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(54) **MULTI-LAYERED PLASTIC FILM WITH SEPARATION EFFECT**

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ABSTRACT

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An at least monoaxially stretched, multi-layer film with separation effect and a total thickness of $\leq 18 \mu\text{m}$ which has on at least one surface an at least partial embossing.

MULTI-LAYERED PLASTIC FILM WITH SEPARATION EFFECT

[0001] This application is a Continuation of International Patent Application No. PCT/EP2015/000611, filed Mar. 19, 2015, which claims foreign priority benefit under 35 U.S.C. §119 of German Patent Applications 10 2014 004 042.9 filed Mar. 21, 2014, and 10 2014 010 691.8 filed Mar. 21, 2014, the contents of all of which are incorporated herein by reference.

[0002] The present invention relates to a multilayer polymeric film with release effect which is oriented at least monoaxially and has a total thickness $\leq 18 \mu\text{m}$, preferably $\leq 12 \mu\text{m}$, having on at least one surface an at least partial embossment, and the use of the inventive polymeric film as packaging material, preferably for individually packaged hygiene products or incontinence products.

BACKGROUND OF THE INVENTION

[0003] It is known that polymeric films with release effect are used for numerous applications, such as, for example, as protective films and/or release films for adhesive products which are used in industrial areas, such as in the construction sector, in the furniture industry, or in the packaging industry, for example. Polymeric films with release properties are also used preferentially in the hygiene sector for the packaging of adhesive articles, preferably self-adhesive articles, preferably for single use. Since such hygiene articles, like pantliners or sanitary towels, but also incontinence articles, are packaged individually with an increasing tendency, the demand for such packaging material is rising increasingly. Since not only this use as packaging material, but also other uses as protective films and release films, prevent any recycling and hence practically any repeat use, attempts are also increasing to use as few fossil resources as possible for the provision of these polymer materials as well. This means that such polymeric films should be produced by using as little as possible of polymers based on fossil raw materials, but without making any impacts on the vital quality requirements of such polymeric films, more particularly on their mechanical properties, on their release effect, barrier properties, and other necessary physical properties.

[0004] In order to save on polymer material in the production of the polymeric film, it is obvious first of all to reduce the overall layer thickness of a multilayer polymeric film of this kind. Since, however, this usual approach can cause in some cases a drastic reduction of the mechanical properties of such a polymeric film, such as of its tensile stress, of its tear resistance, and possibly of its puncture resistance, for example, which has not only adverse effects on the handling of the polymeric film during its further processing to the end product, but may also have a negative influence on the durability of the corresponding packaging.

[0005] Accordingly, such possibility for saving material creates inconsiderable risks. Moreover, there can also occur difficulties during the application of the release coating on the polymeric films having only a total layer thickness of $\leq 20 \mu\text{m}$.

[0006] It was an object of the present invention, therefore, to provide a polymeric film with release properties which in spite of a reduction of the total thickness of the polymeric film to below $20 \mu\text{m}$, still has excellent mechanical properties, particularly for undisturbed handling and further processing, as well as an excellent release properties.

SUMMARY OF THE INVENTION

[0007] This object is achieved by the provision of a multilayer polymeric film with release properties which is oriented at least monoaxially and has a total thickness of $\leq 18 \mu\text{m}$, preferably $\leq 12 \mu\text{m}$, more particularly of $5 \mu\text{m}$ to $\leq 12 \mu\text{m}$, having an at least partial embossment on at least one of its surfaces.

[0008] The inventive multilayer polymeric film is characterized in that it has an at least monoaxial orientation in machine direction of at least 1:2, preferably of 1:3 to 1:5.

[0009] Where appropriate, the inventive polymeric film can also be biaxially orientated, which means it could also be orientated transversely to the machine direction in a range of 1:2 to 1:3.5. In the case of biaxial orientation, i.e., of orientation both in machine direction and transversely to the machine direction, the orientation ratio in these two directions may be different, in which case the orientation in machine direction is preferably higher than transversely to the machine direction.

DETAILED DESCRIPTION

[0010] The inventive polymeric film is a multilayer film, having preferably at least three layers, more preferably at least five layers. In other preferred embodiments, the polymeric film of the invention may even have 7 to 11 layers.

[0011] Preferably, the inventive multilayer polymeric film comprises a layer sequence composed of the following polymer layers:

[0012] (a) an optionally sealable layer (a) or a layer (a) optionally provided with a release finishing, as surface layer,

[0013] optionally (b) an adhesion promoter layer (b), (c) a layer (c), optionally with barrier effect, optionally (d) an adhesion promoter layer (d), (e) an optionally sealable layer (e) as surface layer.

[0014] Preferably, the layers of the inventive polymeric film are produced from thermoplastic polymers selected from the group comprising polyolefins, polyamides, polyesters, biodegradable polymers, copolymers of at least two monomers of the mentioned polymers and mixtures of at least two of the mentioned polymers.

[0015] Preferably, the inventive polymeric film consists of at least 50 wt %, more preferably of at least 70 wt %, of polyolefins, olefin copolymers or mixtures thereof, with the exception of cyclo-olefins or cyclo-olefin copolymers or mixtures thereof.

[0016] Preferably, the layers (a) and (e) and, optionally also layer (c) of the inventive multilayer film are based, in each case identically or differently, on polyolefins and olefin copolymers of α,β -unsaturated olefins having 2-8, preferably 2-3, carbon atoms, which are preferably selected from the group comprising polyethylenes (PE)—especially polyethylenes with a low-density between 0.86 and 0.93 g/cm^3 (LDPE), linear low-density polyethylenes with a density between 0.86 and 0.94 g/cm^3 (LLDPE), which as LLDPE include as comonomer one or more α -olefins having more than 2 carbon atoms, polyethylenes with a medium-density between 0.926 and 0.94 g/cm^3 (MDPE), polyethylenes with a high-density between 0.94 and 0.97 g/cm^3 (HDPE), copolymers of ethylene and an α -olefin having 4 or more carbon atoms (mPE); polypropylenes (PP), polyisobutylenes (PI), polybutylenes (PB) and ethylene-propylene copolymers with preferably 1-10 mol % of ethylene (EPC). Particular

preferably, a mixture of at least one PE and at least one PP, preferably a mixture of LDPE, MDPE or LLDPE or a mixture of LLDPE and/or MDPE and/or PP can be used, in which case the fraction of the MDPE or PP in the mixture is in each case 5 wt % to 80 wt %, based on the total weight of the mixture.

[0017] The layers (a) and (e) may also consist of copolymers of olefin/vinylcarboxylic acid or of olefin/vinyl esters, such as copolymers of ethylene-acrylic acid (EAA), their esters such as (EMA), copolymers of ethylene-methacrylic acid (EMAA), their esters such as (EMMA), copolymers of ethylene-vinyl acetate with preferably 60-99 mol % of ethylene (EVA), or mixtures of in each case at least two of the before mentioned polymer.

[0018] According to a further embodiment, at least the layer (e) as surface layer may be based on at least one polyester or at least one copolyester which is preferably selected from the group comprising polyethylene terephthalates (PET, c-PET, a-PET) and copolymers such as coPET, PET, and coPBT. "PET" refers to polyethylene terephthalates which have been prepared by polycondensation of ethylene glycol and terephthalic acid. It is also possible to use amorphous PET (a-PET) and crystalline PET (c-PET), "coPET" refers to copolyesters of ethylene glycol and terephthalic acid further including other monomers, such as branched or aromatic diols, for example. "coPET" refers to polybutylene terephthalates. Preferably, the polyester or copolyester used have an intrinsic viscosity of preferably 0.1 to 2.0 dl/g, more preferably of 0.3 to 1.5 dl/g, more particularly of 0.6 to 1.0 dl/g, the methods for determining the intrinsic viscosity being known to a person skilled in the art. A comprehensive description of suitable PET and PET is disclosed in *Kunststoffhandbuch Volume 3/1—technische Thermoplaste: Polycarbonate, Polyacetale, Polyester, Celluloseester*; Carl Hanser Verlag, 1992, the content of which is hereby referenced in full.

[0019] In a further embodiment, at least the layer (e) may be based on at least one biodegradable polymer. Suitable biodegradable thermoplastic polymers are at least one biodegradable polymer selected from the group comprising lactic acid homopolymers and copolymers, preferably polylactides, more preferably DL-lactide, L-lactide and D-lactide polymers, polyhydroxyalkanoates, cellulose, cellulose derivatives, thermoplastic starch, polyesters, preferably polycaprolactones, polyethers, at least partly hydrolyzed polyvinyl acetates, ethylene-vinyl alcohol copolymers and copolymers of at least two monomers of the mentioned polymers.

[0020] In one preferred embodiment the inventive multilayer film has at least one layer (c) with a barrier effect. The person skilled in the art is aware of suitable polymers which provide a barrier effect, particularly against loss of gas or loss of aroma, against migration of low molecular weight components and/or against impaired taste or impaired odor, or against moisture and/or against oils and fats,

[0021] The layer (c) with a barrier effect against gases, preferably against O₂, H₂O vapor or loss of aroma, against migration of low molecular weight components and/or against impaired taste or impaired odor, is based on at least one thermoplastic polymer selected from the group comprising ethylene-vinyl alcohol copolymers, polyvinyl alcohols, polyvinylidene chlorides, vinylidene chloride copolymers, polyether-polyamide block copolymers and mixtures of the polymers with ethylene-vinyl acetate copolymers.

Preferred chloride fraction of 80% or more. Ethylene-vinyl alcohol copolymers are particularly preferred.

[0022] According to another preferred embodiment, the barrier effect against moisture and/or oils and fats is achieved preferably by providing a layer (c) being based on a thermoplastic, aliphatic or (partially) aromatic polyamide or copolyamide or mixtures thereof,

[0023] For the purpose of producing at least one layer (c) it is possible to use as polyamides (PA) or copolyamides (coPA) preferably aliphatic or (partially) aromatic polyamides, preferably having a melting point in the range from 160 to 240° C., more preferably from 170 to 220° C. Preferred are aliphatic polyamides of which at least one polyamide or copolyamide selected from the group comprising PA 6, PA 12, PA 6,6, PA 6,12, PA 6/6,6, PA 6,6/6, or partially aromatic polyamides such as PA6T and PA6I, With preference it is also possible to use polyamides having isophoronediamine units, A comprehensive description of polyamides and copolyamides is found in *Kunststoff-Handbuch Volume VI, Polyamide*, Carl Hanser Verlag Munich, 1966; and Melvin I. Kohan, *Nylon Plastics Handbook*, Carl Hanser Verlag Munich, 1995, the content of which is hereby referenced in full.

[0024] As already mentioned, particularly useful for producing the layer (c) are homopolyamides and/or copolyamides selected from the group comprising thermoplastic, aliphatic, partially aromatic, and aromatic homopolyamides or copolyamides with isophoronediamine units. These homopolyamides or copolyamides with isophoronediamine units can have further units derived from other aliphatic and/or cycloaliphatic diamines having 2-10 carbon atoms such as hexamethylenediamine and/or aromatic diamines having 6-10 carbon atoms such as p-phenylenediamine, and from aliphatic or aromatic dicarboxylic acids having 6-14 carbon atoms such as adipic acid, terephthalic acid or isophthalic acid, for example. Moreover, homopolyamides or copolyamides having isophoronediamine units may be prepared from lactams having 4-10 carbon atoms such as from ϵ -caprolactam, for example. For the preparation of homopolyamides and/or copolyamides the use of isophoronediamine as at least one diamine component is preferred to provide homopolyamides and/or copolyamides suitable for producing a layer (c) having isophoronediamine units. In accordance with the invention, homopolyamides and/or copolyamides with isophoronediamine units are preferred and copolyamides derived from ϵ -caprolactam, isophoronediamine and an aromatic dicarboxylic acid, preferably isophthalic acid, are especially preferred.

[0025] In one preferred embodiment the fraction of isophoronediamine units and isophthalic acid units in the polyamide component used for the layer (c) is at least 1 up to 10 wt %, especially preferably 2 to 6 wt %, based on the total weight of the polyamide component.

[0026] The thermoplastic polyesters listed before for the production of the layer (e) may also be used for producing the layer (c).

[0027] With the addition of the layer (c) as barrier layer and an appropriate selection of suitable polymers it is possible to provide an inventive, multilayer polymeric film having a significantly reduced oxygen permeability in accordance with DIN 53380-3, which amounts to at most 10.00 cm³/(m²·d·bar) at 23° C. and 50% rh, The oxygen permeability of the inventive multilayer polymeric film may even be reduced to at most 8 cm³/(m²·d·bar), preferably at most

7 or 6 cm³/m²·d·bar), more preferably at most 5, 4 or 3 cm³/m²·d·bar), even more preferably at most 2, 1 or 0.5 cm³/m²·d·bar), most preferably at most 0.4, 0.3 or 0.2 cm³/m²·d·bar), and most particularly at most 0.1, 0.09 or 0.08 cm³/m²·d·bar) (in each case at 23° C. and 50% rh).

[0028] With the addition of the layer (c) as barrier layer and with appropriate selection of suitable polymers it is possible to reduce the water vapor permeability of the inventive multilayer polymeric film, at most, the values equal to the values mentioned before for the oxygen permeability; the water vapor permeability is determined in accordance with DIN ISO 53 122.

[0029] Insofar as the layer (c) functions as a barrier layer, it is joined preferably by the adhesion promoter layers (b) and (d) to the adjacent layers.

[0030] Suitable thermoplastic polymers which can be used as adhesion promoter polymers are known to the person skilled in the art. The adhesion promoter layers (b) and (d), identically or differently, are based preferably on a preferably modified polyolefin and/or olefin copolymer, preferably selected from the group comprising carboxyl group-modified or cyclic anhydride group-modified polyethylenes, polypropylenes, more particularly maleic anhydride group-modified polyethylenes, polypropylenes, and ethylene vinyl acetate copolymers. Preferred are polymers with maleic anhydride-modified PE, with COOH group-modified PE, with carboxyl group-modified copolymers of ethylene-vinyl acetate, ethylene (meth) acrylate copolymers, anhydride-modified ethylene-vinyl acetate copolymers and polymer blend comprising at least two of the afore mentioned polymers. Copolymers modified with maleic anhydride are particularly preferred.

[0031] In a further particularly preferred embodiment, the inventive, multilayer polymeric film comprises more than one layer (c) and comprises the following layer sequence;

[0032] (a) an optionally heat-sealable, optionally multiply layer (a) preferably based on at least one thermoplastic olefin homopolymer or copolymer or mixtures thereof, the layer having optionally possibly a release coating on its surface,

[0033] (b) an adhesion promoter layer (b),

[0034] (c) layer (c) preferably based on at least one homopolyamide and/or copolyamide,

[0035] (b) optionally a further adhesion promoter layer (b), (c) a further layer (c) preferably based on at least one homopolyamide and/or copolyamide, or of ethylene-vinyl alcohol copolymer,

[0036] (d) a further adhesion promoter layer (d),

[0037] (e) an optionally heat-sealable surface layer based on at least one thermoplastic olefin homopolymer or copolymer or mixtures thereof.

[0038] The layers (c), identically or differently, are based on homopolymers, copolymers or mixtures of polymers as described before, more preferably on polyamides ethylene-vinyl alcohol copolymers. This is also the case for the other layers.

[0039] The layers of the inventive multilayer polymeric film may each have the same or different additives selected from the group comprising antioxidants, antiblocking agents, antifog agents, antistats, active antimicrobial ingredients, light stabilizers, UV absorbers, UV filters, dyes, color pigments, stabilizers, preferably heat stabilizers, process stabilizers, UV and/or light stabilizers, preferably based on at least one sterically hindered amine (HALS), process

assistants, flame retardants, nucleating agents, crystallizing agents, preferably crystal seed formers, lubricants, fillers, such as CaCO₃, silicates, peel additives, seal additives, waxes, we agents, surface-active compounds, preferably surfactants, and dispersants.

[0040] The layers of the inventive polymeric film may contain at least 0.01-30 wt %, preferably at least 0.1-20 wt %, of at least one of the before mentioned additives, based in each case on the total weight of the individual layer.

[0041] The inventive polymeric film is not only at least monoaxial orientated, but is also embossed. As a result thereof, at least one surface layer, preferably the layer (a) of the inventive polymeric film, has an embossed structure at least on one particular region of the surface layer, more preferably on the entire surface of the layer, preferably of the surface layer (a).

[0042] This embossed structure of the inventive release film is based, preferably on a repeating, regularly or irregularly arranged pattern. The embossed structure can be a continuous embossed structure such as a continuous groove structure for example, or two or more, preferably repeating, individual embossed structures, or a regularly repeating but inherently random embossed structure, in each case corresponding to the embossing roll used.

[0043] According to one embodiment, each embossed structure can be based on a multiplicity of preferably repeating individual embossed structures. These respective individual embossed structures can be preferably a structure with embossed grooves, which have more or less pronounced embossed elevations such as ridges, for example, by which the embossed height of the film is defined as the sum total of embossment elevation and thickness of the unembossed oriented film—as measured according to DIN 53370 2006. In accordance with the respective geometry of the elevations of a preferably repeating individual embossed structure, a plan view may show a multiplicity of respectively different, preferably repeating, individual embossed structures such as, for example, preferably serpentine, saw-tooth, hexagonal, diamond-shape, rhomboidal, parallelogrammatical, honeycomb, circular, dot-shaped, star-shaped, rope-shaped, reticular, polygonal, preferably triangular, tetragonal, more preferably rectangular and square, Pentagonal, hexagonal, heptagonal, and octagonal, wire-shaped, ellipsoidal, oval, and lattice-shape-designed patterns, it also being possible for at least two patterns to be superimposed on one another. The embossment elevations can each preferably have a length of up to one centimeter, particular preference being given to a length of 0.001 mm to 10 mm. The fraction of the elevations as a proportion of the total length of the embossed structure with indentations may be preferably 75%, more preferably from 5% to 60%, and more preferably from 10% to 50%. The elevations are arranged preferably at uniform or alternating repeating distances. The elevations of the individual embossed structures can also preferably have a curvature, i.e., a convex or concave structure.

[0044] In a further preferred embodiment, the embossed structure has repeating units of randomly arranged embossment indentations and embossment elevations. The embossment elevations of the embossed structure are to amount preferably to ≤75%, more preferably ≤50%, based on the overall embossed area of the inventive polymeric film.

[0045] The embossed elevation of the optionally uniform embossed elevations of the inventive polymeric film amounts preferably to $\geq 5 \mu\text{m}$ as measured according to DIN 53370 2006.

[0046] The embossed elevation of the embossed structure on the inventive polymeric film of the invention is determined in accordance with DIN 53370 2005 by mechanical scanning of the surface. In this procedure, the embossed elevations are measured at not less than 10 locations, distributed uniformly in a line over the web width of the sample, whereby it being necessary to ensure that the scanning device does not compress the embossed structure of the polymeric film, and the average is formed, from which the thickness of the corresponding oriented unembossed polymeric film is subtracted.

[0047] In a further preferred embodiment, the multilayer polymeric film of the invention has an asymmetric embossed structure, i.e., an embossed structure which is present consistently through the whole thickness of the film and provides both the top face and the bottom face of the film with an embossment, meaning that these faces are no longer planar, however the extent of the embossment is different on the two sides of the film. According to the present invention the top face of the film is identified as that film side on which the embossing tool acts or has acted. Accordingly, the opposite (bottom) face of the film can have a weaker embossment (negative form).

[0048] By the embossment of the inventive multilayer polymeric film not only a release effect is achieved, but also, surprisingly, the shrinkability of the oriented embossed film is reduced, by more than 50% in relation to a corresponding oriented, but unembossed film. The inventive oriented, embossed film furthermore exhibits excellent tensile strength, good to very good tear behavior, and excellent puncture resistance.

[0049] In order to improve its release effect, the inventive multilayer polymeric film can also have a release coating on one of its surface layers. The release coating is based preferably on a cured polysiloxane coating, which can be applied to the inventive multilayer polymeric film even before orientation or after orientation, or after orientation and embossing. The embossment and release coating generating the release effect are present over substantially the whole surface of the film, preferably except for at least one strip running in machine direction, or except for a part of the surface area, preferably in the form of repeat-accurate transverse strips.

[0050] The term "polysiloxane" refers in the sense of the present invention to compounds polymer chains of which are composed alternately of silicon atoms and oxygen atoms. A polysiloxane is based on n repeating siloxane units $(\text{---}[\text{Si}(\text{R}_2)\text{---O}]\text{---})_n$, which in each case independently of one another are disubstituted by two organic radicals R , where R preferably in each case is R^1 or OR^1 and R^1 in each case is an alkyl radical or an aryl radical. The cured polysiloxane coating is based preferably on a repeating dialkylsiloxane unit or on a repeating alkylarylsiloxane unit. Depending on the number of $\text{Si}\text{---O}$ bonds an individual siloxane unit has, based in each case on a tetravalent silicon atom, these units may be differentiated as terminal monofunctional siloxanes (M), having one $\text{Si}\text{---O}$ bond; difunctional siloxanes (D), having two $\text{Si}\text{---O}$ bonds; trifunctional siloxanes (T) having three $\text{Si}\text{---O}$ bonds; and tetrafunctional siloxanes (Q) having four $\text{Si}\text{---O}$ bonds. The polysiloxane

coating of the invention preferably has a crosslinked cyclic or catenated structure, more preferably a crosslinked catenated structure, which is linked by (D), (T), and/or (Q) units to form a two- or three-dimensional network. The number n of the repeating siloxane units $[\text{Si}(\text{R}_2)\text{---O}]\text{---}_n$ in the polysiloxane chain is termed the degree of polymerization of the polysiloxane.

[0051] The cured polysiloxane coating of the inventive polymeric film is based preferably on at least one cured, i.e., crosslinked, polysiloxane selected from the group encompassing addition-crosslinked polysiloxanes, preferably those addition-crosslinked with metal catalysis, condensation-crosslinked, radically crosslinked and/or cationically crosslinked polysiloxanes.

[0052] More preferably the polysiloxane coating is based on at least one cured polysiloxane which has been cured by thermal curing and/or with exposure to UV radiation. The polysiloxane coating is based preferably on at least one cured polysiloxane selected from the group encompassing polydialkylsiloxanes, preferably polydimethylsiloxanes, and polyalkylarylsiloxanes, preferably polymethylphenylsiloxanes, which in each case are cured. Thermally cured polysiloxanes may be obtained by thermal hydrosilylation of polysiloxanes containing silane functions with a compound containing at least one carbon double bond. UV curing takes place preferably after the orientation of the inventive film, whereas thermal curing is carried out preferably after orientation and after embossing.

[0053] The inventive polymeric film can in principle be produced by any known production method such as, for example, by extrusion or by coextrusion.

[0054] Here, both individual layers and all the layers of the inventive polymeric film can be formed by extrusion, more particularly by blown film extrusion and/or flat film extrusion (cast extrusion), or preferably coextrusion, more particularly blown film coextrusion and/or flat film coextrusion (cast coextrusion), the latter being preferred. It should be noted here that in the case of adding to the layer (a) or to further layers additives, these additives are employed for processing by being blended, where appropriate in the form of a masterbatch, with the polymer component or components of the layer in question. This blending can take place dry in pellet/powder form or pellet/pellet form. It is also possible, however, for the additive to be added to the melted polymer component or components of the layer in question, preferably by metered addition in an extruder used for the extrusion of the layer in question.

[0055] After the coextrusion process, which is known per se, the melts corresponding to the individual layers of the film of the invention are coextruded simultaneously and jointly through a circular die or a flat die, the resulting film is taken off for solidification on one or more rolls, and the oriented film is heat-set.

[0056] Biaxial orientation (stretching) may be carried out sequentially or simultaneously. Sequential orientation is carried out generally in succession, with preference being given to successive biaxial orientation, where is orientation takes place first longitudinally (in machine direction) and transversely (perpendicular to the machine direction). In the case of film production by flat film extrusion, with subsequent monoaxial or biaxial orientation, the polymer and/or the polymer mixture of the individual layers is compressed in an extruder and liquefied, it being possible for any additives added to be already present in the polymer or in the

polymer mixture. The melts are then pressed simultaneously through a flat die (slot die), and the multilayer film extruded is taken off on one or more takeoff rolls at a temperature of 10 to 100° C., preferably 10 to 50° C., and cools and solidifies.

[0057] The inventive multilayer polymeric film is then oriented either only longitudinally or both longitudinally and transversely to the direction of extrusion, leading to orientation of the molecule chains. Longitudinal orientation will be carried out preferably at a temperature of 70 to 130° C., preferably 80 to 110° C., expediently with the aid of two rolls which run at different speeds in line with the target draw ratio, and the possible additional transverse orientation will be carried out preferably at a temperature of 120 to 180° C. by means of a corresponding tenter frame. In these procedures, the desired transverse, draw ratios can be set. Orientation in machine direction only is preferred in accordance with the invention.

[0058] The orientation of the film is followed preferably by its heat-setting (heat treatment), where the film is held for about 0.1 to 10 s at a temperature of 100 to 160° C. Subsequently, where appropriate after interim storage, the film may be furnished with any release coating present and subsequently embossed, or may be furnished, after having been embossed, with any release coating present. Another possibility is for the extruded multilayer polymeric film to be provided, even prior to orientation, with any release coating present.

[0059] The embossing of the inventive polymeric film with only a single-side embossed structure or with an entirely continuous embossed structure may be accomplished according to an embossing process, using a structuring or embossing calender comprising a system for applying a grid pattern, in-line or off-line. This calender preferably has counterrotating rolls arranged at a defined distance vertically one above another, the release film to be provided with an asymmetric embossed structure being supplied to the rolls and passed through the roll nip which forms, the nip width being variably adjustable. The grid roll mechanism here preferably comprises a first roll having a comparatively hard surface, more preferably a steel roll, and a second roll, which has a comparatively less hard surface and is formed preferably of an elastic material, more preferably of rubber or ebonite.

[0060] The harder of the two rolls carries, in negative form, the pattern to be embossed into the polymeric film (embossing roll). The second roll, opposite this roll, serves preferably as a counterpressure roll or pressing roll, and presses the polymeric film to be provided with a structured or embossed pattern against the first, embossing roll. The polymeric film is embossed preferably at elevated temperature, and therefore, in the case of off-line embossing, the polymeric film passes first through a heating roller mechanism, optionally thereafter is irradiated with infrared light, after which the above-described embossing operation proper takes place. After being embossed, the polymeric film may pass through a cooling roll mechanism for cooling. The negative form of the structure to be embossed is produced according to the methods customary and known to the person skilled in the art, and specific methods may be particularly advantageous, depending on structure and materials. Fundamentally, the structures on the embossing roll may either have a continuous structure or else may be formed as an interrupted structure (sequence of individual

embossed structures), with a combination of both structures also being possible. The respective structures on the embossing roll may have any of a very wide variety of geometric forms, depending on the intended (asymmetric) structure of the polymeric film.

[0061] A further object of the present invention is the use of the inventive polymeric film as a removable release film or protective film, preferably for adhesive articles of any kind, more preferably for self-adhesive articles of any kind.

[0062] The use of the inventive polymeric film as detachable packaging film and/or protective film for self-adhesive labels or adhesive tapes of any kind, especially in the construction industry, is a further subject of the present invention.

[0063] This also applies to the use of the inventive polymeric film as a removable, flexible packaging film and/or protective film for hygiene articles, preferably individually packaged, optionally folded, self-adhesive panty liners, sanitary towels or incontinence articles.

[0064] The removable, flexible packaging material of the invention preferably has the advantage that it can be used to produce packaging which can be disposed of and can be opened with little noise, especially for individually packaged hygiene products. The noise produced in this context is ≤ 60 [db], measured as equivalent continuous sound level L_{eq} [db].

[0065] For the determination of the equivalent continuous sound level, a film sample in DIN A5 size is fixed centrally and horizontally on each long side by means of a clasp apparatus. One of the clasp apparatuses is immobile, while the other apparatus can be moved on an eccentric path in order to generate noises by continual compressing and stretching of the film sample. The speed of the eccentric drive during the measurement is 36 min^{-1} . As the noise emission parameter, the equivalent continuous sound level L_{eq} [db] is determined by means of a sound recording device, which records the noises during the continual compressing and stretching of the film sample for a duration of 30 seconds from a distance of 30 cm from the middle of the wide side of the DIN A5 film sample. The film sample must not be damaged during the stretching and compressing. The measuring device used is a measuring device from Brüel & Kjær, 2250-L.

[0066] A further object of the invention, is also a flexible packaging material composed of an inventive polymeric film for individually packaged, adhesive articles, preferably for self-adhesive articles for single use.

[0067] Also a further object of the present invention is a sanitary product or hygiene product provided with the inventive polymeric film as removable release film or protective film.

[0068] Another subject of the present invention, moreover, is a flexible packaging material composed of an inventive polymeric film for individually packaged, self-adhesive hygiene articles or incontinence articles.

Method for Measuring Shrinkage

[0069] The shrinkage is measured according to DIN 5543/4. Accordingly, 10 samples in each case, measuring $100 \text{ mm} \times 100 \text{ mm}$, with the running direction marked in each case, are left in machine direction or transversely to the machine direction in a high-boiling oil bath of 90° C. for 3 minutes in each case; the average value of the change in

length in the MD and in the CD, respectively, is averaged from each of the 10 samples, and the respective change is reported as shrinkage.

[0070] The inventive and comparative examples which follow serve to illustrate the invention, but should not be interpreted restrictively.

[0071] I. Chemical Characterization of the Raw Materials Used.

TABLE I

	Density	MFR (° C./kg)
LDPE	0.923	0.75 (190/2.16)
LLDPE	0.921	0.9 (190/2.16)
MDPE	0.935	1.4 (190/2.16)
PP	0.90	0.95 (230/2.16)
Copolyamide of isophoronediamine/ isophthalic acid/ ε-caprolactam with about 5 mol % of isophoronediamine (IPDI copolyamide)	1.13	5 (235/2.16)
AP = PE modified with maleic anhydride	0.91	2.6 (190/2.16)
Chalk		Masterbatch of LDPE with 70 wt % CaCO ₃
Colorant		Masterbatch of LDPE with 70 wt % TiO ₂

[0072] II. Production of Inventive Polymeric Films (B1/ B2) and of Polymeric Films (V1/V2) According to Comparative Testing

[0073] Each of the multilayer polymeric films, with the compositions reported in table 11, was produced by coextrusion on a blown film coextrusion line, initially with a total layer thickness of 40 μm. After the film bubble had been collapsed, it was supplied to a roll orienting unit and oriented by a factor of 1:4 in the longitudinal direction, meaning that the total film thickness resulting therefrom was 10 μm. The inventive polymeric films B1 and B2, following orientation, were given microembossment (embossment elevation) of about 5 μm on an embossing calender, and, for the inventive polymeric film a and also for the comparative polymeric films, the physical and also their shrinkage characteristics reported in table IV below were ascertained and reported.

[0074] III. Construction of the Polymeric Films

[0075] All of the % figures below are weight % in each case

[0076] III.1 Inventive Examples B1/Comparative Example V1

[0077] (3-layer, total layer thickness 10 μm)

TABLE II

Layer construction	Raw materials B1	Raw materials V1
Layer (a)	30% MDPE	30% MDPE
Layer thickness 2.5 μm	49.5% LDPE	49.5% LDPE
	20% chalk	20% chalk
	0.5% additive	0.5% additive
Layer (c)	48.4% MDPE	48.4% MDPE
Layer thickness 5 μm	33.3% PP	33.3% PP
	13.3% LDPE	13.3% LDPE
	4% colorant	4% colorant
	1% additive	1% additive
Layer (e)	30% MDPE	30% MDPE
Layer thickness 2.5 μm	49.5% LDPE	49.5% LDPE
	20% chalk	20% chalk
	0.5% additive	0.5% additive
Unembossed		+
Oriented		+
Embossed	+	
Oriented	+	

[0078] III.2 Inventive Examples B2/Comparative Example V2

[0079] (5-layer, total layer thickness 10 μm)

TABLE III

Layer construction	Raw materials B2	Raw materials V2
Layer (a)	54% MDPE	54% MDPE
Layer thickness 2.9 μm	20% LDPE	20% LDPE
	15% chalk	15% chalk
	10% colorant	10% colorant
	1% additive	1% additive
Adhesion promoter layer	100% AP	100% AP
(b)		
Layer thickness 0.85 μm		
Layer (c)	100%	100%
Layer thickness 2.5 μm	IPDI copolyamide	IPDI copolyamide
Adhesion promoter layer	100% AP	100% AP
(d)		
Layer thickness 0.85 μm		
Layer (e)	54% MDPE	54% MDPE
Layer thickness 2.9 μm	20% LDPE	20% LDPE
	15% chalk	15% chalk
	10% colorant	10% colorant
	1% additive	1% additive
Unembossed		+
Oriented		+
Embossed	+	
Oriented	+	

TABLE IV

	Monoaxial		MD		CD		MD
	Orientation	Thickness	Tear force	Tear resistance	Tear force	Tear resistance	Shrinkage
Inventive example 1/Comparative example 1 (3-layer)							
Unembossed	1:3.8	≈11 μm	23.6	143.0	3.5	21.2	18%
Oriented							
Embossed	1:3.8	≈11 μm	11.2	67.9	4.3	25.8	3-4%
Oriented							

TABLE IV-continued

	Monoaxial		MD		CD		MD
	Orientation	Thickness	Tear force	Tear resistance	Tear force	Tear resistance	Shrinkage
Inventive example 2/Comparative example 2 (5-layer)							
Unembossed Oriented	1:4	10 μ m	30.7	204.7	5.6	37.3	9%
Embossed Oriented	1:4	10 μ m	14.0	84.8	5.8	35.8	1.5%

1. A multilayer polymeric film with release effect, which is oriented at least monoaxially in machine direction with an orientation of at least 1:2 and is comprised at least to an extent of 50 wt % of polyolefins, and which has a total thickness $\leq 18 \mu\text{m}$, having an at least partial embossment on at least one surface, the embossed elevation of the at least partial embossment being $\geq 5 \mu\text{m}$ as measured according to DIN 53370 2006.

2. A polymeric film as claimed in claim 1, having an orientation in machine direction of at least 1:5.

3. A polymeric film as claimed in claim 1, wherein the release effect of the polymeric film is based on the at least partial embossment of at least one surface.

4. A polymeric film as claimed in claim 1, wherein the polymeric film has a release coating on at least one of its surfaces.

5. A polymeric film as claimed in claim 1, wherein the polymeric film has a shrinkage lower by at least 50% in comparison to a corresponding unembossed oriented polymeric film.

6. A polymeric film as claimed in claim 1, wherein the embossment and/or release coating that generates the release effect is present over substantially the whole surface area, or over a partial area of the surface of the polymeric film.

7. A polymeric film as claimed in claim 1, wherein the polymeric film is comprised to an extent of at least 70 wt % of polyolefins.

8. A polymeric film as claimed in claim 1, wherein as polyethylenes LDPE, MDPE, LLDPE or a mixture of at least two of the mentioned PE are used.

9. A polymeric film as claimed in claim 1, wherein at least one layer of the polymeric film is based on a mixture of at least one PE and one PP.

10. A polymeric film as claimed in claim 1, wherein the film has a barrier layer against gases, against migration of low molecular mass organic compounds and/or impairment of taste or of odor, and/or against moisture and/or fats and/or oils.

11. A polymeric film as claimed in claim 10, wherein the barrier layer is made up of ethylene/vinyl alcohol copolymers, polyvinyl alcohols, polyamides, polyesters and/or polyether-polyamide block copolymers.

12. A release film or protective film comprising the multilayer polymeric film with release effect of claim 1.

13. A removable packaging film and/or protective film for self-adhesive articles of any kind comprising the multilayer polymeric film with release effect of claim 1.

14. A carrier layer for adhesive tapes comprising the multilayer polymeric film with release effect of claim 1.

15. A low-noise, optionally detachable packaging material for individually packed hygiene articles or incontinence products comprising the multilayer polymeric film with release effect of claim 1.

16. A flexible packaging material composed of polymeric film as claimed in claim 1 for individually packaged, adhesive articles.

17. A flexible packaging material composed of a polymeric film as claimed in claim 1 for individually packaged, self-adhesive hygiene articles or incontinence articles.

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