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SANITARY NAPKIN HAVING A CENTRAL ACQUISITION ZONE

Field of the invention

The invention relates to sanitary napkin comprising a liquid pervious topsheet, a liquid impervious backsheet and an absorbent core interposed between the topsheet and the backsheet, the core comprising two longitudinal sides, a central acquisition zone, two side zones that are located

the core further comprising a layer containing absorbent gelling material, the concentration of absorbent gelling material in the acquisition zone of the core being lower than the concentration of absorbent gelling material in the side zones.

Background of the invention

Such an absorbent article is known from US-A-4,988,345.

In this patent an absorbent article is described in which the absorbent core comprises a lower liquid handling layer of relatively low density and an upper liquid storage layer comprising absorbent gelling materials. The upper liquid storage layer has a basis weight of between 0.01 and 0.1 g/cm² and can contain up to 60% by weight of absorbent gelling material. The liquid storage layer is provided with acquisition apertures for transmission of liquids to the underlying liquid handling layer, in which layer transport of fluids can take place in a longitudinal and lateral direction of the absorbent article. The liquid handling layer has a void volume of over 80%, a basis weight of between 15 to 75 g/sq yard, and can comprise synthetic foam materials or synthetic fibers. The fluids that are transmitted through an acquisition aperture in the liquid storage layer, are transported in the liquid handling layer to portions of the liquid storage layer remote from the



acquisition apertures. Due to the difference in capillary size between the storage layer and the liquid handling layer, the liquid is drawn out of the latter which is thereby emptied and can transport subsequent gushes of body fluids.

Since the liquid handling layer is relatively broad, lateral spread of liquids towards the sides of the absorbent article can relatively easily take place. The purpose of the known liquid handling layer is to improve the distribution of large quantities of liquid away from the acquisition apertures and to increase the absorption speed without gel blocking of the absorbent material taking place. Especially in narrow absorbent articles, too large a lateral spread of liquids can however lead to undesired side soiling.

From the American patent US-A-5,009,653 a sanitary napkin is known having an absorbent core that is formed of a layer of hydrogel material interposed between two layers of air-laid tissue sheets. The core is covered by a wet-laid tissue which serves to improve wicking of the discharged body fluids over the core, so that a more efficient use of the hydrogel material is made. However, next to improving liquid migration in the longitudinal direction of the sanitary napkin, liquid migration in the lateral direction also takes place, so that side soiling remains possible.



It is an object of the invention to provide an absorbent article of relatively small caliber that has a good liquid distribution capacity and is of a relatively simple structure.

It is another object of the invention to provide for an absorbent article having low side soiling and a relatively high effective absorption capacity.

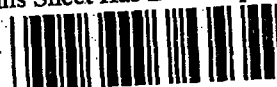
It is again another object of the invention to provide an absorbent article having a relatively high acquisition speed and is of relatively low cost.

Summary of the invention

An absorbent article according to the invention is characterized in that the absorbent gelling material is comprised between an upper and a lower fibrous layer, the amount of absorbent gelling material per unit area of fibrous layer in the acquisition zone being lower than the amount of absorbent gelling material per unit area in the side zones, the width of the acquisition zone and the concentration of absorbent gelling material in the side zones being adapted for transport of liquids in a predominantly longitudinal direction of the core.



By reducing the amount of absorbent gelling material in the central part of the core of the sanitary napkin, an acquisition zone is obtained having a relatively large fluid-acquisition and -transport capacity compared to the side areas which contain a higher level of absorbent gelling material and hence have a relatively high fluid retention capacity. Surprisingly it was found that by selective reduction of the concentration of absorbent gelling material in the central acquisition area, a higher effective capacity (capacity before occurrence of side soiling) of the sanitary napkin can be achieved. This is especially important for sanitary napkins having a relatively small caliber, for instance smaller than 3 mm. The capacity of such sanitary napkins in the vertical direction is low so that optimum use of the absorbent surface of the sanitary napkin need be made. To achieve a sufficient absorption capacity of the small caliber sanitary napkin, the concentration of absorbent gelling material in the core is relatively high compared to the concentration of absorbent gelling materials in cores wherein the absorbent gelling material is mixed with the core's fibers. The absorbent gelling material concentration in the wide zones of the small caliber sanitary napkin can not be increased at will due to "gel blocking", so that the capacity of such sanitary napkins is determined by the maximum possible absorbent gelling material concentration without gel blocking occurring.



According to the invention it was found that by using less than the maximum absorbent gelling material concentration in the acquisition zone, a higher effective capacity was obtained.

Since the amount of absorbent gelling material of the sanitary napkin according to the invention, is lower than the amount used in sanitary napkins in which the absorbent gelling material is evenly applied across the whole surface of the fibrous layers that retain the absorbent gelling material, or is evenly mixed with the core's absorbent bulk material, the sanitary napkin can be manufactured at a reduced price.

The increased concentration of absorbent gelling material in the side zones can also be obtained by folding over of the core onto itself in the side zones, or by superimposing on the core an extra pair of fibrous layers enclosing absorbent gelling material in the side zones.

From European patent application EP-A-0 217 566, a diaper is known in which two or more strips of super absorbent material are placed between the core and the topsheet. The area between the absorbent strips can quickly acquire large quantities of body fluids, in particular urine. However, lateral spread of liquids can still take place in a significant amount in the core, which is located underneath



the superabsorbent strips. The relatively large width of the acquisition zone also allows significant lateral transport of liquids.

An embodiment of a sanitary napkin according to the invention is characterized in that the width of the acquisition zone is between 5 and 28 mm, preferably about 15 mm.

By providing a relatively narrow central acquisition zone in the sanitary napkin, the transport of body liquids, in particular menses, in a predominantly longitudinal direction is increased. Upon wetting of the absorbent gelling materials, these materials swell and show a decreased rate of fluid absorption, a phenomenon which is called "gel blocking". The relatively low amounts of absorbent gelling materials in the acquisition zone cause little gel blocking and pose a low resistance to flow. At the borders of the acquisition zone, the lateral spread of liquids is reduced, due to the gel blocking of the wetted absorbent gelling material. Hence longitudinal spread of the fluids discharged into the acquisition zone is improved. Next to the reduction of the amount of absorbent gelling material in the acquisition zone, the relatively narrow dimension of the central acquisition zone forces the fluid which is discharged into this zone in the longitudinal direction of the absorbent article.



An embodiment of an absorbent article according to the invention, in particular a sanitary napkin, is characterized in that the concentration of absorbent gelling material in the acquisition zone is between 0 and 3.59 g/sq foot and the concentration of absorbent gelling material in the side zones is between 2 and 7.5 g/sq foot for absorbent gelling material having a gel strength less than about 1.2 kPa after exposure to synthetic urine in a modified AGEP test and between 2 and 15 g/sq foot for absorbent gelling material having a gel strength higher than about 1.2 kPa after exposure to synthetic urine solution in a modified AGEP test.

Concentrations of low gel strength absorbent gelling materials in the side zones, such as, for instance under the brandname Aqualon C from Hercules Inc of Wilmington Del, higher than 7.5 g/sq foot were found to give rise to undesired gel blocking which causes liquids discharged into the acquisition zone to flow laterally across the gel blocked parts of the side zones. Concentrations of absorbent gelling material in the side zones of below 2 g/sq foot were found to reduce the overall capacity of the sanitary napkin to an undesirable low level. For high gel strength absorbent gelling materials, such as for instance Aquakeep 13 SHPS, a sodium polyacrylate supplied by Autochem S.A., Cours Michelet, La Defense, Paris, France and Sanwet IM 5600-S, a cross linked starch grafted sodium



polyacrylate supplied by Farbwerke Hoechst AG of Frankfurt, Germany, concentrations above 15 g/sq foot were found to lead to undesirable gel blocking.

Another embodiment of an absorbent article according to the invention is characterized in that the acquisition zone the upper fibrous layer is depressed to form a channel.

When in the side zones of a laminate core (a core wherein the absorbent gelling material is comprised between two tissue sheets) the absorbent gelling material, which preferably is of granular nature, is applied as a uniform layer, the omission of absorbent gelling material in the acquisition zone will leave an open space between the upper and the lower tissue between which the absorbent gelling material is comprised. By depression of the upper tissue into the open space of the acquisition zone, a channel is formed in the core which aids in collecting and distributing body fluids.

Instead of depressing the upper tissue into the acquisition zone, the absorbent gelling material in the acquisition zone can be replaced by a wicking material, such as a web of low density and high resiliency, for instance comprising synthetic fibers such as polyester fibers, or crimped or coiled PET fibers. A better wetting can be achieved by



treating the acquisition zone with a wetting agent such as a surfactant.

It is noted that in order to promote liquid transport in the longitudinal direction of an absorbent article it is known from the European patent EP-A-0 173 068, to provide a sanitary napkin with a longitudinal channel. No mention is made however about the presence of absorbent gelling material in the core material flanking the channel and the concentration of absorbent gelling material in the area of the absorbent article wherein the channel is located.

Again another embodiment of a sanitary napkin according to the invention is characterized in that the upper and the lower fibrous sheet are formed by a single tissue, the tissue having two mutually opposed longitudinal edges which are superimposed in the acquisition zone.

By enveloping the absorbent gelling material in a single tissue, the edges of which overlap in the acquisition zone, an extra layer of tissue is present in the acquisition area for quick absorption of gushes of liquids and improved wicking.

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Brief description of the drawings

Some embodiments of an absorbent article according to the present invention will be described in detail with reference to the accompanying drawings. In the drawings:

Fig. 1 shows a top plan view of a sanitary napkin wherein a part of the overlying layers have been cut away to expose underlying structures, the sanitary napkin having a generally straight core,

Fig. 2 shows a top plan view of a sanitary napkin having a shaped core,

Fig. 3 shows a cross sectional view of the sanitary napkin of fig 1 along the transverse center line 16,

Fig. 4 shows the sanitary napkin of figure 3, no absorbent gelling material being provided in the acquisition zone,

Fig. 5 shows the sanitary napkin of Fig 4, the upper tissue being depressed into the acquisition zone,

Fig. 6 shows the sanitary napkin of figure 5, the topsheet being provided with a channel,

Figs. 7 and 8 show the sanitary napkin of Fig. 3, a single tissue enveloping the absorbent gelling material, the tissue's longitudinal edges overlapping,

Fig. 9a and 9b show an alternative embodiment of an absorbent core of a sanitary napkin according to the invention,

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Fig. 10 shows a graph of liquid distributions at various loadings for a sanitary napkin according to the invention.

Fig. 11 shows another embodiment of an absorbent core of a sanitary napkin according to the invention.

Detailed description of the Invention

The embodiments of the absorbent article as illustrated in the drawings refer to a disposable sanitary napkin, i.e. an article which is worn by females adjacent to the pudendal region and which is intended to absorb and contain the various exudates which are discharged from the body (e.g. blood, menses and urine) and which are intended to be discarded after a single use. The invention is however not limited to sanitary napkins only, but also covers other absorbent articles such as pantiliners, which generally have a lower capacity than sanitary napkins. Although the embodiment described in detail in the drawings has a so called "laminate" core wherein the absorbent gelling material is present as a layer between two sheets, the invention is not limited thereto and also applies to Cores wherein the absorbent gelling material is mixed with fibers, such as described in the American patent application No 07/810,774, filed on December 17, 1991 in the name of The Procter & Gamble Company, which is hereby incorporated by reference.



Figure 1 shows a sanitary napkin 1 comprising a liquid pervious topsheet 3, an absorbent core 5 underlying the topsheet and a liquid impervious backsheet 7. The core 5 has two longitudinal sides 9 and 11, which extend in a generally longitudinal direction of a longitudinal center line 13 of the core 5. The longitudinal sides 9,11 need not be straight but can also be curved towards the longitudinal center line, to provide a shaped core, as shown in figure 2. The absorbent core 5 can be covered by one or more acquisition layers for distributing fluids which have penetrated through the topsheet 3, across the absorbent core 5. The acquisition sheets have for reasons of clarity been omitted from the schematic drawings of Figs 4 to 8. The absorbent core 5 comprises a laminate wherein the absorbent gelling material is interposed between an upper tissue 24 and a lower tissue 25, as shown in figures 3-6. The tissues 24, 25 can be part of a single sheet enveloping the absorbent gelling material 29 as is shown in Figs. 7, 8 and 9.

The core 5 is provided with a central acquisition zone 15 that is flanked by two side zones 17 and 19. The central acquisition zone 15 comprises a lower concentration of absorbent gelling materials than the side zones, the concentration in the side zones 17,19 being between 2 and 7.5 g./sq. foot, preferably about 5.5 g/sq foot, for a relatively low gel strength absorbent gelling material and



between 2 and 15 g/sq foot, preferably about 10 g/sq foot for relatively high gel strength absorbing gelling materials, and in the acquisition zone 15 being preferably about 0 g/sq. foot.

The concentration of absorbent gelling material need not change abruptly when going from side zones to the acquisition zone, but can for instance decrease linearly from high to low, or according to any other desired profile.

The width, W, of the acquisition zone preferably is narrow compared to the narrowest width, L, of the absorbent core 5 and amounts to between 5 and 28 mm. For sanitary napkins having a shaped core 5, as is shown in figure 2, the narrowest lateral dimension L of the sanitary napkin is located along the transverse center line 16 thereof and measures preferably about 70 mm. The sanitary napkin 1 is at its longitudinal perimeter provided with two lateral flaps or wings, which can during use be folded around the edge of the user's garment to position the sanitary napkin width respect to the garment and to reduce side soiling.

Looking at some of the elements of the sanitary napkin more specifically, the absorbent core 5 may be any means which is generally compressible, conformable, non-irritating to the wearer's skin and capable of absorbing and containing



body exudates. The absorbent core 5 may be manufactured in a wide variety of sizes and shapes (e.g. rectangular, hour-glass, etc.). A preferred shape of the absorbent core 5 is the dogbone shape shown in FIG 2. This preferred absorbent core 5 is about 22.0 centimeters long (longitudinal dimension along the longitudinal centerline 13), about 7.0 centimeters wide across its midportion (lateral dimension) along the traverse center line 16. The absorbent core 5 is symmetrically configured for ease of manufacture and so that no conscious effort is required by the wearer to properly place the napkin 1 in the direction it should be worn. The midportion is configured to basically conform to the wearer's thighs and to the thinner crotch portion of the wearer's panties so as to prevent excessive bunching. The size of the absorbent core 5 may be varied to accommodate wearers ranging in size and also ranging in the expected amount of exudate fluid volume. The absorbent core 5 may be attached over the core's major top and bottom surfaces respectively, to adjacent members such as the topsheet 3 and back sheet 7 by any of the means well known in the art, such as by spray-gluing or lines or spots of adhesive. Such attachment facilitates integrity and recoverability of the absorbent materials in use so as to maintain an optimum degree of absorbency. Preferably, the absorbent core 5 has a wet-tensile strength in the cross-direction of at least about 100.0 grams per centimeter.



Wet tensile strength is determinable by ASTM Standard D 829-49.

The absorbent core 5 may be manufactured from a wide variety of liquid absorbent materials commonly used in disposable sanitary napkins, diapers, and other absorbent articles. Examples of suitable absorbent materials include comminuted wood pulp which is generally referred to as airfelt, creped cellulose wadding, absorbent foams, absorbent sponges, synthetic staple fibers, polymeric fibers, hydrogel-forming polymer gelling agents, or any equivalent materials or combinations of materials. A particularly preferred absorbent material are absorbent gelling materials or polymeric gelling agents. Polymeric gelling agents are those materials which, upon contact with fluids (i.e., liquids) such as water or body fluids, imbibe such fluids and thereby form hydrogels. In this manner, fluid discharged into the absorbent core 5 can be acquired and held by the polymeric gelling agent, thereby providing the articles herein with enhanced absorbent capacity and/or improved fluid retention performance.

The polymeric gelling agent which is employed in the absorbent core 5 will generally comprise particles of a substantially water-insoluble, slightly cross-lined, partially neutralized, hydrogel-forming polymer material. Such polymer materials can be prepared from polymerizable,



unsaturated, acid-containing monomers. Suitable unsaturated acidic monomers for use in preparing the polymeric gelling agents used in this invention include those listed in US-A-4,654,039, entitled "Hydrogel-Forming Polymer Compositions for Use in Absorbent Structures", which issued to Brandt, Goldman and Inglin on March 31, 1987, and which patent is incorporated herein by reference. Preferred monomers include acrylic acid, methacrylic acid, and 2-acrylamido-2-methyl propane sulfonic acid. Acrylic acid itself is especially preferred for preparation of the polymeric gelling agent material.

In the hydrogel-forming polymeric gelling agent the polymeric component formed from unsaturated, acid-containing monomers may be grafted onto other types of polymer moieties such as starch or cellulose. Polyacrylate grafted starch materials of this type are especially preferred for use herein.

Preferred polymer gelling agents which can be prepared from conventional types of monomers include hydrolyzed acrylonitrile grafted starch, polyacrylate grafted starch, polyacrylates, maleic anhydride-based copolymers and combinations thereof. Especially preferred are the polyacrylates and polyacrylate grafted starch.



Whatever the nature of the basic polymer components of the hydrogel-forming polymeric gelling agents used in the absorbent core 5 herein, such materials will in general be slightly cross-linked. Cross-linking serves to render the hydrogel-forming polymer gelling agents used in this invention substantially water-insoluble, and cross-linking thus in part determines the gel volume and extractable polymer characteristics of the hydrogels formed from the polymeric gelling agents employed. Suitable cross-linking agents are well known in the art and include, for example, those described in greater detail in US-A-4,076,663, which patent issued to Masuda et al on February 28, 1978, and which patent is incorporated herein by reference.

Preferred cross-linking agents are the di- or polyesters of unsaturated mono- or polycarboxylic acids with polyols, the bisacrylamides and the di- or triallyl amines. Especially preferred cross-linking agents are N,N'-methylenebisacrylamide, trimethylol propane triacrylate and triallyl amine. The cross-linking agent can generally comprise from about 0.001 mole percent to 5.0 mole percent of the resulting hydrogel-forming polymer material. More preferably, the cross-linking agent will comprise from about 0.01 mole percent to 3.0 mole percent of the hydrogel-forming polymeric gelling agent used herein.

The slightly cross-linked, hydrogel-forming polymeric gelling agents which may be used in the articles of the



present invention are generally employed in their partially neutralized form. For purposes of this invention, such materials are considered partially neutralized when at least 25.0 mole percent and preferably at least 50.0 mole percent of monomers used to form the polymer are acid group-containing monomers which have been neutralized with a salt-forming cation. Suitable salt-forming cations include alkali metal, ammonium, substituted ammonium, and amines. This percentage of the total monomer utilized which are neutralized acid group-containing monomers is referred to herein as the "degree of neutralization".

The polymeric gelling agent materials used in the absorbent articles as shown in Figs 3 and 8 must have a relatively high capacity for imbibing fluids encountered in such articles. The absorbent capacity of these materials can be quantified by referencing the "gel volume" of the polymeric gelling agents which are to be selected for use in the present invention.

For purposes of this invention, gel volume can be defined in terms of the amount of synthetic urine absorbed by any given polymeric gelling agent and is specified as grams of synthetic urine per gram of polymeric gelling agent. Gel volume in synthetic urine can be determined for forming a suspension of about 0.1-0.2 parts of dried polymeric gelling agent to be tested with about 20 parts of synthetic



urine. This suspension is maintained at ambient temperature under gentle stirring for a time sufficient, e.g., about 1 hour, for swelling equilibrium to be attained. The gel volume of the polymeric gelling agent then calculated from the weight fraction of the polymeric gelling agent in grams of synthetic urine per gram of polymeric gelling agent is then calculated from the weight fraction of the polymeric gelling agent in the suspension and the ratio of the liquid volume excluded from the formed hydrogel to the total volume of the suspension.

The gel volume of the gelling agents used in the absorbent core 5 herein will generally be at least about 20.0 grams of synthetic urine per gram of polymeric gelling agent. More preferably, the gel volume of the materials employed will range from about 20.0 to about 60.0, most preferably from about 22.0 to about 35.0 grams of synthetic urine per gram of polymeric gelling agent.

In a preferred embodiment, the sanitary napkin has a minimum core width measured along the transverse center line 16, of 70 mm, the central acquisition zone 15 comprising between 0 and 3.5 gram per square foot, preferably about 0 gram/square foot polymeric absorbent gelling material of the type. The width w of the acquisition zone 15 is between 10 and 20 mm, preferably about 15 mm. The concentration of polymeric absorbent



gelling material in the side zones 17 and 19 is preferably an even distribution, i.e. constant in the direction, of the transverse center line of about 4 gram/square foot for an acquisition zone of width w of 15 mm, and 5.5 gram/square foot for an acquisition zone of a width of about 20 mm, the overall concentration of absorbent gelling material of the core being about 3.1 gram/square foot. The preferred dimensions of the sanitary napkin, the width of the acquisition zone and the concentration of absorbent gelling material relate to the absorbent article as shown in Figs 2-8, i.e. a sanitary napkin having a shaped core 5, and comprising a laminate of air laid sheets 24 and 25. The absorbent gelling material 29 used in the preferred embodiment has a gel strength of less than 1.2 kPa. However a central acquisition zone 15 having a low concentration of absorbent gelling material can also advantageously be used in combination with high gel strength absorbent gelling materials, which can be applied in higher concentrations without gel blocking occurring.

The concentrations of absorbent gelling materials in the side zones and the width of the central acquisition zone will have to be varied according to the gel strength, the different absorbent gelling materials used, the caliper of the core and the minimum lateral dimension, L , of the core.

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The gel strength of absorbent gelling materials can be measured according to the modified Absorbent Gel Expansion Pressure test (AGEP). The modified AGEP test measures the force exerted by the gel as it expands following exposure absorption to a synthetic urine solution. The force is measured by a circular pressure foot that fits closely within a 2 cm diameter sample cell of an Ametek Precision Stage Model C1395X available from Ametek Corporation, Mansfield & Brown Division, 8600 Somerset Drive, Largo, Florida 36543, USA. The Force guage is an 'Accuforce' device available from Brown Tool & Supply Co, Solon, Ohio, USA.

The following procedure is used:

1. Weigh out 0.179g +/- 0.001g polymeric gelling agent material into the absorption cell.
2. Place the cell containing the sample in the sample alignment bracket on the precision stage of the Ametek, and line up the sample holder so that the pressure foot will be centered when in the tube.
3. Add a 56 x load (10 ml) of Jayco synurine (see note 1) to the sample.
4. Using the level on the Ametek stand, raise the sample until the foot is almost touching the fluid.
5. Zero and clear the Ametek Force Guage and if using a chart recorder start it with the speed set to 1cm/min.



6. Turn the illuminator off.
7. Using the coarse and fine adjustments on the precision stage, raise the sample until the level of the fluid is even with the top of the foot. This is achieved by sighting across the foot. The fluid that is on the wall of the absorption cell due to the surface tension will appear as a white band. As this band moves up the cell it will block the silver colour of the foot. When the white band is above the top of the foot a silver band will reappear. At this point lower the sample using the fine adjuster until the silver band disappears.
8. Turn off the illuminator immediately.
9. When the gel reaches the foot, set the timer for 30 minutes and start it.
10. At the end of 5, 10, 15, 20 and 30 minutes record the force in grams.

Calculations

Pressure = Reading of machine (g) / area of foot (cm²) x
98.1 (kPa)

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Notes1. Jayco Synurine

The Jayco Synurine is made up with the following quantities of compounds per litre of solution.

Na_2SO_4	2.0g/l
KCl	2.0g/l
$(\text{NH}_4)_2\text{HPO}_4$	0.15g/l
$(\text{NH}_4)\text{H}_2\text{PO}_4$	0.85g/l
$\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$	0.5g/l
$\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$	0.25g/l

2. Testing should be conducted with the equipment and sample at a stable temperature of 25°C.
3. The tube internal diameter is 2 cm so that the surface area of the foot is 3.14 cm².

The absorbent gelling materials having an absorbent gel strength of more than 1.2 kPa after 5 minutes are classified as high gel strength absorbent gelling materials and can be used in higher concentrations in the side zones. Preferred absorbent gelling materials show a generally regular increase in gel strength from the value after 5 minutes exposure to the value after 30 minutes exposure.



In the preferred embodiments shown in Figs. 3-8, the absorbent core 5 is a laminate comprised of a layer of absorbent gelling material disposed between two air-laid tissues 24 and 25. A suitable laminate is the absorbent laminate WATER-LOCK L-535 available from the Grain Processing Corporation of Muscatin, Iowa (WATER-LOCK registered TM by Grain Processing Corporation). Such superabsorbent laminates are disclosed in US-A-4,467,012, entitled "Composition for Absorbent Film and Method of Preparation", which patent issued to Pedersen et al. on August 21, 1984, and US-A-4,260,443, entitled "Laminated Absorbent Process", which patent issued to Lindsay et al. on April 7, 1981, and which patents are incorporated herein by reference. The WATER-LOCK L535 has a hydrogel polymer loading of 0.005 grams per square centimeter, however, loadings of 0.001-0.009 grams per square centimeter have been found acceptable. The first and second tissue layers 24 and 25 provide containment of the absorbent polymer material, improve lateral wicking of the absorbed exudates throughout the absorbent core 5 and provide a degree of absorbency. In the case of non-particulate hydrogel-forming polymer gelling agents which can be formed into fibrous sheets, foams or films, the non-particulate gelling agent may comprise from about 15% to about 100% by weight of the absorbent core 5, more preferably of from about 40% to about 100%, and most preferably of from about 60% to



about 100%. Two suitable and commercially available non-particulate absorbent materials of relatively low gel strength for use in the absorbent core 5 are a double layer acrylic fibrous material available under the tradename Lanseal F from the Choli Company, LTD., of Higashi, Osaka, Japan and a carboxymethylcellulose fibrous material available under the tradename Aqualon C from Hercules, Inc. of Wilmington, Del.

The total absorbent capacity of the absorbent core 5 should be compatible with the design exudate loading for the intended use of the sanitary napkin 1. Further, the absorbent capacity of the absorbent core 5 may be varied to accommodate wearers ranging in the expected amount of exudate fluid volume. For instance, a different absorbent capacity may be utilized for sanitary napkins intended for daytime use as compared with those intended for night-time use, or for sanitary napkins intended for use by teenage females as compared with those intended for use by more mature women.

Superimposed over the absorbent core 5 and extending 3.0 millimeters beyond the edges 9 and 11 of the absorbent core 5 can be placed wet-laid tissue 31. The wet-laid tissue 31 is liquid permeable. A satisfactory wet-laid tissue 31 has a basic weight of about 15.8 grams per square meter and an air permeability of about 30.5 cubic meters per minute per



square meter at a pressure differential of about 12.08 millimeters of water.

Preferably, the wet-laid tissue 31 maintains integrity when wetted, in use. The wet-laid tissue 31 preferably has a wet tensile strength in the cross-direction of at least about 15.0 grams per centimeter. Suitable tissues 31 and their manufacture are disclosed in U.S. Patent No. 3,301,746, entitled "Process for Forming Absorbent Paper by Imprinting a Fabric Knuckle Pattern thereon prior to Drying and Paper thereof", which patent issued to Sanford and Sisson on January 31, 1967, and which patent is incorporated herein by reference. In a preferred embodiment, those parts of the wet-laid tissue 31 which extend beyond the longitudinal sides 9 and 11 of the absorbent core 5 are associated with the back sheet 7. The wet-laid tissue 31 may be associated with the back sheet 7 by attachment means as are well known in the art such as by spray-gluing on lines or spots of adhesive. The wet-laid tissue 31 serves a number of purposes. The tissue 31 serves to confine any loose superabsorbent material 37 between the tissue 31 and the back sheet 7 thereby preventing the superabsorbent material 27 from coming in contact with the wearer's skin. Also, the tissue 31 improves lateral wicking of the absorbed exudates over the absorbent core 5 thereby providing a more even distribution of the exudates throughout the absorbent core 5. Further,



the tissue 31 provides some degree of absorbency and further inhibits exudates which have reached and been absorbed by the absorbent core 5 from rewetting the wearer's skin.

Superimposed over the wet-laid tissue 31 can be a liquid permeable wipe acquisition sheet 33. In a preferred embodiment, the wipe acquisition sheet 33 is a nonwoven sheet, such as a spunlaced 70%/30% rayon/polyester fiber sheet. Spunlaced fabrics of this type are manufactured by E.I. DuPont Nemours and Company of Wilmington, Delaware, and are made available under the tradename "SONTARA" (SONTARA registered TM by E.I. DuPont Nemours P Company). These fabrics are available in a number of suitable styles; however, Style 8407 in its apertured form, having a basis weight of 0.005 grams per square centimeter and a thickness of about 0.04 millimeters, is preferred. The wipe acquisition sheet 33 extends beyond the edges of the wet-laid tissue 31 where it too is associated with back sheet 7. The wipe acquisition sheet 33 greatly improves lateral wicking of exudates over the absorbent core 5 thereby, in combination with the central acquisition zone 15, providing a more even distribution of the exudates throughout the absorbent core 5. The lateral wicking of the wipe acquisition sheet 33, in combination with the longitudinal spread of liquids in the central acquisition

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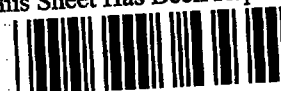
prior art sanitary napkins rely on a high degree of vertical absorption at the point where exudates are initially deposited. In other words, because the absorbent cores of these napkins are fairly thick, they can absorb a high degree of exudates throughout their thickness while utilizing only a small degree of their surface area or lateral absorption capability. However, the relatively thin napkins 10 of the present invention have a comparatively small degree of vertical absorption. Therefore, for a relatively large amount of exudates to be absorbed, a wipe acquisition sheet 33, and a central acquisition zone 15, which can transversely and longitudinally, disperse the exudates over a large surface area of the absorbent core 5 where the exudates can better and faster be vertically absorbed is highly desirable.

Superimposed over the wipe acquisition sheet 33 is the liquid permeable topsheet 3. In a preferred embodiment, the topsheet 3 is associated with the wipe acquisition sheet 33 by spray-gluing the topsheet 3 to the surface of the wipe acquisition sheet 33. The topsheet 3 is compliant, soft feeling, and non-irritating to the wearer's skin. Further, the topsheet 3 is liquid pervious, permitting liquid to readily transfer through its thickness. A suitable topsheet 3 may be manufactured from a wide range of materials such as polymeric materials, formed thermoplastic films, apertured plastic films, porous



foams, reticulated foams, natural fibers (e.g., wood or cotton fibers), synthetic fibers (e.g., polyester or polypropylene fibers) or from a combination of natural and synthetic fibers, with apertured formed films being preferred. Formed films are preferred for the topsheet 3 because they are pervious to liquids and yet non-absorbent. Thus, the surface of the formed film which is in contact with the body remains dry, thereby reducing body soiling and creating a more comfortable feel for the wearer. Suitable formed films are described in US-A-3,929,135, entitled "Absorptive Structure having Tapered Capillaries", which patent issued to Thompson on December 30, 1975, US-A-4,324,246, entitled "Disposable Absorbent Article having a Stain Resistant Topsheet", which patent issued to Mullane and Smith on April 13, 1982, US-A-4,342,314, entitled "Resilient Plastic Web Exhibiting Fiber-like Properties", which patent issued to Radel and Thompson on August 3, 1982, and US-A-4,463,045, entitled "Macroscopically Expanded Three-Dimensional Plastic Web Exhibiting Non-Glossy Visible Surface and Cloth-like Tactile Impression", which patent issued to Ahr, Louis, Mullane, and Ouellette on July 31, 1984, all of which patents are incorporated herein by reference.

In a preferred embodiment of the present invention, the body surface of the topsheet 3 is hydrophilic. The hydrophilic body surface helps liquid to transfer through



the topsheet 3 faster than if the body surface was not hydrophilic. This diminishes the likelihood that menstrual fluid will flow off the topsheet 3 rather than being absorbed by the absorbent core 5. In a preferred embodiment, the body surface of the topsheet 3 is made hydrophilic by treating the body surface with a surfactant. It is preferred that the surfactant be substantially evenly and completely distributed throughout the body surface of the topsheet 3. This can be accomplished by any of the common techniques well known to those skilled in the art. For example, the surfactant can be applied to the topsheet 3 by spraying, by padding, or by the use of transfer rolls. Further, the surfactant can be incorporated into the polymeric materials of a formed film topsheet or between or within the fibers of a nonwoven topsheet.

The back sheet 7 is adjacent the absorbent core 5. In a preferred embodiment, the absorbent core may be affixed to the back sheet 7. Any of the common techniques well known in the art, such as spray-gluing or lines or spots of adhesive may be used for this purpose. The back sheet 7 generally defines the garment surface of the sanitary napkin. The back sheet 7 may be any means which is impervious to liquids and which prevents exudates absorbed and contained in the absorbent core 5 from soiling articles, such as panties, which come in contact with garment surface of the sanitary napkin 1. In the preferred



embodiment of the sanitary napkin 1 illustrated in Figs. 1 and 6, the back sheet 7 is a barrier sheet manufactured from a thin plastic film. Other flexible liquid impervious materials may also be used. Preferably, the back sheet 7 is a polyethylene film having a thickness of from about 0.012 millimeter to about 0.051 millimeter. As used herein, the term "flexible" refers to materials which are compliant and which will readily conform to the general shape and contours of the human body.

A suitable polyethylene film is manufactured by Monsanto Chemical Corporation and marketed in the trade as Film No. 8020. The back sheet 7 is preferably embossed and/or matte finished to provide a more clothlike appearance. Further, the back sheet 7 may permit vapors to escape from the absorbent core 5 which still preventing exudates from passing through the back sheet 7.

Preferably, the topsheet 3 and the back sheet 7 have length and width dimensions generally larger than the absorbent core 5 so that they extend beyond the longitudinal edges 9 and 11 of the absorbent core 5 where they are associated together in a suitable manner. As used herein, the term "associated" encompasses configurations whereby a first member is directly joined to a second member and configurations whereby a first member is indirectly joined to a second member by affixing the first member to



intermediate members which in turn are affixed to the second member. In an embodiment, the back sheet 7 and the topsheet 3 have an elliptical shape and extend beyond the absorbent core 5 a distance of at least about 1.0 centimeter where they are joined directly to each other by attachment means as are well known in the art. The attachment means may be, for example, a uniform continuous layer of adhesive, patterned layer of adhesive, or an array of separate lines or spots of adhesive.

In Fig. 4 the acquisition zone 5 comprises no absorbent gelling material so that the upper sheet 24 can be pressed into the acquisition zone 5 to form a channel 30, as is shown in Fig. 5. The topsheet 3 can also be pressed into the channel 30 to provide a longitudinal groove on the body facing side of the sanitary napkin, thus assisting in increasing the longitudinal spread of liquids along the topsheet 3. As is shown in Fig 7 and 8, the upper and lower sheet 24 and 25 can be parts of a single sheet which sides overlap in the acquisition zone 5, so that an extra layer of tissue is present in the acquisition zone to assist in wicking liquids in the longitudinal direction. Figs. 9a and 9b show how an absorbent core can be produced from a single sheet 35, wherein a strip 37 having a low concentration of absorbent gelling material is symmetrically located. After e-folding of the sheet 35



material is centrally located in the acquisition zone 15 as shown in figure 9b.

In the embodiment as shown in Fig. 11, the layers 24 and 25 of the absorbent core 5 are folded over, so that in the side zones 17 and 19, the core comprises two layers of absorbent gelling material, whereas in the central acquisition zone 15 a single layer of absorbent gelling material is present. A layer of wicking material 30, which may comprise a hydrophilic tissue or non-woven material, or a hydrophilic coating, can extend across the bottom of the acquisition zone 15 and between the layers of absorbent gelling material 29 in the side zones 17 and 19.

Instead of folding over of the core to obtain a double layer of absorbent gelling material in the side zones 17 and 19, a separate pair of fibrous layers enclosing absorbent gelling material may be superimposed in the side zones on a lower pair of fibrous layers enclosing absorbent gelling material. The open sides of the fibrous layers can be sealed off by for instance a hot melt adhesive 26.

It is noted that the acquisition zone 15 does not necessarily extend along the whole length of the absorbent core 5, but can be located in the central region of the core only to prevent leakage of liquids from the core's ends.



To demonstrate the increased product performance of the sanitary napkin according to the invention versus a similar sanitary napkin having a uniform distribution of absorbent gelling across the surface of the absorbent core, the sanitary napkins were wetted by a step-wise increasing load. The test conditions and the products under test will be set out herebelow. The test results are summarized in tables I, II, III and Fig 9.

The tested products

The reference product comprised a shaped laminate core, having a length of 207 mm and a width along the transverse center line 16 of 70 mm. The concentration of absorbent gelling material commercially available from Shokubai under type number L-074 was 5.5 g/sq foot.

The tested sanitary napkins according to the invention comprised a first type having a central acquisition zone of 15 mm in width containing no absorbent gelling material (type A) and a second type having a central acquisition zone of 20 mm in width not containing absorbent gelling material (type B), the concentration of absorbent gelling material in the side zones being 5.5 g/sq feet for both types A and B. The dimensions and materials of the sanitary napkins according to the invention were identical to those of the reference product.



Load to width distribution

To measure the ratio of transverse liquid spread to longitudinal liquid spread under various loading conditions, the sanitary napkins were wetted with Paper Industrial Fluid, having a viscosity of 16.5 cps and containing:

Glycerol	80 g/l
NaCl	10 g/l
NaHCO ₃	4 g/l
Carboxymethylcellulose	18 g/l

The pads were flattened out on a flat surface and the center of the absorbent core 5 was marked on the topsheet of each pad. The center of the core 5 corresponds to the point of interaction of the longitudinal center line 13 and the transverse center line 16, as shown in Fig. 2. 2 ml of fluid were discharged onto the center of the pad within 4s, using a peristaltic pump of type PA-SF 5, marketed by IKA. 5 minutes after completion of the discharge, the farthest points reached by the fluid in the direction of the longitudinal center line 13 and the transverse centerline 16 were measured. Table I gives the results of width of the fluid for respective loadings for the reference product, and the sanitary napkin having a 20 mm wide acquisition zone without absorbent gelling material (type B).



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Table I

Loading versus width distribution

loading (ml)	Distribution width (cm)	
	reference product	type B
2	4.1	4.0
6	6.6	5.8
10	7	6.5
12	7	6.8
14	7	7

From table I it appears that for the sanitary napkin having the central acquisition zone, the liquid reaches the longitudinal sides 9,11 of the core 5 after absorption of 14 ml for which loading the distribution width equals the narrowest width of the core, which is 70 mm. This means that the effective capacity of the sanitary napkin with the acquisition zone is larger than the effective capacity of the reference product, for which at a load of 10 ml the fluid reached the longitudinal sides 9,11 of the product.

Length versus width distribution

From the measurements on the length and the width of the fluid distribution as made in the above described test, the ratio of length and width (l/w) of the fluid distribution was calculated for the sanitary napkin of type A (width of

acquisition zone of 15 mm) and for a sanitary napkin having an acquisitions zone free of absorbent gelling material and measuring 25 mm in width, the concentration of absorbent gelling material in the side zones being 5.5 g/sq foot (type C). Another sanitary napkin, similar to type A, but having a concentration of absorbent gelling material in the acquisition zone of between 1-2 g/sq foot (type D) was also tested. Of each type of sanitary napkin (type A, type C and the reference product), three samples were wetted with stepwise increasing loads of fluid. The results of the average length to width ratio and the standard deviation (av and st. dev) for 3 samples each time, are summarized in table II for type A, type C and the reference product. For the sanitary napkin of type D, only one sample was wetted with increasing loads, so that no standard deviation is available for this type of sanitary napkin.

As appears from table II, and more clearly from Fig. 10, the length-to-width distribution of the sanitary napkins having an acquisition zone not containing any absorbent gelling material, increases with respect to the reference product, for loads larger than 6 ml. It also can be seen by comparing the results of type A and type D product, that a total absence of absorbent gelling material from the acquisition zone results in the larger length-to-width distribution, and that too high a concentration of absorbent gelling material in the acquisition zone results





in a reduced length-to-width ratio compared to the reference product. For an acquisition zone of a width of 15 mm, the length-to-width distribution is better than for an acquisition zone of a width of 25 mm.

Table II

Length versus width distribution

loading (ml)	type A		type C		reference	
	l/w av	st. dev	l/w av	st. dev	l/w av	st. dev
2	1.29	0.02	1.20	0.07	1.18	0.04
4	1.26	0.03	1.26	0.07	1.23	0.11
6	1.40	0.03	1.32	0.02	1.25	0.04
8	1.62	0.02	1.50	0.02	1.34	0.05
10	1.77	0.03	1.68	0.05	1.49	0.09
12	1.93	0.05	1.86	0.06	1.63	0.10
14	2.12	0.04	2.05	0.04	1.75	0.06

Repetitive strike-through test

For type A and type C sanitary napkins, the strikethrough time was tested versus the reference product for stepwise increasing loads. The napkins were placed on a flat surface, and the center of the core was marked on the topsheet. The hole of an electronic strike-through plate was centered on the center of the core, and 2 ml of liquid was discharged via a funnel through the hole of the strike-

through plate. A strike-through timer which is connected to the strike through plate and which stops counting if all fluid has cleared the plate, was set to "record".

Subsequently the liquid was released through the strike-through plate and the time was recorded from the strike-through timer. After 60 seconds, the following load of 2 ml was discharged from the funnel onto the pad, the procedure being repeated until 14 ml was discharged. For each load, three samples of the product of type A, C and the reference product were loaded, and the strike-through time was averaged over these products. The results are summarized in table III. From table III appears that for type C product, having the larger width of the acquisition zone (25 mm), the strike through times are shortest. The difference in strike-through time with respect to the reference product becomes more pronounced for higher loadings (higher than 6 ml).

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Table III

Strike through time

loading (ml)	time (s) type A		time (s) type C		time (s) reference	
	av.	st. dev	av.	st. dev	av.	st. dev
2	4.40	0.17	4.03	0.06	4.13	0.25
4	17.77	2.35	15.30	1.40	21.60	1.32
6	26.27	0.98	23.77	1.50	39.20	1.47
8	39.23	0.12	32.43	1.37	55.43	4.73
10	56.77	4.04	47.23	2.65	77.10	12.87
12	74.60	0.17	61.47	4.56	95.00	11.82
14	86.17	1.62	74.67	2.65	115.03	23.49

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WHAT IS CLAIMED IS:

1. Sanitary napkin comprising a liquid pervious topsheet (3), a liquid impervious backsheet (7) and an absorbent core (5) interposed between the topsheet and the backsheet, the core (5) comprising two longitudinal sides (9,11), a central acquisition zone (15), two side zones (17,19) that are located between the acquisition zone (15) and the longitudinal sides (9,11), the core (5) further comprising a layer (24,25,29) containing absorbent gelling material (29), the concentration of absorbent gelling material in the acquisition zone (15) of the core being lower than the concentration of absorbent gelling material in the side zones (17,19),

characterized in that the absorbent gelling material (29) is comprised between an upper and a lower fibrous layer (24,25), the amount of absorbent gelling material per unit area of fibrous layer in the acquisition zone (15) being lower than the amount of absorbent gelling material per unit area in the side zones, the width of the acquisition zone and the concentration of absorbent gelling material in the side zones being adapted for transport of liquids in a predominantly longitudinal direction of the core.

2. Sanitary napkin comprising a liquid pervious topsheet (3), a liquid impervious backsheet (7) and an absorbent





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core (5) interposed between the topsheet and the backsheet, the core (5) comprising two longitudinal sides (9,11), a central acquisition zone (15), two side zones (17,19) that are located between the acquisition zone (15) and the longitudinal sides (9,11), the core (5) further comprising a layer (24,25,29) containing absorbent gelling material (29), the concentration of absorbent gelling material in the acquisition zone (15) of the core being lower than the concentration of absorbent gelling material in the side zones (17,19),

characterized in that the absorbent gelling material (29) is comprised between an upper and a lower fibrous layer (24,25), the side zones (17,19) comprising at least one more layer of absorbent gelling material than the acquisition zone (15), the width of the acquisition zone being adapted for transport of liquids in a predominantly longitudinal direction of the core.

3. Sanitary napkin according to claim 2, characterized in that the upper and the lower fibrous layer (24,25) are folded over along the longitudinal sides (9,11), each side zone (17,19) comprising at least two pairs of fibrous layers, a layer of absorbent gelling material (29) being comprised between each pair of fibrous layers.

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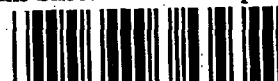
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4. Sanitary napkin according to claims 2 or 3, characterized in that a layer of wicking material (30) is located between the layers of absorbent gelling material (29) in the side zones (17,19), the wicking material extending across the width of the central acquisition zone (15).

5. Sanitary napkin comprising a liquid pervious topsheet (3), a liquid impervious backsheet (7) and an absorbent core (5) interposed between the topsheet and the backsheet, the core comprising two longitudinal sides (9,11), a central acquisition zone (15), two side zones (17,19) that are located between the acquisition zone (15) and the longitudinal sides (9,11), the core further comprising a layer wherein an absorbent gelling material is mixed with an absorbent bulk material, preferably fibers or foam,

characterized in that the layer is continuous, the side zones and the acquisition zone being located within the layer, the width of the acquisition zone and the concentration of absorbent gelling material in the side zones being adapted for transport of liquids in a predominantly longitudinal direction of the core.

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6. Sanitary napkin according to any of the previous claims characterized in that the width of the acquisition zone is between 5 and 28 mm, preferably about 15 mm.
7. Sanitary napkin according to any of the previous claims, the sanitary napkin comprising a transverse center line (16) characterized in that a dimension of the sanitary napkin along the transverse center line is between 4 and 10 cm, preferably between 6 and 7.5 cm, the width of the acquisition zone being between 10 and 20 mm, preferably about 15 mm.
8. Sanitary napkin according to claim 6 or 7 characterized in that the concentration of absorbent gelling material in the acquisition zone is between 0 and 3.59 g/sq foot and the concentration of absorbent gelling material in the side zones is between 2 and 7.5 g/sq foot for absorbent gelling material having a gel strength less than about 1.2 kPa after exposure to synthetic urine in a modified AGEP test and between 2 and 15 g/sq foot for absorbent gelling material having a gel strength higher than about 1.2 kPa after exposure to synthetic urine solution in a modified AGEP test.
9. Sanitary napkin according to claim 8 characterized in that the concentration of absorbent gelling material in the acquisition zone is between 0 and 2 g/sq foot, preferably





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about 0 g/sq foot, the concentration of absorbent gelling materials in the side zones being between 3.5 and 6.5 g/sq foot, preferably about 5.5 g/sq foot for absorbent gelling material having a gel strength lower than about 1.2 kPa after exposure to synthetic urine in a modified AGEF test, and between 7 and 12 g/sq foot, preferably about 10 g/sq foot for absorbent gelling material having a gel strength higher than about 1.2 kPa after exposure to synthetic urine solution in a modified AGEF test.

10. Sanitary napkin according to any of the previous claims, characterized in that in the side zones the absorbent gelling material is evenly distributed.

11. Sanitary napkin according to any of the previous claims, characterized in that the length of the acquisition zone is between 0.5 and 1 times the core length.

12. Sanitary napkin according to any of the previous claims, characterized in that in that the acquisition zone (15) the upper fibrous layer is depressed to form a channel (30).

13. Sanitary napkin according to any of the previous claims, characterized in that in the acquisition zone, the absorbent gelling material has been replaced by a wicking material.

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14. Sanitary napkin according to any of the previous claims, characterized in that in the acquisition zone has been treated with a wetting agent.
15. Sanitary napkin according to any of the previous claims, characterized in that the acquisition zone is symmetrical about a longitudinal center line (13) of the sanitary napkin.
16. Sanitary napkin according to any of the previous claims, characterized in that the upper and the lower fibrous sheet (24,25) are formed by a single tissue (35), the tissue (35) having two mutually opposed longitudinal edges which are superimposed in the acquisition zone (15).



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