

## HYDROPHILIC ELASTICALLY STRETCHABLE COMPOSITE SHEET

## BACKGROUND OF THE INVENTION

This invention relates to an elastically stretchable  
5 composite sheet containing hydrophilic material.

Japanese Patent Application Publication No.  
1994-184897A and Japanese Patent Application (PCT)  
Publication No. 1996-504693 describe an elastically  
stretchable composite sheet comprising an elastic sheet  
10 having stretchability and a sheet-like fibrous assembly  
having inelastic stretchability bonded together. The  
presence of the fibrous assembly enables such a composite  
sheet to offer a flexible touch desired for a topsheet in a  
wearing article such as a disposable diaper or a sanitary  
15 napkin.

The composite sheet of prior art advantageously  
eliminates a rubber touch possibly experienced by a wearer  
as the elastic sheet comes in contact with the wearer's skin  
and offers a cloth-like touch. However, the fibrous assembly  
20 constituting the composite sheet is formed, for example, with  
long fibers obtained through the melt spinning process or by  
microfibers obtained through the melt blown process. The  
composite sheet of prior art is disadvantageous in that these

fibers are not sweat-absorbent.

#### SUMMARY OF THE INVENTION

It is an object of this invention to provide an elastically stretchable composite sheet with cloth-like touch and sweat-absorbability and thereby to improve feeling to wear a wearing article using this composite sheet.

According to this invention, there is provided an elastically stretchable composite sheet having a X- and Y-directions orthogonal to each other and comprising a first sheet adapted to be elastically stretchable at least in the Y-direction and a second sheet formed with fibrous assembly adapted to be inelastically stretchable in the Y-direction and bonded to at least one surface of the first sheet.

The improvement according to this invention is in that the first and second sheets are bonded together in bonding zones arranged intermittently in the Y-direction wherein each section of the fiber forming the second sheet extending between each pair of the adjacent bonding zones is longer than a straight distance between the pair of the adjacent bonding zones and at least one of the first and second sheets contains hydrophilic material.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view showing a composite sheet according to this invention.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

5       Details of a elastically stretchable composite sheet containing hydrophilic material will be more fully understood from the description given hereunder with reference to the accompanying drawings.

10       An elastically stretchable composite sheet 1 containing hydrophilic material shown by Fig. 1 in a perspective view is suitable as a liquid-pervious or liquid-impervious topsheet used for a disposable wearing article such as a disposable diaper, a sanitary napkin or a disposable gown adapted to be used in medical site. This  
15 composite sheet 1 comprises an upper layer 2 and a lower layer 3 welded together in bonding zones 4. The composite sheet 1 is elastically stretchable preferably in X- and Y-directions orthogonal to each other or at least in the Y-direction as indicated by chain lines.

20       The upper layer 2 of the composite sheet 1 is inelastically stretchable preferably in the X- and Y-directions or at least in the Y-direction. This upper layer 2 is formed with an assembly of fibers 6 extending at least

between a pair of the bonding zones 4, 4. Such fibers 6 may be short fibers, preferably long fibers, more preferably continuous fibers. Each of these fibers 6 extending between a pair of the bonding zones 4, 4 is longer than a straight distance between these two bonding zones 4, 4 and describes an irregular curve between these bonding zones 4, 4 over the entire upper surface of the lower layer 3. Preferably, the fibers 6 are neither welded nor bonded together, i.e., separated one from another between the bonding zones 4. The upper layer 2 is inelastically stretched and the fibers 6 respectively having described curves between respective pairs of the adjacent bonding zones 4, 4 are reoriented to extend in the Y-direction between these bonding zones 4, 4 as the composite sheet 1 is stretched in the Y-direction.

Such fibers 6 may be, for example, blend of inelastic synthetic resin such as polypropylene, polyester, polyethylene or polypropylene with terpolymer of propylene, ethylene and butene. The fibers 6 may be at least partially incorporated with or coated with hydrophilic material such as sodium alkylsulfonate as hydrophilicity giving agent to make the fibers 6 hydrophilic. Each of the fibers 6 has a diameter preferably of  $0.1 \sim 50 \mu\text{m}$ , more preferably of  $0.1 \sim 20 \mu\text{m}$  and a basis weight preferably of  $2 \sim 100 \text{ g/m}^2$ , more

preferably of  $2 \sim 20 \text{ g/m}^2$ . In the illustrated embodiment, the fibers 6 are provided in the form of continuous fibers treated to become hydrophilic.

The lower layer 3 of the composite sheet 1 is  
5 elastically stretchable preferably in both the X-direction and the Y-direction or at least in the Y-direction. The lower layer 3 is stretchable preferably at least by 200 %, more preferably by 400 % in the Y-direction. After having been stretched by 100 %, the lower layer 3 elastically contracts  
10 to a length less than 1.3 times its initial length as the lower layer 3 is relieved of the stretching effect. Such lower layer 3 may be formed with an assembly of short fibers, preferably of long fibers, more preferably of continuous fibers wherein these fibers forming such assembly are mechanically entangled  
15 or welded together to form a nonwoven fabric, or with a film made of thermoplastic elastomer. These fibers or film may be incorporated with or coated with suitable hydrophilicity giving an agent such as sodium alkylsulfonate to make the lower layer 3 hydrophilic. Such lower layer 3 preferably has  
20 a basis weight of  $5 \sim 200 \text{ g/m}^2$ . In the illustrated embodiment, the lower layer 3 is formed with continuous fibers 10.

When it is desired that the composite sheet 1 to be used should be breathable, the lower layer 3 preferably presents

breathability of at least  $10 \text{ cm}^3/\text{cm}^2.\text{s}$  as measured according to the method A prescribed by §6.27 of JIS L 1096. When it is desired that the composite sheet 1 to be used should be moisture-permeable, the lower layer 3 preferably presents  
5 moisture-permeability of at least  $1000 \text{ g/m}^2/\text{day}$  as measured according to the method B prescribed by JIS Z 0208. In combination with such breathable and/or moisture-permeable lower layer 3, it is preferred to use the upper layer 2 having the breathability and/or the moisture-permeability equal to  
10 or higher than those of the lower layer 3. Depending on material selection for the upper and lower layers 2, 3, it is possible to make the composite sheet 1 liquid-pervious or liquid-impervious.

The bonding zones 4 may be arranged intermittently at  
15 least in the Y-direction of X- and Y-directions. The upper and lower layers 2, 3 be bonded to each other by heating them together under a pressure or using a supersonic sealing technique. It is also possible to unite the fibers 6 of the upper layer 2 and the fibers 10 of the lower layer 3 using  
20 a needle punching or high pressure columnar water jet treatment. Each of the bonding zones 4 has an area of  $0.03 \sim 10 \text{ mm}^2$  and a total area of these bonding zones 4 is preferably  
1 ~ 50 % of the composite sheet's total area.

Pulling such composite sheet 1 in the Y-direction causes the lower layer 3 to be elastically stretched in the Y-direction and this stretching of the lower layer 3 causes, in turn, the fibers 6 of the upper layer 2 describing the curves to be reoriented and to be inelastically stretched in the Y-direction. A force required to stretch the composite sheet 1 is substantially equal to force required to stretch the lower layer 3 before the curves described by the fibers 6 are completely straightened. In the upper layer 2, the fibers 6 are merely reoriented and therefore substantially do not affect the force required to stretch the composite sheet 1. The fibers 6 are completely straightened between the respective pairs of the adjacent bonding zones 4, 4 as the composite sheet 1 is further stretched. Further stretching of the composite sheet 1 from such state requires the force required to stretch the lower layer 3 plus the force required to stretch the fibers 6 having already been straightened. The fibers 6 presenting such behavior preferably describe loops on the upper surface of the composite sheet 1 so that the upper layer 2 is stretchable not only in the Y-direction but also in the X-direction.

On the upper layer 2 of the composite sheet 1, the fibers 6 describe curves overlapping one another and some of the

fibers 6 extend to curve upward from the composite sheet 1 so that the upper layer 2 as a whole offers soft cloth-like touch. In this upper layer 2, interstices of the fibers 6 assist good breathability. In addition, the fibers 6 are at least partially hydrophilic and offer good sweat-absorbability as they come in contact with the wearer's skin. The fibers 6 having absorbed a certain amount of sweat can be rapidly dried as a plenty of air passing through the interstices of these fibers 6. The wearing article using such composite sheet 1 is advantageous in its soft touch, high breathability as well as high absorbing and drying rate for sweat so far as the upper layer 2 used to lie on body side. The composite sheet 1 may be used as stock material for the wearing article in the manner that both the upper layer 2 and the lower layer 3 are hydrophilic or the upper layer 2 is hydrophilic while the lower layer 3 is hydrophobic. However, depending on its purpose of use, it is possible to use the composite sheet 1 in the manner that the upper layer 2 is hydrophobic while the lower layer 3 is hydrophilic.

To exploit this invention, the fibers 6 of the upper layer 2 is not limited to the thermoplastic synthetic fibers treated to become hydrophilic, but may be hydrophilic regenerated fibers or natural fibers such as rayon, cotton,

silk or jute fibers. Alternatively, both the fibers 6 of the upper layer 2 and the fibers 10 of the lower layer 3 may comprise mixture of hydrophilic and hydrophobic fibers. In such case, the hydrophilic fibers include also pulp fibers.

5 This invention may be also implemented in a manner that the lower layer 3 of the composite sheet 1 shown in Fig. 1 is provided on its lower surface also with the inelastically stretchable fibrous assembly similar to the upper layer 2. This additional fibrous assembly may contain hydrophilic  
10 fibers or not contain such hydrophilic fibers.

In the composite sheet according to this invention, any one of the elastically stretchable sheet and the inelastically stretchable fibrous assembly sheet bonded to at least one surface of the elastically stretchable sheet  
15 contains hydrophilic material so that the wearing article using this composite sheet may offer soft touch, high breathability and sweat-absorbability.

## WHAT IS CLAIMED IS:

1. An elastically stretchable composite sheet (1) having a X- and Y-directions orthogonal to each other and comprising a first sheet (3) adapted to be elastically stretchable at least in said Y-direction and a second sheet (2) formed with fibrous assembly adapted to be inelastically stretchable in said Y-direction and bonded to at least one surface of said first sheet (3), wherein:

said first and second sheets (3,2) are bonded together in bonding zones arranged intermittently in said Y-direction wherein each section of the fiber (6) forming said second sheet (2) extending between each pair of the adjacent bonding zones (4) is longer than a straight distance between said pair of the adjacent bonding zones (4) and at least one of said first and second sheets (3,2) contains hydrophilic material.

2. The composite sheet (1) according to Claim 1, wherein said first sheet (3) comprises an assembly of elastically stretchable thermoplastic synthetic fibers (10).

3. The composite sheet (1) according to Claim 1, wherein said first sheet (3) comprises elastically stretchable

thermoplastic synthetic resin film.

4. The composite sheet (1) according to Claim 1, wherein said hydrophilic material comprises hydrophilic fibers.

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5. The composite sheet (1) according to Claim 1, wherein said hydrophilic material comprises hydrophilicity giving agent coating any one of said first and second sheets (3,2).

10 6. The composite sheet (1) according to Claim 1, wherein said hydrophilic material comprises hydrophilicity giving agent incorporated into any one of said first and second sheets (3,2).

15 7. The composite sheet (1) according to Claim 1, wherein said first and second sheets (3,2) are breathable and moisture-pervious.

8. The composite sheet (1) according to Claim 1, wherein  
20 any one of said first and second sheets (3,2) is liquid-impervious.