoic acid).

As noted above, the mixture of cellulosic and non-cellulosic fibers in the non-woven web is treated with a mixture of a thermosetting synthetic resin and a thermoplastic binding agent which will be defined more specifically in the following paragraphs.

The thermosetting synthetic resin may be selected from substantially any thermosetting resin capable of cooperating with the thermoplastic binder agent to yield the desired properties of launderability and dry cleaning resistance in the non-woven fabric. Condensation products wherein an aldehyde is a reactant are particularly applicable. For example, the thermosetting resin may be a material selected from the group comprising melamine-formaldehyde, the methylated or methyl alcohol-reacted methylol melamines, urea-formaldehyde, phenol-formaldehyde, dicyandiamide formaldehyde, resorcinol formaldehyde, acetone-formaldehyde, phenol furfural, etc.

The thermoplastic binding agent which is used in the mixture adheres the fibers together whereby the required dimensional and structural stability of the non-woven fabric is obtained with the addition of the thermosetting resin. Such thermoplastic binding agents are soft and rubbery and are tripolymeric materials prepared from three monomers, one from each of the following groups: (1) a lower alkyl ester of acrylic acid wherein said alkyl group contains from one to four carbon atoms, such as methyl acrylate, ethyl acrylate, n-propyl acrylate, isopropyl acrylate, n-butyl acrylate, isobutyl acrylate, sec.-butyl acrylate, etc., or mixtures thereof; (2) an alkylene diester of an alkenoic acid wherein said akylene group contains from two to four carbon atoms, such as ethylene diacrylate, ethylene dimethylacrylate, propylene diacrylate, propylene dimethylacrylate, etc., or mixtures thereof; and (3) an alkenoic acid containing from three to five carbon atoms, such as acrylic acid, methacrylic acid, ethacrylic acid, etc. or mixtures thereof.

The proportions by weight of the individual monomers used in the preparation of the tripolymeric binding agent may be varied according to the requirements of the particular situation. In the case of the lower alkyl ester of acrylic acid, from about 94% to about 99.9% has been found satisfactory, with the more commercial ranges being from about 97% to about 99.8%. In the case of the alkylene diester of the alkenoic acid, a range of from about 0.05% to about 2% has been found satisfactory, with the more commercial ranges being from about 0.1% to about 1% by weight. In the case of the alkenoic acid, a range of from about 0.05% to about 4% has been found satisfactory, with the more commercial ranges being from about 0.1% to about 2% by weight.

Although it is preferred that the coating or impregnant mixture be applied to the web so that it will constitute from about 20% to about 65% by weight (dry solids basis) of the weight of the finished fabric, a range of from about 30% to about 55% by weight is preferred in the commercial applications of the present invention. Percentages up to 75% or more are usable where increased resistance to washability and dry cleaning is desired, although it is to be stated that at such higher percentages other properties and advantages suffer.

In this mixture of thermoplastic and thermosetting materials, the proportions of these materials should be so adjusted that the thermoplastic synthetic tripolymeric binding agent is present in an amount equal to from about

1½ to about 20 times the weight of the thermosetting synthetic resin. Within the more commercial aspects of the present invention, however, the thermoplastic binding agent should be present in an amount equal to from about 1½ to about 8 times the weight of the thermosetting synthetic resin, with the optimum results being obtainable at a ratio of about 3½ parts of thermoplastic binding agent for each part of thermosetting synthetic resin.

The mixture of thermoplastic and thermosetting materials may be applied to the non-woven fabric by any means known to the industry. For example, if the thermosetting and thermoplastic materials are to be applied in the form of an aqueous dispersion, the dry or substantially dry non-woven fabric to be impregnated may be dipped or immersed in the dispersion to provide sufficient wet pick-up of the mixture. The wetted-out material then passes through pressure-applying rolls to secure a substantially uniform impregnation and a controlled application of the desired amount of dispersion. If desired or required, the non-woven fabric may be impregnated by any other methods known in the art. Another such method would include spraying brushing, and the like.

The wet impregnated non-woven fabric is dried and cured in the usual manner known to the art. The drying and curing temperatures may be varied considerably depending upon the particular thermosetting resin in the mixture. Ordinarily, however, temperatures within the range of from about 250° F. to about 400° F. are employed. The impregnated fabric may be initially dried at a relatively low temperature on the order of from about 200° F. to about 220° F. to remove all or a portion of the water, after which the dried or partially dried non-woven fabric is heated for a shorter period at a temperature within the range of from about 250° F. to about 400° F. to convert the thermosetting material to a substantially water-insoluble condition. The drying and curing operations are flexible and may be varied to suit the available equipment. Other methods naturally may be employed.

The invention will be further illustrated in greater detail by the following specific examples. It should be understood, however, that although these examples may describe in particular detail some of the more specific features of the invention, they are given primarily for purposes of illustration and the invention in its broader aspects is not to be construed as limited thereto.

EXAMPLE I

In this example, the non-woven fabric comprises 50% nylon (3–6 denier, 2 inch length) and 50% rayon, 1½ denier, 2 inch length. The fiber web is isotropic, with the fibers therein randomly distributed. The fiber web has a total weight of 580 grains per square yard.

The impregnating bath comprises the following ingredients:

Component:	Pounds
Ethyl acrylate (98%), ethylene dimethylacrylate (0.4%), acrylic acid (1.6%) (46% solids)	121
Dioctyl phthalate	16
Titanium dioxide pigment	32
Melamine formaldehyde (80% solids)	18
Dicyandiamide	1
Accelerator	1
Thickener	10
Water	246

The non-woven web is passed through the impregnating bath and then through a drying and curing oven for 6 minutes at about 325° F. The dried non-woven fabric weighs 870 grains per square yard, indicating a binder add-on of 290 grains per square yard. The fabric is resilient, dimensionally stable and is relatively unaffected structurally by laundering or dry cleaning. It possesses stability to light and good resistance to gas fading. When used as an interlining for fabrics such as collars, lapels, etc., it is found excellent.

EXAMPLE II

The procedures set forth in Example I are followed substantially as set forth therein except that ethylene diacrylate is substituted for the ethylene dimethacrylate.

EXAMPLE III

The procedures set forth in Example I are followed substantially as set forth therein except that methacrylic acid is substituted for the acrylic acid.

EXAMPLE IV

The procedures set forth in Example I are followed substantially as set forth therein except that butyl acrylate is substituted for the ethyl acrylate.

EXAMPLES V–X

The procedures set forth in Example I are followed substantially as set forth therein except that the proportions of the thermoplastic binder agent (TP), the thermosetting resin (TS) and other solids (OS) are varied as follows:

Example	5	6	7	8	9	10
Percent TP	26	29	30	60	78	168
Percent TS	15	10	19	25	30	31
Percent OS	8	10	9	19	21	19
Wt. TP	159	176	155	313	372	740
Wt. TS	91	60	97	128	148	135
Wt. OS	50	64	48	99	100	85
Wt. Web	620	620	520	520	480	440
Wt. Fabric	920	920	820	1,060	1,100	1,400

All weights are in grains per square yard; the percentages of the add-on ingredients are based on the weight of the non-woven web.

The properties of the finished non-woven fabric are as follows:

Example	5	6	7	8	9	10
Bounce	Good	Good	Fair	Good	Good	Good.
Crease Resistance	Good	Good	Fair	Good	Fair	Fair.
Softness-Stiffness	Stiff	Good	Fair	Good	Stiff	Good.
Dry Cleaning Resistance.	Good	Good	Good	Good	Good	Good.
Shrinkage	None	None	None	None	None	None.
Color	White	White	White	White	White	White.

EXAMPLE XI

The procedures set forth in Example I are followed substantially as set forth therein except that the thermosetting resin is omitted. The results are as follows:

Percent TP	104.
Percent TS	0 (omitted).
Percent OS	9.
Wt. TP	461.
Wt. TS	0 (omitted).
Wt. OS	40.
Wt. web	440.
Wt. fabric	940.
Bounce	Very poor.
Crease-resistance	Do.
Softness-stiffness	Good.
Dry cleaning resistance	Poor.
Shrinkage	Good.
Color	White.

EXAMPLE XII

The procedures set forth in Example I are followed substantially as set forth therein with the exception that the non-woven fabric comprises a mixture of 50% "Dacron" (ethylene glycol-terephthalic acid polyester) (3–6 denier) and 50% cellulose acetate fibers. The fabric is useful as a resilient interlining for garments. It is capable of resisting repeated washing and dry cleaning and demonstrates excellent dimensional and structural stability.

EXAMPLE XIII

The procedures set forth in Example I are followed substantially as set forth therein with the exception that the non-woven fabric comprises a mixture of 50% "Dacron" (3–6 denier), 25% cellulose acetate, and 25% cotton fibers. The fabric is useful as a resilient interlining for garments. It is capable of resisting repeated washing and dry cleaning and demonstrates excellent dimensional and structural stability.

EXAMPLE XIV

The procedures set forth in Example I are followed substantially as set forth therein with the exception that the non-woven fabric comprises a mixture of 25% viscose rayon, 25% "Dacron," 25% nylon (3–6 denier) and 25% cotton fibers. The fabric is useful as a resilient interlining for garments. It is capable of resisting repeated washing and dry cleaning and demonstrates excellent dimensional and structural stability.

EXAMPLE XV

The procedures set forth in Example I are followed substantially as set forth therein with the exception that the non-woven fabric comprises 100% cotton fibers.

EXAMPLES XVI–XVII

In these examples, the following formulation is used:

Component:	Pounds
TP as in Example I (46% solids)	233
Dioctyl phthalate	15
Urea formaldehyde (85% solids)	33
Accelerator	1
Pigment	40
Water	68

Drying and curing is effected at a rate of 10 yards per minute and a total drying time of 4 minutes. The temperature is in the range of 260°–300° F. The web weight is 700 grains per square yard and comprises (Example XVI) 50% 3-denier "Dacron" and 50% 2-denier cellulose acetate and (Example XVII) 25% 3-denier "Dacron," 25% 6-denier "Dacron" and 50% 2-denier cellulose acetate. The add-on is 450 grains per square yard. The total non-woven fabric weight is 1150 grains per square yard.

The fabrics are evaluated with the following results:

Property	Example XVI	Example XVII
Hand	Soft, fabric-like.	Soft, fabric-like.
Color Stability	Excellent	Excellent.
Opacity	Good	Good.
Resilience	Fair	Good.
Bulk	0.021	0.022.
Dry Cleaning Resistance	Satisfactory	Satisfactory.
Discoloration on Dry Cleaning	None	None.
Washing Resistance	Fair	Fair.
Washing Resistance after Curing	Good	Good.

Although several specific examples of the inventive concept have been described, the same should not be construed as limited thereby nor to the specific substances mentioned therein but to include various other compounds of equivalent constitution as set forth in the claims appended hereto. It is understood that any suitable changes, modifications and variations may be made without departing from the spirit and scope of the invention.

What is claimed is:

1. A resilient non-woven textile material comprising a fibrous web containing a mixture of from about 25% to about 100% by weight of non-cellulosic fibers and from about 75% to about 0% by weight of cellulosic fibers and a stabilizing and binder mixture substantially uniformly distributed throughout said web comprising a thermosetting synthetic resin and a thermoplastic synthetic tripolymeric binder agent prepared from (1) a lower alkyl ester of acrylic acid wherein said alkyl group contains from one to four carbon atoms, (2) an alkylene di-ester of an alkenoic acid wherein said alkylene group contains from two to four carbon atoms and (3) an alkenoic acid containing from three to five carbon atoms.

2. A resilient non-woven textile material as defined in claim 1 wherein the mixture of fibers comprises from about 35% to about 90% by weight of non-cellulosic fibers and from about 65% to about 10% by weight of the cellulosic fibers.

3. A resilient non-woven textile material as defined in claim 1 wherein the non-cellulosic fibers comprise nylon and the cellulosic fibers comprise cotton.

4. A resilient non-woven textile material as defined in claim 1 wherein the non-cellulosic fibers comprise nylon and the cellulosic fibers comprise viscose rayon.

5. A resilient non-woven textile material as defined in claim 1 wherein the stabilizing and binder mixture constitutes from about 20 to about 65% of the weight of the textile material.

6. A resilient non-woven textile material as defined in claim 1 wherein the thermoplastic binder agent is present in an amount equal to from about 1½ to about 20 times the weight of the thermosetting resin.

7. A resilient non-woven textile material comprising a fibrous web containing a mixture of from about 25% to about 100% by weight of non-cellulosic fibers and from about 75% to about 0% by weight of cellulosic fibers and a stabilizing and binder mixture substantially uniformly distributed throughout said web comprising a thermosetting synthetic resin and a thermoplastic synthetic tripolymeric binding agent prepared from (1) ethyl acrylate; (2) ethylene dimethacrylate, and (3) acrylic acid.

8. A resilient non-woven textile material comprising a fibrous web containing a mixture of from about 25% to about 100% by weight of non-cellulosic fibers and from about 75% to about 0% by weight of cellulosic fibers and a stabilizing and binder mixture substantially uniformly distributed throughout said web comprising a thermosetting synthetic resin and a thermoplastic synthetic tripolymeric binder agent prepared from (1) ethyl acrylate; (2) ethylene diacrylate, and (3) acrylic acid.

9. A resilient non-woven textile material comprising a fibrous web containing a mixture of from about 25% to about 100% by weight of non-cellulosic fibers and from about 75% to about 0% by weight of cellulosic fibers and a stabilizing and binder mixture substantially uniformly distributed throughout said web comprising a thermosetting synthetic resin and a thermoplastic synthetic tripolymeric binding agent prepared from (1) ethyl acrylate; (2) ethylene dimethacrylate, and (3) methacrylic acid.

10. A resilient non-woven textile material comprising a fibrous web containing a mixture of from about 25% to about 100% by weight of non-cellulosic fibers and from about 75% to about 0% by weight of cellulosic fibers and a stabilizing and binder mixture substantially uniformly distributed throughout said web comprising a thermosetting synthetic resin and a thermoplastic synthetic tripolymeric binding agent prepared from (1) butyl acrylate; (2) ethylene dimethacrylate, and (3) acrylic acid.

11. A resilient non-woven textile material comprising a fibrous web and a stabilizing and binder mixture substantially uniformly distributed throughout said web comprising a thermosetting synthetic resin and a thermoplastic synthetic tripolymeric binder agent prepared from: (1) about 94% to about 99.9% of a lower alkyl ester of acrylic acid wherein said alkyl group contains from one to four carbon atoms; (2) about 0.05% to about 2% of an alkylene di-ester of an alkenoic acid wherein said alkylene group contains from two to four carbon atoms; and (3) about 0.05% to about 4% of an alkenoic acid containing from three to five carbon atoms, said percentages being by weight.

12. A resilient non-woven textile material comprising

a fibrous web containing a mixture of from about 25% to about 100% of non-cellulosic fibers and from about 75% to about 0% of cellulosic fibers and a stabilizing and binder mixture substantially uniformly distributed throughout said web comprising a thermosetting synthetic resin and a thermoplastic synthetic tripolymeric binder agent prepared from: (1) about 94% to about 99.9% of a lower alkyl ester of acrylic acid wherein said alkyl group contains from one to four carbon atoms; (2) about 0.05% to about 2% of an alylene di-ester of an alkenoic acid wherein said alkylene group contains from two to four carbon atoms; and (3) about 0.05% to about 4% of an alkenoic acid containing from three to five carbon atoms, said percentages being by weight.

13. A resilient non-woven textile material comprising a fibrous web and a stabilizing and binder mixture substantially uniformly distributed throughout said web consisting of a thermosetting synthetic resin and a thermoplastic synthetic tripolymeric binder agent prepared from: (1) about 94% to about 99.9% of a lower alkyl ester of acrylic acid wherein said alkyl group contains from one to four carbon atoms; (2) about 0.05% to about 2% of an alkylene di-ester of an alkenoic acid wherein said alkylene group contains from two to four carbon atoms; and (3) about 0.05% to about 4% of an alkenoic acid containing from three to five carbon atoms, said percentages being by weight.

14. A resilient non-woven textile material comprising a fibrous web containing a mixture of from about 25% to about 100% of non-cellulosic fibers and from about 75% to about 0% of cellulosic fibers and a stabilizing and binder mixture substantially uniformly distributed throughout said web consisting of a thermosetting synthetic resin and a thermoplastic synthetic tripolymeric binder agent prepared from: (1) about 94% to about 99.9% of a lower alkyl ester of acrylic acid wherein said alkyl group contains from one to four carbon atoms; (2) about 0.05% to about 2% of an alkylene di-ester of an alkenoic acid wherein said alkylene group contains from two to four carbon atoms; and (3) about 0.05% to about 4% of an alkenoic acid containing from three to five carbon atoms, said percentages being by weight.

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