

WATER ABSORBENT SHEET ASSEMBLY AND PROCESS
AND PREPARATION THEREOF

The present invention relates to a water-absorbent sheet assembly, and a process for the preparation thereof.

As the absorbent material of a sanitary article such as a sanitary towel or disposable nappy, there have previously been used pulp, cotton and crepe paper. Recently, research has been carried out with a view to reducing the weight and volume of these sanitary articles and as the result, polymeric absorbent materials have been developed.

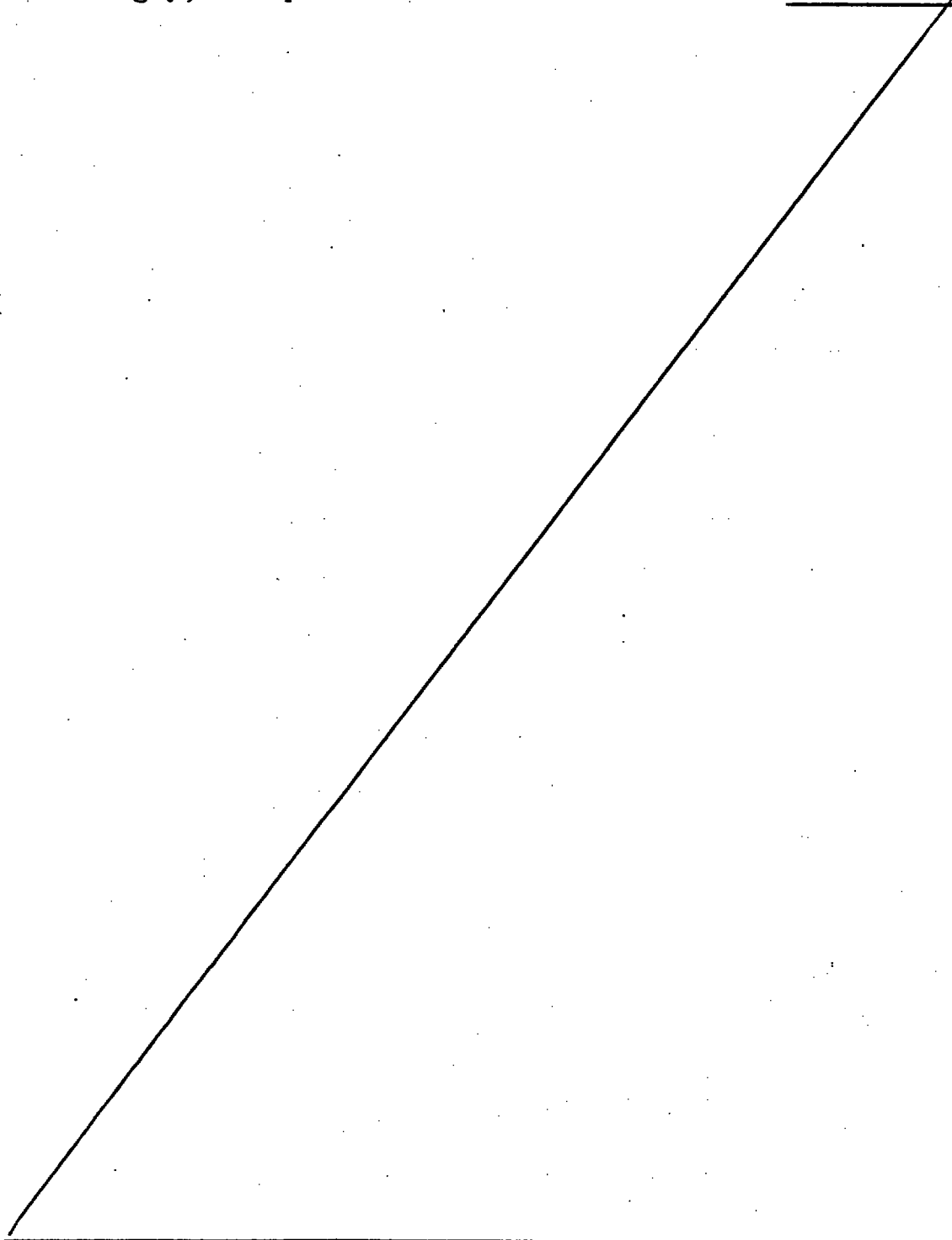
10 We have made investigations on highly absorbent sheet material formed by using these polymeric absorbents and found that good results can be obtained by use of a composite sheet assembly formed by interposing a polymeric absorbent between two sheets, at least
15 one of which is a water-permeable sheet, and bonding at least parts of the two sheets to each other. Based on this finding, we have now completed the present invention.

According to the invention we therefore provide a
20 water-absorbent sheet assembly comprising a polymeric absorbent material which can absorb at least 50 times its weight of liquid held between two sheets, at least one of which is water-permeable, wherein parts of said two sheets have been bonded together by pressing, and the press-

bonded areas of the two sheets include both strongly press-bonded parts and weakly press-bonded parts.

Conventional absorbent crepe paper is conveniently used for the two above-mentioned sheets.

5 Accordingly, the present invention will now be



described with reference mainly to embodiments in which such crepe paper is used. However, in the present invention, if one sheet is a water-permeable sheet, any appropriate material can be used as the other sheet.

For the preparation of a water-absorbent sheet assembly of the present invention, a polymeric absorbent is interposed between two absorbent papers, and the assembly is processed by an embossing roller to fix the sheets together at the embossed areas thereof and form a laminated composite structure. We have found that by adopting an improved mechanism for forming this composite structure, a highly absorbent sheet assembly having an improved capacity can be obtained with great economical advantages.

Some characteristics of constituent materials heretofore used for conventional highly absorbent sanitary sheet material will now be described. In such a conventional highly absorbent sheet material, a water-absorbent paper or non-woven fabric such as rayon paper with a base weight of 10 to 40 g/m² and a crepe ratio of 10 to 40 %, is used as an upper paper, and as a lower paper, there is used (1) the same material as the upper paper, or (2) a water-proof processed paper treated with a sizing agent to render the paper water-proof, or (3) an impermeable sheet of polyethylene, polypropylene or the like, or (4) a sheet formed by laminating a sheet (3) with the paper (1) or (2). This sheet material has good compatibility with blood, urine, water and other liquids (hereinafter collectively called "liquid") and it is creped.

Accordingly, this sheet material is more bulky than ordinary water-absorbent paper and has excellent liquid-retaining properties, water-absorbing properties and water-absorbing speed. However, the liquid-retaining property of this sheet material is still
5 insufficient when it is used as an absorbent material in a sanitary sheet material which is required to have a high capacity. As the polymeric absorbent, there are used starch polymers, acrylic acid type polymers and cellulose type polymers which can absorb 50 times their weight of liquid. These polymeric absorbents have
10 excellent liquid-retaining properties. However, their compatability with liquid is poor and their water-absorbing speed is low.

Accordingly, in order to prepare a composite material without degrading or losing the excellent properties of the
15 constituent materials, it is indispensable that (1) the crepe ratio of the crepe paper should not be reduced and (2) the contact area between the polymeric absorbent and the liquid should be as high as possible. We have found that the embossing pattern and area of the embossing are important factors for satisfying both
20 the requirements (1) and (2).

When a crepe paper is embossed, it is generally stretched in the embossing direction and thus elongated. Accordingly, in order to retain a high crepe ratio, it is preferred to minimize the embossing pressure. On the other hand, in order to retain
25 good dimensional stability and shape-retaining properties in a highly absorbing sanitary sheet material formed by bonding a polymeric absorbent to such crepe paper, some embossing pressure should be applied.

In view of the foregoing, it is preferred to adopt a high-efficiency embossing method, that is, an embossing method in which a good dimension and shape stability can be imparted to the material while the requirements (1) and (2) are satisfied. We have found that when an assembly comprising two sheets as mentioned above and a polymeric absorbent interposed therebetween is embossed by a pressing and bonding apparatus comprising an embossing roll having a surface with a large number of convexities, a large number of concavities, and flat portions, and a receiving roll having a plain surface, thereby to press-bond parts of the two sheets to each other, a highly absorbing sanitary sheet material having an embossed pattern meeting the above-mentioned requirements can be obtained. This apparatus is the subject of our co-pending application No. 8230788.

In the composite sheet assembly according to the present invention, the press-bonded areas of the two sheets comprise relatively weakly press-bonded parts processed by the flat portions of the embossing roll and relatively strongly press-bonded parts processed by the convexities of the embossing roll, and the portions of the sheets corresponding to the concavities on the surface of the embossing roll are formed into non-press-bonded areas. The sheet assembly according to the present invention will now be described with reference to the accompanying drawings.

Various embodiments of the invention will now be described by way of Example and with reference to the accompanying drawings, in which:

Figure 1 is a plan view showing an embossed
5 pattern suitable for practising the present invention;

Figure 2 is a view showing the section taken along the line A-A' in Figure 1;

Figure 3 is a view showing the lateral section of an embossing roll of the pressing and bonding apparatus
10 for use in the present invention;

Figure 4 is a perspective view of the embossing roll shown in Figure 3;

Figure 5 is a sectional view showing a laminated sheet before the embossing treatment;

15 Figure 6 is a sectional view showing the laminated sheet of Figure 3 after the embossing treatment; and Figure 7 is a plan view diagrammatically illustrating an embossing pattern of an embossing roll used in the Examples.

20 A water-absorbing sheet assembly according to the present invention is a novel highly absorbent sanitary sheet material which has an embossed pattern shown in Figures 1 and 2, which is imparted by means of an embossing roll having an embossing surface as shown in
25 Figures 3 and 4.

The convexities of an embossing roll 10 shown in Figs. 3 and 4, that is, high embossing parts 8, correspond to parts 1 of the embossed pattern shown in Figs. 1 and 2.

Furthermore concavities 9 on the embossing roll shown in Figures 3 and 4 correspond to parts 3 of the pattern shown in Figures 1 and 2, that is, non-press-bonded areas. This embossed structure has at every part thereof a function of stabilizing the composite state in the resulting highly absorbing sanitary sheet material. More specifically, the parts 1 shown in Figure 1 stabilize the composite state of the novel highly absorbing sanitary sheet material, and the influence of the embossing processing on these parts 1 is small and the residual crepe ratio is very high. Accordingly, any reduction in the liquid absorbing speed and the water-absorbing property is controlled by these parts. Furthermore, at the parts 3 shown in Figure 1, elongation of the sheets, especially crepe paper sheets, is remarkably reduced, and if these non-press-bonded areas communicated with each other as indicated by reference numeral 16 in Figure 1, the orienting characteristic is not manifested in the crepe paper, and the sheet assembly is kept soft and flexible and absorbed water is dispersed uniformly and promptly. Intermediate flat portions contiguous to the parts 3 in Figure 1, that is, areas 2 in Figure 1, act as zones for controlling elongation of the sheets in the parts 3.

Referring to Figure 3, reference numeral 11 represents a receiving roll and reference numeral 12 represents a laminated sheet to be embossed and pressed.

When the embossing roll which is the subject of our above-mentioned co-pending application is used, the convexities perform strong pressing of both the sheets, and since the total area of these convexities may be much smaller than the area of the flat portions, the softness of flexibility of the resulting laminated sheet is improved. The flat portions press both the sheets appropriately weakly. If the receiving roll is composed of a soft material, pressing by these flat portions is especially necessary and important. The concavities do not press both the sheets at all, and in the areas corresponding to the concavities, the polymeric absorbent is kept free and sufficiently exerts its water-absorbing function. In the sheet assembly of the present invention, the area ratio of the press-bonded areas of the two sheets to the non-press-bonded areas of the two sheets is preferably within the range 1:0.5 to 1:4. It is preferred that the convexities 1 are arranged to surround the concavities 3 as shown in Figure 1, and a pattern in which the convexities are arranged at certain intervals, two convexities are arranged between every two concavities adjacent to each other in either the longitudinal or lateral direction and one convexity is arranged between every two concavities adjacent to each other in the oblique direction is especially preferred. The distance between every two adjacent convexities is preferably about 1 to about 10 mm. If this distance is too small, the softness of the resulting composite is insufficient, _____

and when the distance is too large, fixing of the polymeric absorbent to the sheets is insufficient. Figure 2 is a view showing the section taken along the line A A' in Figure 1. As is seen from Figure 2, the laminate sheet comprising the polymeric absorbent interposed between the upper and lower sheets 4 and 5 is pressed and bonded by the flat portions 2 on the surface of the embossing roll, especially strongly by the convexities 1.

A modification of the pattern imparted to the sheet assembly by the embossing treatment using the pressing and bonding apparatus comprising the embossing roll of the present invention as shown in Figures 3 and 4 is illustrated in Figures 5 and 6. A laminate sheet comprises two upper and lower sheets 13 and 15 and a polymeric absorbent 14 interposed therebetween. Before the embossing treatment, as shown in Figure 5, the laminate sheet is placed between an embossing roll and a receiving roll 11 as shown in Figure 5. When the laminate sheet is subjected to the embossing treatment, the laminate sheet is embossed and pressed as shown in Figure 6. In Figure 6, the areas C and D correspond to the parts processed by low embossing parts 7 and high embossing parts 8, respectively, and the areas D are especially deeply embossed by the high embossing parts 8 so as to perform stabilization of the shape and dimension in the highly absorbing sanitary sheet material of the present invention very effectively. In order to prevent reduction of the crepe ratio of the water-absorbing paper owing to excessive elongation by such deep

embossing, the low embossing parts 7 are formed on the surface of the embossing roll and the weakly embossed areas C are formed. By virtue of the presence of the areas C, the deformation of the water-absorbing paper in the areas A corresponding to the concavities 9 on the surface of the embossing roll is reduced. Accordingly, in the highly absorbing sanitary sheet material having the embossed structure as shown in Figure 6, the areas D are most strongly pressed and bonded and the areas C are lightly pressed and bonded, and in these areas, the liquid-absorbing property is reduced by the embossing treatment. On the other hand, the areas A in Figure 6 are hardly influenced by the embossing treatment, and therefore, in these areas A, the crepe retention ratio is high and the liquid-absorbing property of the upper paper is hardly reduced. Moreover, in these areas A, a slight clearance is retained between the upper paper 13 and the polymeric absorbent 14, and water permeating through the upper paper 13 is stored in this clearance and the time of contact with the polymeric absorbent is prolonged and the liquid-absorbing property can be fully exerted.

In the following Examples, an embossing roll (composed of stainless steel S-25C) having convexities 8 and concavities 9 arranged on the surface thereof as shown in Figure 7 was used. The area of flat portions 7 was determined so that a desired embossing area ratio would be obtained. The diameter of the embossing roll was 100 mm, and the height of the convexities was 0.4 mm (in Examples 1 and 2) or 0.8 mm (in

Examples 3 and 4). The distance between every two adjacent convexities was $3/4$ mm, and the diameter of the concavities was 2.6 mm and the depth of the concavities was 1.6 mm. A roll composed of Teflon (Registered Trade Mark - hardness of 80°) and a diameter of 100 mm was used as the receiving roll.

Example 1

Between absorbing papers, each having a base weight of 25 g/m^2 , a powder of self-crosslinked sodium polyacrylate (having a particle size smaller than 450μ) was interposed at a base weight of 20 g/m^2 . The assembly was embossed at an embossing temperature of 160°C under an embossing pressure of 5 Kg/cm , while the embossing area ratio (press-bonded areas/non-press-bonded areas) was adjusted to 4.1, to fix the polymeric absorbent and obtain a highly absorbing sheet material.

Example 2

Between an absorbing paper and a water-proof paper, each having a base weight of 25 g/m^2 , a powder of crosslinked carboxymethyl cellulose (having a particle size smaller than 450μ) was interposed at a base weight of 30 g/m^2 . The assembly was embossed at an embossing temperature of 160°C under an embossing pressure of 8 Kg/cm , while the embossing area ratio was adjusted to 8.0, thereby to fix the polymeric absorbent and obtain a highly absorbing sheet material.

Example 3

Between a rayon paper (20% of rayon incorporated) and a polythene sheet, each having a base weight of 30 g/m^2 , a powder of a starch-polyacrylic acid graft copolymer (having a particle size smaller than 450μ) was interposed at a base weight of 20 g/m^2 . The assembly was embossed at an embossing temperature of 140°C under an embossing pressure of 10 Kg/cm , while the embossing ratio was adjusted to 10.5, thereby to fix the polymeric absorbent and obtain a highly absorbing sheet material.

Example 4

Between an absorbing paper and a polyethylene-laminated paper, each having a base weight of 30 g/m^2 , a powder of self-crosslinked sodium polyacrylate (having a particle size smaller than 450μ), was interposed at a base weight of 30 g/m^2 . The assembly was embossed at an embossing temperature of 120°C under an embossing pressure of 8 Kg/cm , while the embossing area ratio was adjusted to 5.5, thereby to fix the polymeric absorbent and obtain a highly absorbing sheet material.

Each of the highly absorbing sheets obtained in Examples 1 through 4 was excellent in the softness and flexibility and had a good absorbing property.



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CLAIMS:

1. A water-absorbent sheet assembly comprising a polymeric absorbent material which can absorb at least 50 times its weight of liquid held between two sheets, at least one of which is water-permeable, wherein parts
5 of said two sheets have been bonded together by pressing, and the press-b0nded areas of the two sheets include both strongly press-bonded parts and weakly press-bonded parts.
- 10 2. A water-absorbent sheet assembly according to Claim 1, wherein the sheets have inter-communicating non-press-bonded areas.
3. A water-absorbent sheet assembly according to
15 Claim 1 or 2, wherein both sheets are water-permeable.
4. A water-absorbent sheet assembly according to Claim 1 or Claim 2, wherein one sheet is water-permeable and the other sheet is water-impermeable.
20
5. A water-absorbent sheet assembly according to any of Claims 1 to 4, wherein the ratio of the press-bonded areas of the two sheets to the non-press-bonded areas of the two sheets is from 1 : 0.05 to 1 : 4.
25
6. A water-absorbent sheet assembly according to

any of Claims 1 to 5, wherein the polymeric absorbent is a self-crosslinked polyacrylic acid salt.

7. A process for manufacturing a water-absorbing sheet assembly as claimed in Claim 1, which comprises assembling the two sheets and the polymeric absorbent material and embossing the resulting assembly with apparatus which comprises an embossing roll and a receiving roll, wherein the surface of the embossing roll has a plurality of convexities, a plurality of concavities, and flat portions, and the surface of the receiving roll is plain.

8. A water-absorbent sheet assembly according to Claim 1 and substantially as herein described with reference to Figures 1, 2, 5 and 6 of the accompanying drawings and the Examples.

9. A process for manufacturing a water-absorbing sheet assembly according to Claim 1 and substantially as herein described with reference to the Examples.

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