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Method for producing a continuous thermoplastic coating and articles constructed therefrom

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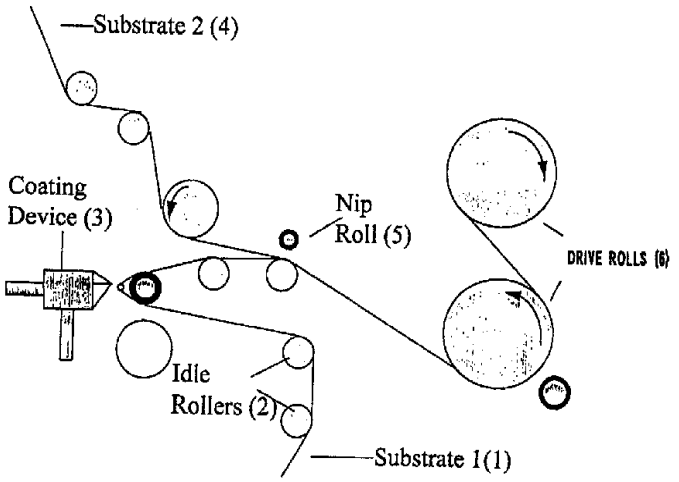

(57) Abstract

This invention relates to a non-contact coating method for producing a continuous coating and articles constructed therefrom. This invention further relates to a method for producing a textile material with a moisture-impermeable barrier layer and to a method for producing a moisture-absorbing article of hygiene which has such a barrier layer. This invention particularly relates to a textile material and hygienic disposable articles comprising a body fluid impermeable barrier layer produced from said coating method. Preferably, the thermoplastic composition used in the method for producing the barrier layer exhibits certain rheological characteristics.

METHOD FOR PRODUCING A CONTINUOUS THERMOPLASTIC COATING AND ARTICLES CONSTRUCTED THEREFROM

Field of the Invention

This invention relates to a non-contact coating method for producing a continuous coating and articles constructed therefrom. This invention further relates to a method for producing a textile material with a moisture-impermeable barrier layer and to a method for producing a moisture-absorbing article of hygiene which has such a barrier layer. This invention particularly relates to a textile material and hygienic disposable articles comprising a body fluid impermeable barrier layer which can be produced from said coating method. Preferably, the thermoplastic composition used in the coating method for producing the barrier layer exhibits certain rheological characteristics.

Background of the Invention

For various applications, materials are required which are impermeable to liquids such as water and body fluids, but at the same time have a textile character which is as close as possible to materials without the impermeability characteristics. One example of such application is hygienic articles such as disposable diapers, feminine napkins, panty liners, surgical drapes, bed pads, and the like. Such hygienic articles often have a substantial absorption capacity. To ensure that the liquid which is to be absorbed does not reach articles of clothing, such hygienic articles customarily have a continuous layer of a body fluid impermeable film on their garment facing side. Since touching this film material is an unwelcome sensation for a number of users, it has been suggested to cover the outward side of the film with a thin layer of textile material so that the article has a textile feel also on its exterior surface. EP-A-0 187 728 teaches a disposable diaper with a barrier layer in the form of a plastics material film, typically consisting of a polyolefin, a polyacrylate, of PVC, nylon or other thermoplastic material. The barrier film is laminated, adhered or

welded onto a thin nonwoven layer, which makes it necessary to prepare the film laminate off-line. As an alternative, it is suggested that the plastics material of the film is to be extrusion coated onto the nonwoven. The laminate, thus formed, is then used as the outermost material layer in such a way that the film layer is on the inside, so that the outer nonwoven layer provides the desired exterior texture. This production method is rather expensive. Highly polymeric plastic materials such as polyethylene, polypropylene, polyacrylate and so on, have low melt flow indices and can (if at all) only be processed into impermeable films on very sophisticated machinery. This would also be true for the suggested direct extrusion coating which does not appear to have been reduced to practice yet. Separately producing the film, with subsequent laminating onto the nonwoven, is even more inefficacious in view of the additional production step required.

US patents 4,692,161 and 4,627,847 teach a leakage waist barrier for the edge of an absorbent hygienic article provided by coating a hotmelt adhesive onto the edge area of a nonwoven sheet material. Depending on the actual type of application, this hotmelt adhesive can also serve a constructive function, in combination with its function as a barrier, in that it can adhere the nonwoven to other materials of the hygienic article. The hotmelt is to be coated in a conventional manner by slot nozzle coating, transfer coating, spray coating or other such methods. The above-mentioned US patents indicate that the hotmelt coating must have a minimum thickness of 25 µm, preferably at least 75 µm, so that a continuous closed barrier layer is achieved. Conventional slot nozzle coatings on uneven substrates such as nonwovens are typically done by keeping the slot nozzle in permanent contact with the substrate such that the nozzle lies on the substrate during the coating. It is unproblematic to coat hotmelt adhesives onto uneven substrates with slot nozzles or spray coating methods, provided that only a discontinuous coating is required such as for constructive applications wherein the coating weight of the hotmelt ranges from about 3 g/m^2 to about 10 g/m^2. If, however, a continuous layer is to be created, this can

only be done using these customary coating methods if the coating weight of the hotmelt is greater than about 30 g/m^2.

Such high coating weights are expensive. Furthermore, direct coating with a slot nozzle provides substantial mechanical and thermal stresses on the coated substrates, especially since the slot nozzle is heated during coating. Therefore, very sensitive substrates such as nonwovens made of very fine or low melting point fibers can not always be coated with hotmelt from a slot nozzle in a customary manner without damaging the substrate. Such problems can not be overcome when coating with heated coating rollers or spray coating with heated airstreams. The high coating weights of this prior art lead to increased stiffness of the coated substrate, thus impairing the textile character.

Similar problems occur in the production of hygienic articles and in other areas, such as fabric production, wherein the resulting materials are required to exhibit liquid impermeability, especially body fluid impermeability, with textile character which is as unimpaired as possible. This is especially pertinent for improving the comfort of the user. Presently, in such technical fields, production methods utilizing preformed laminated films are preferred.

Therefore, there remains a need for a non-contact method capable of producing a continuous coating layer having low coating weights.

Summary of Invention

According to a first aspect of the present invention there is provided an article having a barrier layer, wherein said barrier layer is a coating comprising a thermoplastic composition wherein the complex viscosity at the coating temperature of said composition is less than 500 poise at 1000 radians/second and ranges from 100 to 1000 poise at 1 radian/second, wherein said composition is coated at an area weight of less than 20 g/m^2.

The invention further provides an article comprising a barrier layer, said barrier layer formed by a method comprising the steps of:

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(a) providing a flowable thermoplastic composition having a complex viscosity at a coating temperature of less than 500 poise at 1000 radians/second and ranging from 100 to 1000 poise at 1 radian/second;

(b) providing a moving substrate;

(c) dispensing said thermoplastic composition as a continuous film from a costing device;

(d) suspending said film between said coating device and said substrate; and

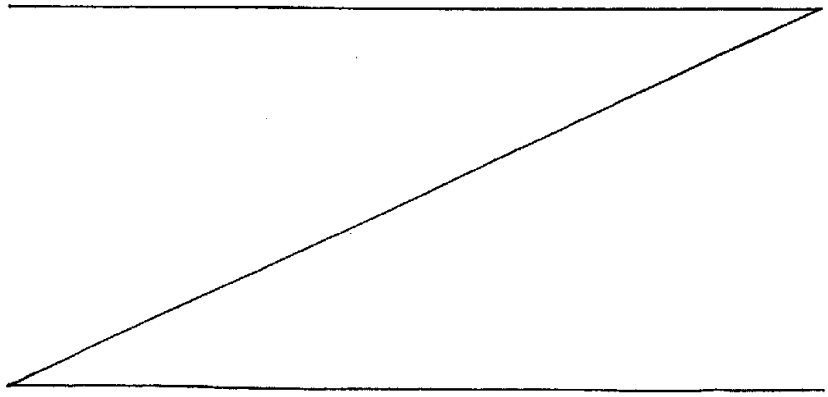
(e) contacting said film with said substrate.

Brief Description of the Drawing

Figure 1 depicts the method of the present invention wherein a continuous thermoplastic coating is formed and adhered to a carrier substrate.

Detailed Description of the Drawing

Substrate 1 (1) travels past a series of idle rollers (2) to ensure the web is in proper alignment prior to approaching the coating device (3). At start up the coating device is initially in contact with the substrate to adhere the leading edge of the coating to the substrate. As substrate 1 is advanced by the drive rolls (6), the coating device is removed from substrate 1 at a distance most



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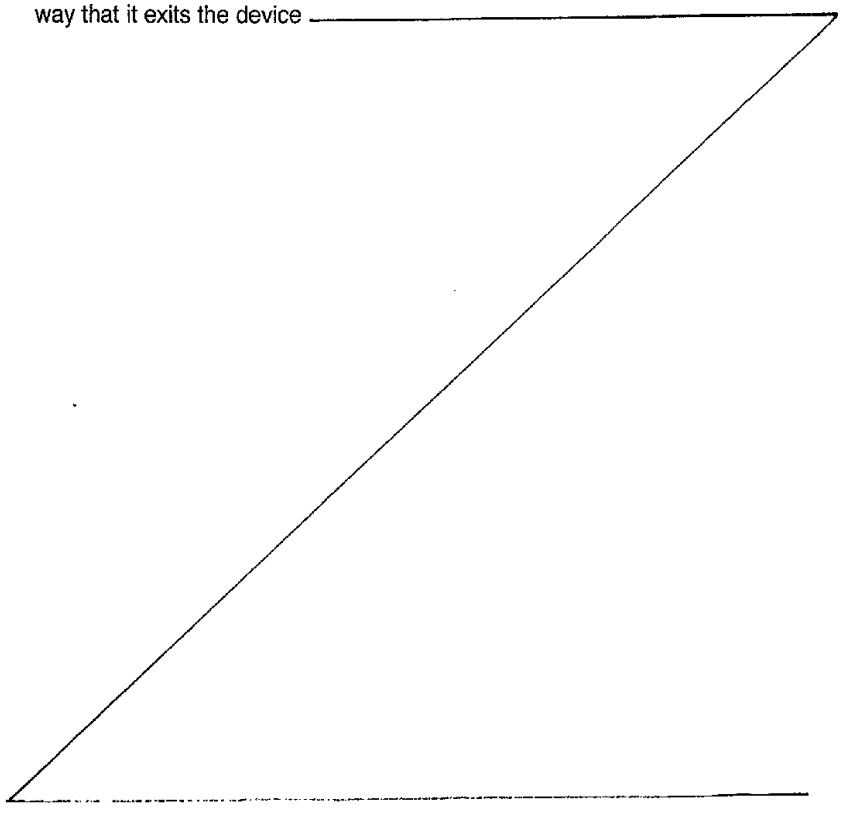
often ranging from about 0.5 mm to about 20 mm, depending on the properties of the thermoplastic composition being coating. Substrate 2 (4) is optionally adhered to the coating surface by means of a nip roll (5). In the preferred embodiment, substrate 2 may be any substrate present in a hygienic article such as an absorbent, elastomeric strands or webs, tissue, films, coverstock materials such as nonwoven or perforated polyethylene, we well as any material that is not necessarily in the form of a web such as superabsorbent polymer.

Detailed Description of the Invention

In the method of the present invention, a melted hotmelt adhesive, preferably substantially air-free is released from a coating or release device in such a way that it exits the device



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as a continuous film. A typical example for this is a slot nozzle, as it has previously been used for coating in direct contact with a substrate. Thus, melt coating devices which are already at hand can be reset for use according to the invention in that the slot nozzle is lifted off the substrate and is adjusted to have a suitable distance from the substrate.

When the viscous but flowable molten adhesive leaves the coating device, it does not contact the substrate immediately, but rather travels for a distance as a continuous coating film suspended above the substrate without touching either the device or the substrate. The distance between the coating device and the substrate ranges from about 0.5 mm to about 20 mm. It is possible that at suitable machine speed settings, and with specific adhesives or other coating materials, the distance can be even greater than 20 mm. The distance is largely dictated by the viscosity and open time of the thermoplastic composition being coated. It is surmised that the thermoplastic composition cools sufficiently in its suspended state such that it has built in viscosity and cohesive strength to the extent that any filaments or fibers present on the substrate surface cannot penetrate the coating, yet the thermoplastic composition is molten or soft enough to adequately adhere to the substrate.

It has been shown to be especially advantageous, that the coating later contacts the substrate in a substantially horizontal direction rather than in a vertical direction. To realize this advantage, a roller can be provided in the path of movement of the substrate to give the substrate a substantially vertical, upward direction, as the substrate passes the coating device. Additionally, the coating device, such as a slot nozzle, can be provided substantially horizontally beside the roller so that the coating travels from the side towards the surface of the substrate.

The diameter of the coating role is preferably about 15 mm to about 50 mm in diameter with the nozzle slightly above the center of the coating roll such that the angle at which the thermoplastic coating contacts the substrate is less than about 60° as the substrate is moving away form the nozzle. The coating

head is adjusted by one of ordinary skill in the art to optimize for even flow and distribution of the thermoplastic coating over the entire width of the application.

Thereafter, the sufficiently cooled coating contacts the substrate surface and adheres to the surface without deeply penetrating into the substrate. When the substrate is preferably a textile material such as a nonwoven, the thus produced material comprises the textile substrate layer and a coating, preferably a hotmelt barrier layer. If the thermoplastic coating is of such a composition that it substantially detackifies after sufficient cooling, the laminate of the coated substrate, thus formed, can be rolled up and stored. The laminate can then be used at some later time e.g. as a body fluid impermeable backsheet having improved tactile quality in a disposable hygienic article. The laminate can be bonded by any suitable bonding technique including ultrasonic bonding, heat welding, or more commonly adhesive bonding.

Preferably, the coating of the barrier layer is done "inline" immediately before any further processing of the thus produced coated textile laminate. In such a case, the surface of the barrier layer which is pointing away from the substrate and is still sufficiently tacky can be used for a constructive adhesion step and therefore can also serve to bond the coated textile material to other elements of a hygienic article. Other elements that could be simultaneously bonded in this manner during the formation of the barrier layer include absorbent, superabsorbent polymer, elastomeric strands or webs, tissue, films, as well as various permeable coverstock materials such as nonwoven or perforated films.

Since the hotmelt coating can be provided at extremely low temperatures, materials can also be provided with barrier layers which are too sensitive mechanically and/or thermally for customary coating methods.

Such sensitive materials include low gauge polyethylene materials, low basis weight nonwovens and the like.

A substantial advantage of the invention is that continuous, sufficiently impermeable barrier layers can be made from hotmelts

at very low coating weights. Even with customary commercially available hotmelts, closed barrier layers can be produced at coating weight of not more than 30 g/m^2, and generally, it is easily possible to achieve coating weights between 10 g/m^2 and 20 g/m^2 and most preferably less than 10 g/m^2. As previously stated, the prior art coating of hotmelts according to customary methods for forming edge leakage barriers, as in US patent 4,692,161, requires area weights of about 70 g/m^2 to create the preferred film thickness of around 75 µm. At thickness of 25 µm, the suggested minimum according to this art, the contact-coated layer is perforated by substrate fibre, and is not closed.

The very thin barrier layers which can be produced according to the invention do not only contribute to the economical advantages of the inventive method, but also make it possible to achieve a very much reduced stiffness of the material, which thus comes much closer, in its properties, to a textile material which is not provided with a barrier layer at all.

The Thermoplastic Composition

As previously mentioned, uncompounded thermoplastic materials such as polyolefins, especially polyethylene, polypropylene, amorphous polyolefins such as Vestoplast 703® (Hüls) and the like, may be suitable thermoplastic materials for the coating method of the present invention. However, hotmelt adhesives are preferred due to the ability to independently tailor the visco-elastic properties, open time, tack, and various other properties. Hotmelt adhesives commonly have melt flow indices required for such processing already at very low temperatures. Typical hotmelts are fluid enough for such processing at temperatures ranging from about 60°C to 110°C.

More preferably, the thermoplastic composition exhibits certain rheological characteristics such that a continuous, especially a body fluid impermeable coating can be produced at coating weights of less than about 30 g/m^2. In general, the rheological properties preferably fall within a rheological window wherein the complex viscosity at high shear rates (1,000 rad/sec) is less than about 500 poise and the complex viscosity at low shear rates

(< 1 rad/sec) is between about 100 and about 1,000 poise. In other words, preferable thermoplastic compositions exhibit Newtonian regions at low shear rates and shear thinning at higher shear rates. Thermoplastic compositions having wide windows of application are those in which the composition exhibits the appropriate rheological properties at a variety of application settings, particularly low temperatures. Narrow application windows are those in which the rheological parameters are only met under very specific conditions. Amorphous polyolefins based hotmelt adhesives such as Lunatack® D-8370 (H.B. Fuller Company) tend to exhibit relatively flat viscosity curves at low shear rates (less than bout 10 rad/sec) and consequently relatively wide application windows. Block copolymer based hotmelt adhesives tend to exhibit particularly steep viscosity profiles causing very narrow application windows.

Data generated that supports this rheological window is depicted in Table I. The test procedures used to determine the rheological data are described in detail hereinafter.

The applicants surmise that the high shear information relates to the processing conditions at the slot die exit. A composition with too high of a complex viscosity at 1,000 radians/sec would require excessive pump pressure to exit the coating device. A die with a shim gap larger than 3 mm could be used to process these materials but a higher coating weight may result.

The low shear information relates to the settling of the coating on the substrate during the time it is suspended above the substrate. If the low shear value is too high, the coating may not adhere adequately to the substrate and/or the thermoplastic composition builds up at the nozzle causing a streaked, discontinuous coating. If the low shear viscosity is too low, the coating may seep into the substrate, causing poor barrier properties.

Extensional viscosity, which was not measured can also strongly influence the melt strength. Higher levels of branching or the addition of a small concentration of a high molecular weight material can strongly influence the melt strength. More preferred, are compositions that meet the target rheological

parameters at low application temperatures of less than about 125°C, most preferably less than about 110°C.

Accordingly, many known hotmelt adhesive compositions are well suited for use in the coating method of this invention. Hotmelt adhesives typically comprise at least one thermoplastic polymer, at least one plasticizer and at least one tackifying resin. Preferably, such suitable hotmelts comprise up to 40% by weight of thermoplastic polymer, up to 40% by weight of a plasticizer and up to 70% by weight of tackifying resin.

With respect to the thermoplastic polymer, atactic polyalphaolefins such as Vestoplast® 708 (Hüls) and synthetic rubbers such as S-EB-S block copolymers have been found to be especially suited, particularly those as used in hotmelt adhesives such as Lunatack® D-3964 (H.B. Fuller). Further, however, also other thermoplastic polymers are suitable, such as ethylene-vinylacetate copolymers or other synthetic rubbers as available in commerce under the tradenames Kraton®, Solprene®, and Stereon®.

Plasticizers and tackifying resins used in hotmelt adhesives are known. Oils such as naphthenic oils are preferred plasticizers. As for tackifying resins, those resins already known for such purposes are generally suitable, especially hydrocarbon resins, ester resins and other such compatible resins. The components are mixed and processed in a known manner to prepare the hotmelts which can be used according to this invention.

With suitable hotmelts, such as those described in DE-A-41 21 716, it is also possible to make materials which are impermeable to liquid water, yet water vapor permeable rendering the coating "breathable".

In addition to commonly known hotmelt adhesives, thermoplastic compositions comprising a water soluble, saline (body fluid) insoluble copolyester such as Eastman AQ 1350®, commercially available from Eastman, are also particularly useful for creating barrier films that are impervious to body fluid, yet readily water soluble. This feature is of particular interest for creating flushable and compostable disposable hygienic products. Furthermore, there may be applications wherein water permeability

is desired. Accordingly, this coating method may also be suitable for coating water permeable, water soluble and/or biodegradable thermoplastic materials.

Hereinafter, the invention will be further depicted by the following non-limiting examples.

Embodiment example 1:

Several hotmelts which slightly differ from each other in composition were formulated in the following composition ranges:

20 - 25% naphthenic oil

30 - 40% atactic polyolefin(s)

35 - 45% hydrocarbon resin

Embodiment example 2:

Several hotmelts were formulated within the following range limits:

15 - 20% SIS-block copolymer

15 - 25% naphthenic oil

50 - 65% ester resin

Embodiment example 3:

As a commercially available hotmelt adhesive, the "Lunatack D 8370" product was used, which is available from H. B. Fuller GmbH. This is a hot-melt adhesive comprising about 35% polyolefine, about 40% hydrocarbon resin with a cyclopentadiene component, about 15% polyisobutylene and about 10% naphthenic oil.

Testing Procedure

The hotmelts according to embodiment examples 1 through 3 were placed in a customary processing machine provided with a slot nozzle such as Nordson EP 51. The slot nozzle was provided horizontally facing a roller over which a polypropylene nonwoven was led in an upward direction. The distance between the slot nozzle and the substrate was 2 mm, at a nozzle slot length of 70 mm. The web speed of the nonwoven was 25 m/min. At a system pressure of about 53 bar and a release temperature of the

hot-melt of approximately 100°C, the hotmelt was coated onto the substrate, where it formed a closed barrier layer. Immediately thereafter, the thus coated substrate was adhered to a customary absorptive body (tissue). In each case, a reliable adhesive bond between substrate and tissue was provided, and in each case, the hotmelt barrier layer formed between the tissue and the substrate was found to be completely liquid-impermeable. Processing was without any problems. The coating weight was an average of 21 g/m^2. At corresponding fine adjustment of release temperature of hotmelt, system pressure, distance between slot nozzle and substrate, machine speed etc. etc., it was systematically possible to form water-tight closed barrier layers at area weights of less than 20 g/m^2 on this substrate.

Examples 4-16:

Table 1 depicts rheological data on Examples 4 through 16. Column 2 of Table 1 depicts the reference temperature for the rheological parameters as well as the coating application temperature for each sample. Table 2 depicts the chemical description of examples 4 through 9 as well as the coating parameters for those examples in which a continuous coating resulted. A consistent continuous coating was not able to be produced with Samples 4 through 9 at the temperature indicated in Column 2. The applicants surmise that the inability to produce a continuous coating is due to the complex viscosity being greater than about 1000 poise at about 1 rad/sec. By comparing examples 5 with 14 and 4 with 10, the complex viscosity at 1 rad/sec can be forced into the rheological window by increasing the temperature. By comparing example 7 with 16, the applicants have demonstrated the relatively narrow rheological window of Lunatack® D-3964. At 90°C D-3964 exhibits too high of a complex viscosity at 1 rad/sec. At 110°C, D-3964 exhibits to low of a complex viscosity at 1 rad/sec, causing the material to soak into the substrate. The applicants surmise a temperature exists between 90°C and 110°C wherein D-3964 would produce a continuous coating. However, a thermoplastic composition exhibiting such a narrow rheological window would have little chance of commercial success.

Example 14 exhibits the utility of blending a thermoplastic composition that does not meet the rheological window with another material such that the resulting composition is useful for producing a continuous coating. In this particular example, since D-3964 exhibits too low of a complex viscosity at 1 rad/sec, it is blended with a material to raise the complex viscosity at 1 rad/sec such that the blend exhibits the preferable rheological properties. Alternatively, examples exhibiting too high of a complex viscosity at 1 rad/sec, such as examples 4 through 9 can be blended with compatible materials to lower the complex viscosity such that the blended material may be coated at the preferable application temperature of less than 125°C.

Examples 4 through 16 were tested in a similar manner as Examples 1 - 3. The application conditions and rheological data of the adhesive compositions are depicted in Table 1. A system pressure ranging from about 40 to about 65 bar was obtained during coating of examples 10 through 16.

The rheological data was generated from a dynamic mechanical spectrometer such as a Rheometric Scientific RDS 7700 (10,000 g/cm transducer, 10 g/cm - <10,000 g/cm torque). A master curve of G' (shear storage modulus), G" (shear loss modulus) and complex viscosity as a function of frequency was obtained through time temperature superposition. During testing the sample was loaded at the upper test temperature between 50 mm diameter parallel plate discs with a 1 to 2 mm gap. After allowing the sample temperature to stabilize for at least about 10 minutes, a frequency sweep was performed from about 0.1 to about 100 radians per second. Upon the completion of the frequency sweep, the sample temperature was lowered to the next temperature and the procedure repeated. The strain amplitude was adjusted to improve the resolution and ranged from about 20% to about 40%. After the frequency sweep was completed at the final, lowest temperature, time-temperature superposition was used to overlay the data into a single master curve at the application temperature. If the actual coating temperature was not one of the actual temperatures tested, the Williams, Landel, Ferry (WLF) (Ferry, J.D.

Viscoelastic Properties of Polymers, 3rd Ed., Wiley: NY, 1980) equation was used to obtain the master curve.

Table 1

Example	Temp. (°C)	Complex Viscosity 1 rad/sec (poise)	Complex Viscosity 10^3 rad/sec (poise)	G' 1 rad/sec (dynes/cm^2)	Crossover Frequency (rad/sec)	Tan delta @ 1 rad/sec	Slope = Visc @ 1/1000 rad/sec	Continuous Coating Formed yes/no
4	125	15000	100	10000	1	1	150	no
5	90	10000	300	3000	300	3	33	no
6	120	4500	1500	300	1000	30	4.5	no
7	90	3000	100	400	50	7	30	not tested
8	110	2000	500	700	10000	3	4	no
9	140	1000	500	50	>1000	70	2	no
10	160	200	200	5	>1000	4	1.25	yes
11	125	800	100	5000	20	1	8	yes
12	125	800	100	100	1000	10	8	yes
13	125	300	50	200	1	1	6	not tested
14	110	300	50	20	7000	20	6	yes
15	128	100	80	10	1000	10	1.25	yes
16	110	100	3.5	8	100	25	28	no

Table 2

Example	Tradename(s)	Chemical Description	Coating Weight (GSM)	Speed M/MIN	Permeability cm^3 of H_2O pressure
4	347-BD-19 (H.B. Fuller)	atactic polyolefin hotmelt adhesive (HMA)			
5	D-3964 + 10% Vestoplast® 750	SEBS block copolymer/hydrocarbon resin/napthenic oil HMA + atactic polyolefin			
6	Eastman AQ® 1350	water dispersible copolyester (WO 95/18191)			
7	D-3964	SEBS block copolymer/hydrocarbon resin/napthenic oil HMA			
8	NP-2085 (HBF)	urethane			
9	Eastman AQ® 1350	See Example 9			
10	Eastman AQ® 1350	See Example 9			
11	Vestoplast® 703 (Huls)	atactic polyolefin	22	30	-
12	347-BD-33 (HBF)	atactic polyolefin HMA	10	30	100
13	Vestoplast® 703 + 10% Paraflint H4 wax	atactic polyolefin + Fischer Tropsch wax			
14	D-3964 + 10% Vestoplast 750	SEBS block copolymer/hydrocarbon resin/napthenic oil HMA + atactic polyolefin	9-11	34	50
15	D-8370	atactic polyolefin HMA	12	30	46
16	D-3964	See Example 10	8	30	-
17	Vestoplast® 750 + 10 % Wax	See Example 13	15-16	30	-

CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An article having a barrier layer, wherein said barrier layer is a coating comprising a thermoplastic composition wherein the complex viscosity at the coating temperature of said composition is less than 500 poise at 1000 radians/second and ranges from 100 to 1000 poise at 1 radian/second, wherein said composition is coated at an area weight of less than 20 g/m^2.

2. An article according to claim 1, further comprising a permeable substrate layer, said barrier layer being substantially adhered to the permeable substrate layer on at least one face thereof.

3. An article according to claim 2, wherein said barrier layer includes a hotmelt adhesive coated as a continuous film.

4. An article according to claim 1, wherein said barrier layer is a fluid impermeable barrier layer.

5. An article according to any one of the preceding claims, wherein the article further comprises at least one absorbent material.

6. An article according to any one of the preceding claims, wherein the barrier layer is moisture-vapor permeable.

7. An article according to any one of the preceding claims, wherein the permeable substrate layer is a textile material.

8. An article according to any one of claims 3-7, wherein the hotmelt adhesive comprises at least one polymer selected from the group consisting of block copolymers, water dispersible copolyesters, ethylenic copolymers, polyolefins, metallocene polyolefins, atactic polyolefins and mixtures thereof.

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9. An article according to claim 8, wherein the coating temperature is less than 160°C.

10. An article according to any one of claims 3-9, wherein the hotmelt adhesive forming the barrier layer is subsequently bonded to at least one other material.

11. An article according to any one of claims 3-10, wherein the hotmelt adhesive is bonded to at least one other material inline after coating of the thermoplastic composition.

12. An article according to any one of the preceding claims, wherein the area weight of the barrier layer is less than 10 g/m^2.

13. An article according to claim 1 comprising a permeable substrate and a body fluid impermeable barrier layer substantially adhered to the permeable substrate on at least one face, wherein the area weight of said barrier layer is less than 10 g/m^2.

14. An article having a barrier layer according to claim 1, said barrier layer formed by a method comprising the steps of:

(a) providing a flowable thermoplastic composition having a complex viscosity at a coating temperature of less than 500 poise at 1000 radians/second and ranging from 100 to 1000 poise at 1 radian/second;

(b) providing a moving substrate;

(c) dispensing said thermoplastic composition as a continuous film from a costing device;

(d) suspending said film between said coating device and said substrate; and

(e) contacting said film with said substrate.

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15. The article of claim 14 wherein the thermoplastic composition is shear thinning.

16. An article substantially as herein before described and illustrated.

Dated this 31st day of March 1999

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By their Patent Attorneys,
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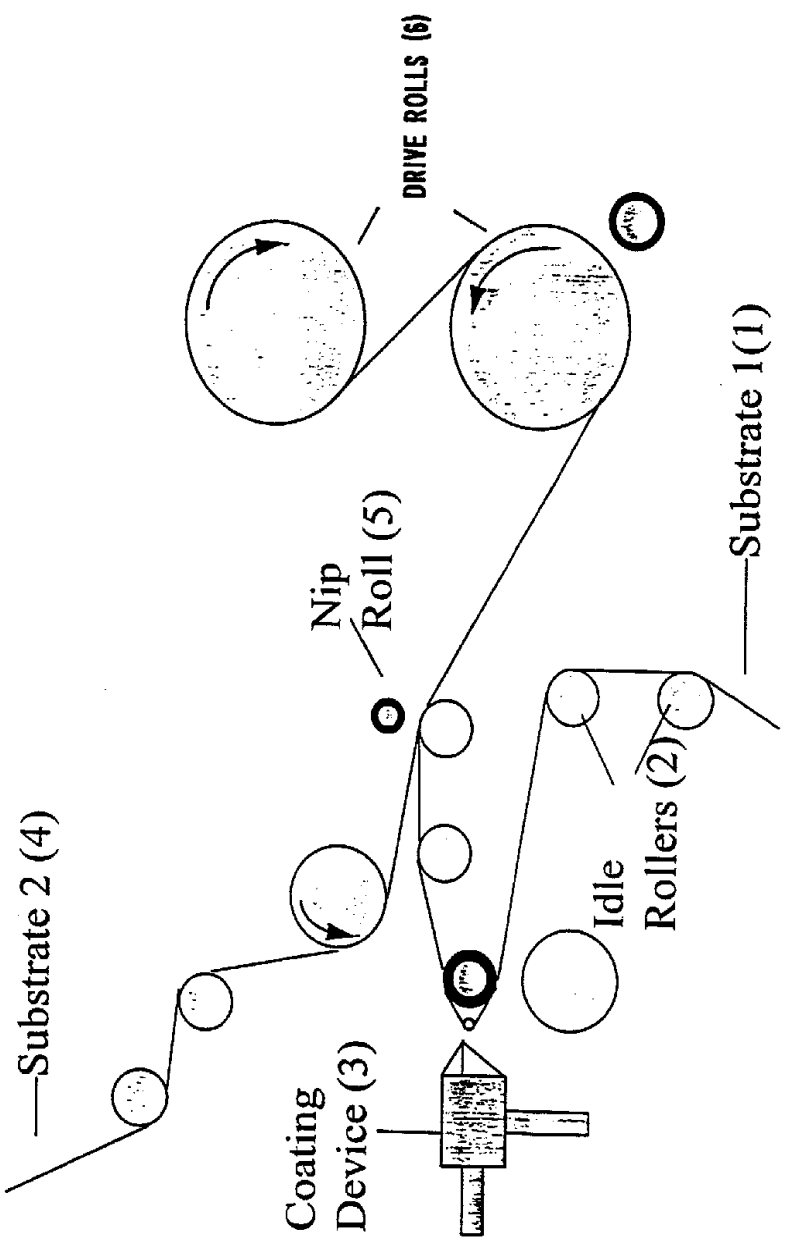
FIGURE 1


DRIVE ROLLS (6)
Substrate 1(1)
Nip Roll (5)
Substrate 2 (4)
Idle Rollers (2)
Coating Device (3)