The invention relates to a single-use absorbent sanitary article, especially diapers, sanitary napkins, and incontinence articles. The inventive sanitary article comprises an absorbent body (30) that consists of at least two layers, one layer (32) for absorbing, distributing and temporarily storing liquid and facing the body when used, and one storage layer (34) on the side facing away from the body which has a content of at least 50% of superabsorbent polymer material. The inventive layer (32) for absorbing, distributing and temporarily storing liquid is extruded from a thermoplastic polymer to which a blowing agent is added.
SINGLE-USE ABSORBENT SANITARY ARTICLE

BACKGROUND

[0001] The invention relates to a single-use absorbent sanitary article, specifically a diaper, women's sanitary napkin or incontinence article, having at least double-layer absorbent body which includes a layer contacting the body in use for absorbing, distributing and temporarily storing fluid and a storage layer furnished on the side facing away from the body having a content of at least 50% by weight of superabsorbent polymer materials.

[0002] The invention further relates to a process for producing a layer for absorbing, distributing and temporarily storing fluid in the course of producing a sanitary article of the said type.

[0003] Large numbers of sanitary articles of this kind are known. In generic sanitary articles, the high superabsorbent polymer materials content in the storage layer facing away from the body in use serves to permanently store the absorbed fluid because the superabsorbent polymer materials bind aqueous fluid and are converted into a gel-like state. Since the time required for this compared with the discharge time for the fluid during passing of water by the wearer of the sanitary article is relatively long, a layer for absorbing, distributing and temporarily storing fluid is provided in a known way, arranged on the side of the storage layer contacting the body. The task of this layer for absorbing, distributing and temporarily storing fluid is to provide an adequately high absorption rate for the flood of impacting fluid to prevent it from running across the sanitary article in the transverse or longitudinal direction, which would detract from its functionality. Furthermore, the layer for absorbing, distributing and temporarily storing fluid is intended to channel the relatively concentrated contacting fluid into other areas of the absorbent body in order to be able to utilize the fluid absorption capacity available there. The aim is then to distribute fluid within the distribution layer contacting the body, but also to temporarily store and subsequently discharge fluid to the storage layer located thereunder.

[0004] Efforts have already been made to use materials for the layer for absorbing, distributing and temporarily storing fluid which, even with wetting, and specifically repeated wetting, can perform the previously named function for the layer contacting the body at least largely unimpaired by the wetting. Preferably entangled cellulose fibers, which are also described as "curled fibers," are used in the distribution layer contacting the body. A distribution layer consisting of entangled cellulose fibers or comprising such fibers to a substantial degree, which is disposed on the side of the storage layer contacting the body, retains a relatively large fluid retention volume even after saturation and does not collapse on itself ("wet collapse") in contrast to a layer formed from natural non-entangled cellulose fibers.

[0005] With this as the point of departure, the object of the present invention is to improve an absorbent sanitary article of the generic type such that its layer for absorbing, distributing and temporarily storing fluid has fluid absorbency, distribution and temporary storage characteristics at least as good as the previously named sanitary article, even without substantial content of entangled cellulose fibers.

SUMMARY

[0006] This object is accomplished in the case of a generic sanitary article of the invention by extruding the layer for absorbing, distributing and temporarily storing fluid from a thermoplastic polymer with the addition of a blowing agent.

[0007] It was shown that impinging aqueous fluid can penetrate very rapidly into the open-pored foamed structure formed by extrusion as a blowing agent expands and be stored there temporarily. Corresponding to the degree of foaming, which is preferably greater than 50% and in an especially preferred manner greater than 100%, the extruded layer makes available a measured take-up volume of preferably more than 30 ml, even following specifically repeated heavy fluid contact while the sanitary article is in use.

[0008] In the case of the layer for absorbing, distributing and temporarily storing fluid extruded in the manner described, the problems discussed above concerning collapse of a fiber structure when saturated does not occur. Following heavy impaction of fluid, the fluid is temporarily stored in the pores and gradually discharged to the storage layer disposed thereunder, where the fluid is then permanently stored by means of the superabsorbent polymer materials there provided.

[0009] The layer for absorbing, distributing and temporarily storing fluid is preferably substantially free of superabsorbent polymer materials, by which it should be understood that it has preferably less than 10%, specifically less than 5% by weight and especially preferably less than 1% by weight of superabsorbent polymer materials.

[0010] A polymer from the group of polyolefins, specifically polypropylenes and/or polyethylene, has proven suitable as a thermoplastic polymer in an especially preferred fashion. Corresponding co-polymers, specifically ethylene vinyl acetate copolymers as well as halogenated polyolefins, can also be used. However, other thermoplastic polymers are suitable in principle for the production of the inventive absorbent structure, e.g., these from the group of the styrene polymers.

[0011] Additives, for example, 3% to 30% by weight, specifically 10% to 20% by weight, in the form of fibers, preferably polyester fibers, can also be provided. By adding fibers whose melting or degradation temperature is higher than the melting temperature of the thermoplastic polymers used, passages are formed during the extrusion process which promote the penetration and distribution of aqueous fluid into the structure and within the structure as well as the transfer of the fluid to the storage layer disposed thereunder.

[0012] The invention makes it possible in a particularly advantageous way for the mass per unit area, i.e., the thickness of the layer for absorbing, distributing and temporarily storing fluid, to be varied in the longitudinal and/or in the transverse direction, where the longitudinal direction by definition should coincide with the direction of extrusion. By suitably shaping an extrusion opening, specifically an extrusion die, structures having any type of cross-section can be achieved. The thickness of the absorbent structure, specifically viewed in cross-section perpendicular to the longitudinal direction, could be thicker in the center and in conformity with the structure of the extrusion opening decrease toward the sides in any fashion desired.

[0013] In the same way it can prove to be advantageous if the width of the extruded layer varies in the longitudinal direction; layers which are profiled in plan view, for example, an hour glass shape, can be created in this way.
The layer for absorbing, distributing and temporarily storing fluid can additionally comprise a surfactant substance, specifically a hydrophilizing agent in an amount of preferably 0.2% to 10% by weight. The already extruded structure can be contacted secondarily with the hydrophilizing agent. In a preferred manner, this agent is fed to an extrusion apparatus jointly with the remaining initial materials or injected into the already molten polymer mass, so it is already in mixture with the polymer melt before said melt is extruded. Advantageously alkyl sulfonates, fatty acid derivates and fluorochemicals are used for this—as described in the publication “Polymer Melt Additives; Their Chemistry, Structure and Use” (authors Gasper et al., lecture during Insight 1999 “Non-wovens Business/Fiber and Fabric Conferences,” San Diego, Calif., Nov. 1–2, 1999, Proceeding published by Marketing Technology Services, Inc.).

To increase the accessibility of the extruded structure for aqueous fluids, it is advantageous to subject the extruded structure to further mechanical treatment, for example, stretching, compression (rolling) and/or perforation by a fine needling tool. A possibly closed pore can thereby come into fluid communication with other pores and contribute to the take-up capacity, also to the distribution and transfer function, or be activated, respectively.

Multi-stage rolling of the extruded structure is particularly advantageous. Multi-stage rolling makes it possible to apply several temperature and/or pressure stages. The extruded structure can thereby be altered/optimized more selectively with respect to the requirements of its later use. Thus it has proven to be advantageous to compress the extruded structure in a first calendaring stage at a temperature that is appropriate for keeping the thermoplastic polymer in the extruded structure above the softening temperature. Depending on the polymer used, a temperature of 40°-90° C, specifically 45°-70° C, specifically 50°-60° C, has proven to be suitable. Afterwards the extruded absorbent structure can be advantageously compressed cold in a second calendaring stage, which is performed specifically at temperatures of 0° C.-30° C., specifically at 10° C.-25° C.

It has furthermore proved to be advantageous to subject the extruded structure to additional stretching.

It is also conceivable that the storage layer is similarly produced as an extruded foamed structure. In such cases, granular particles of superabsorbent materials are introduced into an extrusion apparatus together with thermoplastic polymer, and the thermoplastic polymer materials are melted at temperatures below the degradation temperature of the superabsorbent polymer materials and extruded with said such materials. In such cases, both the layer for absorbing, distributing and temporarily storing fluid as well as the storage layer could be produced inside the production machinery by direct co-extrusion.

A fluid-impermeable film layer disposed on the side of the storage layer facing away from the body can be produced by co-extrusion with the preceding layers. A fixing agent, such as a hot-melt adhesive, can then be advantageously dispensed with, since the extruded layers can be fixed with each other, but also with respect to additional layers and/or elements of the sanitary article by extrusion during the course of production.

In an advantageous improvement of the invention, it is also conceivable that the layer for absorbing, distributing and temporarily storing fluid has wall sections on both sides extending upwardly in the longitudinal direction of the sanitary article and toward the wearer, which form a leakage barrier. These wall sections then assume the function of gatherings which are usually formed in known sanitary articles from non-woven materials with inserted means of elasticization.

Also subject of the present invention is also a process for producing a layer for absorbing, distributing and temporarily storing fluid as part of production of a sanitary article.

CO₂ is preferably used as the blowing agent, although equally conceivable would be saturated, unsaturated, cyclic hydrocarbons and halogenated hydrocarbons as well as noble gases, such as argon, helium or nitrogen, or a water/air mixture or water itself, preferably in the form of moisture which is part of or in the extruded materials.

Inside the extrusion apparatus positive pressure is preferably developed high enough that the blowing agent finds itself in a so-called “supercritical state”, in which the phase boundary between fluid and gaseous aggregate state disappears and only a single homogenous phase is present. In the case of CO₂, this state is present at temperatures above about 31° C. and pressures above 73.5 bar. In this state, the blowing agent can be mixed optimally for preparing a physical foaming process with the molten thermoplastic polymer. If this mixture is then passed through an extrusion opening into an area of lower pressure, the blowing agent evaporates with decreasing temperature, and the foamed open-pore structure of the layer for absorbing, distributing and temporarily storing fluid is created.

But since not only does the blowing agent have to attain a preferably supercritical state, the thermoplastic polymer must be at least partially melted, temperatures of 80° C. to 200° C. are generated inside the extrusion apparatus.

To produce a large number of similarly configured structures, it proves to be advantageous if the extrusion cross-section is changed in a correspondingly oscillating fashion. This takes place transversely to the direction of extrusion, specifically in the discharge direction, whereby the thickness of an extruded web is varied, or transversely to the discharge direction, whereby its width is varied.

It proves to quite particularly advantageous if the extrusion process is directly integrated into the production process for the sanitary article and thereby the layer for absorbing, distributing and temporarily storing fluid is extruded directly inside a high-speed machine for producing sanitary articles.

BRIEF DESCRIPTION OF THE DRAWING
Additional details, features and advantages of the invention can be found in the appended patent claims and from the drawings and the description which follows of an inventive sanitary article. In the drawings:

FIG. 1 shows a schematic view of an apparatus for producing a layer for absorbing, distributing and temporarily storing fluid for an inventive sanitary article;

FIGS. 2 and 3 show a top view and a sectional view through an absorbent body of an inventive sanitary article, respectively; and
FIG. 4 shows a top view corresponding to FIG. 2 of an absorbent body with a width varying in the longitudinal direction.

DETAILED DESCRIPTION

FIG. 1 shows an apparatus for extruding a layer for absorbing, distributing and temporarily storing fluid. The apparatus includes a funnel-shaped feed device 1, through which a solid-matter mixture, which was preferably produced previously in accordance with the composition by weight percentage of the individual ingredients, can be introduced into a cylindrical interior 4 of a high-pressure stable tubular housing 5 of the extrusion device. A shaft 6 extends in this interior 4 having a helical screw 8 driven by an electric motor. When the shaft 6 is driven, the solid-matter mixture which was introduced is further mixed and transported in longitudinal direction 10. Heating devices 12 are provided on the outer circumference of the tubular housing 5.

An extrusion tool 16 can be mounted on the end face of the tubular housing 5 at the end opposite the feed device 2. The extrusion tool 16 communicates through an opening 18 on the end face 14 with the interior 4 of the tubular housing.

Injection devices 20, 22 discharge into the interior 4, whereby the injection devices 20, 22 discharge quasi inside the opening 18. A blowing agent under operating pressure can be introduced into the interior 4 through the injection devices 20, 22. In this way, an operating pressure can be set and maintained in the interior 4 during the extrusion process, depending on the blowing agent employed in the extrusion process, generally above 70 bar.

To produce a layer for absorbing, distributing and temporarily storing fluid, specifically a polypropylene and/or polyethylene granulate, can be used as an example of a thermoplastic polymer. This granulate can be mixed with additives, such as fibers, for example.

The mixture obtained in this way is transported into the interior 4 by means of the conveying device 2. The mixture is brought up to an operating temperature by the heating devices 12 such that the thermoplastic polymer melts.

A blowing agent, for example CO₂, is introduced into the interior 4 through the injection devices 20, 22 so that an operating pressure obtains there which is suitable for extruding the partially molten mixture via the extrusion tool 16.

Since the blowing agent is intended to result in foaming of the thermoplastic polymer, it is preferably introduced into the interior 4 in the so-called “supercritical stage.”

When the mixture obtained in this way passes through the extrusion opening of the extrusion tool 16, the blowing agent expands as result of the accompanying drop in pressure, and the mixture is foamed, that is to say, pores or cavities which communicate with each other are formed by the expanding and usually escaping blowing agent.

FIGS. 1 and 2 show a top view onto or a sectional view through, respectively, a two-ply absorbent body 30 of an inventive sanitary article. The absorbent body 30 comprises a layer for absorbing, distributing and temporarily storing fluid 32 and a storage layer 34 disposed on the side of the layer facing away from the body which comprises a content of at least 50% by weight, specifically at least 80% by weight, of superabsorbent polymer materials which can, for example, be embedded in a fibrous structure (thermoplastic or natural fibers).

The layer for absorbing, distributing and temporarily storing fluid is formed from a thermoplastic polymer foamed by extrusion with the addition of a blowing agent. The polymer comprises polyethylene and/or polypropylene. In accordance with a preferred embodiment of the invention between 3% and 30% by weight of additives in the form of thermoplastic fibers, preferably polyester fibers, is added. Additionally it can contain hydrophilizing agents in the form of alkyl sulfonates, fatty acid derivates or fluorochemicals.

A porous layer which has a total pore volume of at least 30 ml and which is suitable for the rapid absorption, distribution and temporary storage of fluid is created by the extrusion of the thermoplastic polymer with the addition of a blowing agent. The longitudinal and perpendicular dimensions of layer 32 are less than those of the storage layer 34 disposed thereunder such that layer 32 is located on all sides within the storage layer 34 in top view. In this way impinging fluid cannot pass beyond the edges of storage layer 34 because of the distribution effect within layer 32. Preferably the surface percentage of layer 32 is about 55%–90% of the surface of the storage layer 34. But it must be expressly pointed out that any other geometric configuration of layer 32 would be conceivable, specifically layer 32 could have the same length in the longitudinal direction as storage layer 34, which would be advantageous from the point of view of manufacturing.

FIG. 4 shows a top view of a further aspect of an absorptive body 30, in which the layer for absorbing, distributing and temporarily storing fluid 32 has a varying width b in the longitudinal direction, which corresponds to the direction of extrusion. It is hour-glassed shaped in the instance shown.

What is claimed is:

1. Absorbent sanitary article for one-time use, specifically diaper, feminine napkin, incontinence pad, having an at least two-ply absorbent body (30) which comprises a layer for absorbing, distributing and temporarily storing fluid (32) contacting the body when the article is used and a storage layer (34) furnished on the side away from the body having a content of at least 50% by weight of superabsorbent polymer materials, characterized in that the layer for absorbing, distributing and temporarily storing fluid (32) is extruded from a thermoplastic polymer with the addition of a blowing agent.

2. Sanitary article from claim 1, wherein the layer for absorbing, distributing and temporarily storing fluid (32) has a total pore volume of at least 30 ml.

3. Sanitary article from one of the preceding claims, wherein the layer for absorbing, distributing and temporarily storing fluid (32) is essentially free from superabsorbent polymer materials.

4. Sanitary article from one of the claims 1, 2 or 3, wherein the thermoplastic polymer comprises a polyolefin, specifically polypropylene and/or polyethylene.

5. Sanitary article from one or more of the preceding claims, wherein the degree of foaming is greater than 50%.
6. Sanitary article from one or more of the preceding claims, wherein the degree of foaming is greater than 100%.
7. Sanitary article from one or more of the preceding claims, wherein the layer for absorbing, distributing and temporarily storing fluid (32) comprises 3%-30% by weight, specifically 10%-20% by weight fibers as additive materials.
8. Sanitary article from claim 7, wherein the fibers are formed from polyester fibers.
9. Sanitary article from one or more of the preceding claims, wherein the unit weight of the layer for absorbing, distributing and temporarily storing fluid (32) varies in the longitudinal and/or perpendicular direction.
10. Sanitary article from one or more of the preceding claims, wherein the width of the layer for absorbing, distributing and temporarily storing fluid (32) varies over its longitudinal direction.
11. Sanitary article from one or more of the preceding claims, wherein a storage layer (34) is furnished on the side of the layer for absorbing, distributing and temporarily storing fluid (32) facing away from the body when in use and is extruded with said layer.
12. Process for producing a layer for absorbing, distributing and temporarily storing fluid (32) as part of producing a sanitary article from one or more of the preceding claims 1-11, comprising the following steps:
   introduction of a thermoplastic polymer into an extrusion apparatus,
   melting the thermoplastic polymer material,
   introduction of a blowing agent under positive pressure, extrusion of the mixture, where the blowing agent results in foaming of the thermoplastic polymer when pressure is reduced.
13. Process from claim 12, wherein CO₂ is used as the blowing agent.
14. Process from claim 12 or 13, wherein the thermoplastic polymer is melted at temperatures of 80-200 degrees C.
15. Process from claim 12, 13 or 14, wherein fibers are introduced into the extrusion apparatus as an additive.
16. Process from one of the claims 12-16, wherein a surfactant substance is introduced into the extrusion apparatus as an additive.
17. Process from one of the claims 12-16, wherein an extrusion cross-section is changed during extrusion.
18. Process from claim 17, wherein the extrusion cross-section is changed in an oscillating manner.
19. Process from claim 12-18, wherein the process is integrated into a production process for sanitary articles and thereby the layer for absorbing, distributing and temporarily storing fluid (32) is extruded directly inside high-speed production machinery for sanitary articles.
20. Process from claim 19, wherein the layer for absorbing, distributing and temporarily storing fluid (32) and the storage layer are formed inside the high-production machinery by co-extrusion of the layers.