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## (54) Method for making a thermally insulating wadding useful for clothing and upholstery.

(57) The present invention relates to a method for making an improved thermal insulation characteristic wadding, particularly designed for making cloth, furniture and the like articles, which comprises the step of preparing, by means of carding machines, a lap consisting of a mixture of polyester or other nature fibres, which have been possibly siliconized, and subjecting this lap to a subsequent resin treating step, on at least a face thereof, by using cross-linked glues.

The resin treated lap is then calendered, under controlled temperature and pressure conditions, so as to obtain, on its surface, a soft and resilient film and, inside it, an air chamber so as to provide a low thermal exchange coefficient and, accordingly, a proper temperature controlling of the body temperature.

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# A METHOD FOR MAKING AN IMPROVED THERMAL INSULATION CHARACTERISTIC WADDING, PARTICULARLY FOR MAKING CLOTH, FURNITURE AND THE LIKE ARTICLES

## BACKGROUND OF THE INVENTION

The present invention relates to an improved method for making a wadding having improved thermal insulation characteristics, particularly designed for making cloth, furniture and the like articles.

In a preceding Italian Patent Application of the same Applicant (Italian Patent Application No. 20,978 A/84 filed on May 17, 1984), which is included therein by reference, there has been illustrated a method for making a wadding to be used in the cloth and furnishings or furniture fields, which essentially comprises the step of mixing preferably polyether and siliconized polyester fibres so as to provide, upon a carding treatment, a soft lap.

This lap is then overcoated, on one of its faces or both its faces, by a glue mixture, of a specifically designed formulation, so as to provide, upon cross-linking, a very soft and resilient film on said surfaces.

The thus processed lap is then subjected to a calendering step, under variable temperatures and pressures, in order to substantially reduce its starting thickness.

During the calendering step, for a very reduced preset time, one of the cylinders of the calendering machine is held into contact with the surface being processed so as to provide an expansion thereof able of substantially forming an air chamber in the inside of the wadding.

The above illustrated wadding has greatly improved thermal insulation characteristics, with respect to the thermal insulation characteristics of the prior art waddings which, usually, have a very high thickness which prevents these prior art waddings from being suitably applied in the cloth field.

While the wadding according to the above mentioned Italian Patent Application has provided good results, it has been found that its characteristics could be further improved.

## SUMMARY OF THE INVENTION

Accordingly, the main object of the present invention is to provide a method for further improving the thermal insulation characteristics of the aforesaid wadding so as to facilitate the production of a more compact article of manufacture which may be easily used in the cloth field.

Another object of the present invention is to provide a method for making waddings which, in addition to having a very good thermal insulation, also afford the possibility of dynamically adjusting the body temperature.

Another object of the present invention is to provide a method for making waddings which may be simply and quickly carried out and which, moreover, can provide an aesthetically valid product susceptible to be easily processed during the cloth manufacturing steps.

According to one aspect of the present invention, the above mentioned objects, as well as yet other objects, which will become more apparent thereinafter, are achieved by a method for making an improved thermal insulation characteristic wadding, particularly designed for making cloth and the like articles, characterized in that it comprises the steps of:

providing, by means of carding or other suitable machines, a lap obtained from a mixture of polyester or other nature, possibly siliconized fibres;

resin treating the thus provided lap, on at least a surface thereof, by using cross-linked structure glues;

calendering the resin treated lap under controlled temperature and pressure conditions in order to provide, on its surface, a film and, in its inside, an air chamber, so as to obtain a low thermal exchange coefficient and a dynamic adjusting of the body temperature.

It should be apparent that the above dissclosed method may also be applied to laps which have been obtained from other synthetic fibres, in addition to the polyester fibers, such as, for examples, acrylic fibres, polyamide fibres, polyolefine fibres and the like, as well as other natural fibres, such as vegetable and animal fibres.

In order to resin treat the lap, there are used specifically designed glues, the chemical formulation of which is very important to obtain the above mentioned thermal insulation and aesthetical characteristics.

Preferably, the glues used in the method according to the invention, consist of emulsions of aliphatic and aromatic polyurethane resins, both from polyethers and polyesters, and acrylic or metaacrylic

copolymers, ethylene-vinilacetate copolymers, styrene, butadiene copolymers, butadiene-acrylonitrile copolymers, natural rubber latex and other products, having a low glass transition temperature (Tg) and low filming temperatures, adding with cross-linking agents, surfactant agents, antifoaming agents, slipping and the like agents, in order to facilitate the application of the lap and increase the properties of the fibres.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Thereinbelow there are given some indicative but not limitative examples of primary glue formulation emulsions.

TABLE 1

EMULSION EXAMPLE

| EMULSION | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| Chemical nature | Aromatic polyurethane resin | Aliphatic polyuretanic resin (Polyether) | Aliphatic polyurethane resin (polyester) | Ethylene-vinyl acetate copolymers | Acrylic copolymers | Styrene-butadyene copolymers |
| Solids contents % | 40 | 40 | 40 | 52 | 49 | 52 |
| Density $g/cm^3$ | 1.06 | 1.02 | 1.04 | 1.05 | 1.05 | 1.06 |
| pH | 8.5 | 7.7 | 9.5 | 4.5 | 3.2 | 10.4 |
| Viscosity mpa.s | 70 | 50-100 | 200-900 | 50-350 | 40 | 30 |
| Particle size /um | 0.2 | 0.35 | 0.015 | 0.25 | - | - |
| Filming temperature °C | 9 | - | - | 0 | 0 | 0 |
| Type of dispersion | anionic | anionic | anionic | non ionic | anionic | anionic |
| Tg °C (glass transition tempereautre of the film) | -46 | -60 | -56 | - | -12 | -31 |

Emulsion
A= Ex.: Luphen D 200 A - BASF
B= Ex.: WC-6534 - Wilmington Chem. Corp.
C= Ex.: Wo- 6501 -
D= Ex.: Vinnapas EN 428 - Wacker
E= Ex.: Polysar Latex 0149 - Polysar
F= Ex.: Polysar Latex 5162 - Polysar

TABLE 2

Examples of glues

| Example N° | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Glue A p.p. | 100 | - | - | - | - | - | 50 | 50 | 50 | 50 | - | - |
| " B " | - | 100 | - | - | - | - | - | - | - | - | 50 | - |
| " C " | - | - | 100 | - | - | - | - | - | - | - | - | 50 |
| " D " | - | - | - | 100 | - | - | - | 50 | - | - | - | - |
| " E " | - | - | - | - | 100 | - | 50 | - | 50 | - | 50 | - |
| " F " | - | - | - | - | - | 100 | - | - | - | 50 | - | 50 |
| Deionized water | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| a) Antifoaming agent | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| b) Surfactant | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| c) Cross-linking agent | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 |
| d) Slipping agent | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| a) Ex. = | Nopco | NXZ | -Nopco | | | | | | | | | |
| b) " | Triton | x 100 | -Rohm and Haus | | | | | | | | | |
| c) " | Basona | A270 | - BASF | | | | | | | | | |
| d) " | Cirrasol | | -I.C.I. | | | | | | | | | |

TABLE 3

Characteristics of sprayed waddings

| Example | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hand | soft elastic | soft elastic | soft elastic | soft | plastic | soft | soft elastic | soft elastic | soft elastic | soft elastic | soft elastic | soft elastic |
| Slippery Characteristics | good | good | good | good | good | good | good | good | good | good | good | good |
| Pile Embedding | very good | very good | very good | good | good | good | good | good | good | good | good | good |
| Thermal coibency in UCT according to UN1597/67 | 30,6 | 30,2 | 30,0 | 28,2 | 29,3 | 28,6 | 30,0 | 29,8 | 30,2 | 30,0 | 28,8 | 29,4 |
| Hot Water Test T% (IRD+) | 25 | 23 | 24 | 20 | 22 | 19 | 22 | 20 | 23 | 20 | 21 | 18 |

See the enclosed test disclosure.

From an examination of Table 3, there will be self evident mainly the good characteristics of thermal coibency and the good comfort performance, which may be deduced from the values obtained by subjecting the samples to a thermal dynamic test, with respect to the examples from 1 to 12.

More specifically, the thermal dynamic test has been designed for simulating the performance of the subject wadding under conditions in which the wadding has been processed starting from a rest status to an intense physical activity status.

The thermal dynamic test has been carried out by using the following method.

A high thermal conductivity plastics material vessel has been filled with a given water amount, at a temperature of at least 45 ° C.

The vessel was enclosed in a jacket made from the product to be tested, and thereinto there has been introduced the probe of a digital thermometer, having a precision of ± 0.05 ° C.

The vessel has been plugged with a cork or other insulating material plug and arranged on an insulating base so as to prevent heat from disperding in different directions from those covered by the product to be tested; the assembly has been subsequently arranged in an environment at a temperature of 0 ° C.

In order to stabilize the system the temperature of the water is left to reach 41 ° C.

Starting from this time, at intervals of a precise minute, the water temperature has been sensed and noted in a suitable table; the test has been terminated after 20 minutes.

Then,the Dt's (DeltaT = temperature variation in ° C) for each of the 19 test points have been calculated, obviously starting from the second test point, so as to obtain the following illustrated Table, which represents the test results:

| time | temperature | Dt |
|---|---|---|
| 1' | t 1 | (n.a.) |
| 2' | t 2 | t 2 - t 1 |
| 3' | t 3 | t 3 - t 2 |
| ... | ... | ... |
| 19' | t19 | t19 - t18 |
| 2C' | t2C | t20 - t19 |

From an analyzation of the obtained data, and, in the case of conventional products, it should be noted that the Dt values hold nearly constant.

On the contrary, in the case of the wadding according to the present invention, all of the values of Dt remain comparatively high in the first readings, but they show a sharp decreasing (-20%) corresponding to a temperature t of about 37 ° C.

This means that the thermal dispersion is very high as the temperature is held above 37 ° C, but, as the temperature reaches 37 ° C, the thermal dispersion decreases by 20% and, accordingly, the held heat amount is greater.

From the Table, from the bottom to the top (that is from the 20th reading to the first), it is possible to clearly understand what happens as the wearer of a cloth including the padding according to the invention passes from a rest status to an intense physical activity status.

As far as the wearer is in a rest condition or not physically engaged, its body temperature is held at about 37 ° C and the subject wadding provides a maximum thermal coibency in order to assure this temperature; as the temperature increases, because of the physical activity, the same wadding provides a greater heat exchange between the wearer body and environment, thereby greatly limiting the perspiration.

A "on-fly" reading of the Table will be sufficient to show a dynamic performance; however it may be useful to calculate the so-called "dynamic response index" according to the following method:

By assuming

Dt37+ = the average value of all of the Dt corresponding to temperatures greater than 37° C
and
Dt37- = the average of all of the Dt corresponding to temperatures less than or equal to 37° C
it is possible to write

$$IRD+ = 100 \frac{(Dt37+ - Dt37-)}{Dt37-}$$

and

$$IRD- = 100 \frac{(Dt37+ - Dt37-)}{(Dt37+ - Dt37-)}$$

in which IRD+ is calculated as INCREASING of the heat loss as the temperature increases above 37° C

(by reading from t20 to t1)

IRD- is calculated as a DECREASING of the heat loss as the temperature lowers under 37° C.

(by reading from t1 to t20)

It should be apparent that since Dt37+ - Dt37-, we will have IRD- | IRD+.
On the other hand, there will be preferably used IRD+ since it is closest to the actual performance (that is an increasing of the temperature due to the physical activity).
By using the disclosed glues, to resin treat one of or both the surfaces of a lap, made by carding possibly siliconized polyester fibres, there is obtained, because of the cross-linking phenomenon related to their chemical formulation, a very soft and elastic film coating the lap.
By calendering the resin treated lap under controlled temperature and pressure conditions, in the inside of the wadding an air chamber is generated which improves the wadding thermal insulation characteristics, since it reduces the overal thermal exchange coefficient of the wadding, both with respect to the convection heat transmission and the conduction heat transmission.
In practicing the invention it has been found that the method according to the invention, in which for resin treating the laps there are used the above mentioned glue formulations, fully achieves the intended objects, since it affords the possibility of making waddings which, in addition to having very good thermal insulation properties, also have very good aesthetical characteristics, with the possibility of fitting the variable body temperature, with a consequent very high comfort for the user.
Moreover, the thus made product also has the remarkable advantage of having a high washing resistance, since it may be subjected to more than ten washing operations, which correspond to a life greater than the average life of the cloth articles.
The invention, as disclosed, is susceptible to several modifications and variations, all of which come within the scope of the inventive idea.
Moreover, in practicing the invention, all of the details may be replaced by other technically equivalent elements.

## Claims

1. A method for making an improved thermal insulation wadding, particularly designed for cloth articles and the like, characterized in that it comprises the steps of:
providing, by means of carding machines, a lap consisting of a mixture of polyester or other nature possibily siliconized fibres;

resin treating the thus provided lap on at least a side thereof, by means of a cross-linked structure glue;

calendering the resin treated lap under controlled temperature and pressure conditions so as to provide, on its surface, a film and, in its inside, an air chamber, providing a low thermal exchange coefficient and a dynamical adjusting of the body temperature.

2. A method according to the preceding Claim, characterized in that said glue substantially consists of water emulsions or dispersions of aromatic polyuretane resins.

3. A method, according to the preceding Claims, characterized in that said glue substantially consists of water emulsions or dispersions of aliphatic polyurethane resins of the polyether and/ or polyester type.

4. A method, according to one or more of the preceding Claims, characterized in that said glue substantially consists of water emulsions or dispersions of ethylene-vinylacetate copolymers.

5. A method, according to one or more of the preceding Claims, characterized in that said glue substantially consists of emulsions or dispersions of acrylic copolymers.

6. A method, according to one or more of the preceding Claims, characterized in that said glue substantially consists of emulsions or dispersions of styrene-butadiene copolymers.

7. A method, according to one or more of the preceding Claims, characterized in that said glue comprises slipping agents and/or cross-linking agents.

8. A glue for carrying out a method according to the preceding Claims, characterized in that it consists of an emulsion of polymers having a low glass transition temperature and a low filming temperature.

9. A glue, according to the preceding Claim, characterized in that it comprises surfactants.

10. A glue, according to one or more of the preceding Claims, characterized in that it comprises antifoaming agents.

11. A glue, according to one or more of the preceding Claims, characterized in that it comprises slipping agents.

12. A glue, according to one or more of the preceding Claims, characterized in that it comprises cross-linking agents.