

DESCRIPTION

TITLE OF THE INVENTION: SURFACE-PROTECTIVE FILM

TECHNICAL FIELD

[0001]

The present invention relates to a separator attached optical surface protective film. In particular, such a surface protective film can be obtained by bonding (laminating) a specific separator used to protect the surface of a pressure-sensitive adhesive layer constituting an optical surface protective film used for protecting the surface of an optical member (for example, a polarizing plate, a wavelength plate, a retardation plate, an optical compensation film, a reflection sheet, a brightness enhancement film, etc. used in liquid crystal displays) until the time of actual use, and is useful because of its excellent workability and being able to prevent the occurrence of dents.

BACKGROUND ART

[0002]

A surface protective film generally has a configuration in which a pressure-sensitive adhesive layer is provided on a film-like substrate film (a support). Such a surface protective film is bonded to an adherend

that is an optical member, via the pressure-sensitive adhesive layer, and thereby used for the purpose of protecting the optical member from scratches and dirt on the surface during processing, transportation, inspection, etc. For example, a panel of a liquid crystal display is formed by bonding an optical member such as a polarizing plate or a wavelength plate to a liquid crystal cell via a pressure-sensitive adhesive layer. The pressure-sensitive adhesive layer is protected by a release-treated separator or the like and then stored, since it is necessary to protect the pressure-sensitive adhesive layer from drying and the like before being actually applied to an optical member (Patent Document 1).

[0003]

Thereafter, when the surface of the pressure-sensitive adhesive layer of the surface protective film is actually bonded to an optical member and then used, the separator is peeled off and removed.

PRIOR ART DOCUMENTS

PATENT DOCUMENT

[0004]

Patent Document 1: JP-A-2012-224811

DISCLOSURE OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0005]

In the case where the separator is thick, the weight of the separator is increased when the separator is peeled off and removed, thereby to cause problems such as increased waste separators and inferior workability.

[0006]

In addition, when a thin separator is used at the time of pressure-sensitive adhesive coating instead of a thick separator, a dent on the surface of the pressure-sensitive adhesive layer at the time of forming a pressure-sensitive adhesive layer is caused by microparticles (for example, a polyester-based filler etc.) contained in a substrate etc. constituting the separator attached to the separator surface. Furthermore, when bonding to an adherend in a state where dents occur on the surface of the pressure-sensitive adhesive layer, air bubbles enter the dented portion (space) between the pressure-sensitive adhesive layer and the adherend, and when testing the adherend, there is a problem of deteriorating the inspectability.

[0007]

Then, as a result of intensive studies by the inventors of the present invention in view of the above-mentioned circumstances, the purpose of the present

invention is to provide a separator attached optical surface protective film excellent in inspectability, in which voids are provided in a polyester-based substrate constituting the separator to be laminated on the optical surface protective film and the specific gravity of the polyester-based substrate is kept low, whereby the weight of the separator as such is kept low and the separator has excellent workability, and the occurrence of dents due to the separator can be suppressed by the excellent cushioning properties of the separator obtained by having voids.

MEANS FOR SOLVING THE PROBLEMS

[0008]

That is, the separator attached optical surface protective film of the present invention comprises an optical surface protective film comprising a pressure-sensitive adhesive layer on at least one surface of a substrate film, and a separator on the surface of the pressure-sensitive adhesive layer opposite from the surface of the substrate film contacting the pressure-sensitive adhesive layer, wherein the separator comprises a release layer and a polyester-based substrate, the separator comprising voids in the polyester-based substrate, and a specific gravity of the polyester-based substrate being 1.2 g/cm³ or less.

[0009]

The separator attached optical surface protective film of the present invention preferably has a void ratio of 15% or more with respect to the volume of the polyester-based substrate.

[0010]

As for the separator attached optical surface protective film of the present invention, the substrate film is preferably a polyester film.

[0011]

It is preferable that the separator attached optical surface protective film of the present invention is formed from a pressure-sensitive adhesive composition in which the pressure-sensitive adhesive layer contains at least one selected from an acrylic pressure-sensitive adhesive, a urethane-based pressure-sensitive adhesive, and a silicone-based pressure-sensitive adhesive.

EFFECT OF THE INVENTION

[0012]

The present invention is useful because by using a specific separator, the weight of the separator itself is kept low and the separator has excellent workability of bonding to an optical surface protective film, and further, the occurrence of dents due to the separator can be

suppressed by excellent cushioning properties of the separator, whereby it is possible to obtain a separator attached optical surface protective film, which is excellent in inspectability in a state where the optical surface protective film is bonded to an adherend.

BRIEF DESCRIPTION OF THE DRAWING

[0013]

Fig. 1 is a schematic cross-sectional view showing an example of the configuration of a separator attached optical surface protective film according to the present invention.

MODE FOR CARRYING OUT THE INVENTION

[0014]

Hereinafter, embodiments of the present invention will be described in detail.

[0015]

<Whole Structure of Separator Attached Optical Surface Protective Film>

In the separator attached optical surface protective film disclosed herein (hereafter, such film may only be called a "surface protective film".), the surface of the pressure-sensitive adhesive layer of a form generally called a pressure-sensitive adhesive tape, a pressure-

sensitive adhesive label, a pressure-sensitive adhesive film, etc. is protected by the separator. In particular, the separator attached optical surface protective film is suitable as a surface protective film for protecting the surface of an optical component during processing, inspection, and transportation of an optical component (for example, an optical component used as a liquid crystal display panel component such as a polarizing plate or a wavelength plate). The pressure-sensitive adhesive layer in the surface protective film is typically formed continuously, but is not limited to such a form, and may be formed, for example, in a regular or random pattern such as dot-like or stripe-like. In addition, the surface protective film disclosed herein may be in the form of a roll or in the form of a single sheet.

[0016]

<Substrate Film>

The optical surface protective film which constitutes the separator attached optical surface protective film of the present invention is characterized by having a substrate film. In the technology disclosed herein, a resin material constituting the substrate film can be used without particular limitation, and it is preferable to use such a resin material having properties, such as transparency, mechanical strength, heat stability, moisture

shielding property, isotropy, flexibility, and dimensional stability. In particular, it is useful that when the substrate film has flexibility, a pressure-sensitive adhesive composition can be applied by a roll coater or the like and can be wound into a roll.

[0017]

A plastic film composed of a resin material containing, for example, a polyester-based polymer such as polyethylene terephthalate (PET), polyethylene naphthalate (PEN), and polybutylene terephthalate; a cellulose-based polymer such as diacetyl cellulose and triacetyl cellulose; a polycarbonate-based polymer; or an acrylic polymer such as polymethyl methacrylate as a main resin component (a main component in the resin component, typically a component that occupies 50% by weight or more) can be preferably used as the substrate film (support). Other examples of the resin material include styrene-based polymers such as polystyrene and acrylonitrile-styrene copolymer; olefin-based polymers such as polyethylene, polypropylene, polyolefin having a cyclic or norbornene structure, and ethylene-propylene copolymer; vinyl chloride-based polymers; amide-based polymers such as nylon 6, nylon 6,6 and aromatic polyamide; or the like as a resin material. Still other examples of the resin material include imide-based polymers, sulfone-based polymers,

polyethersulfone-based polymers, polyetheretherketone-based polymers, polyphenylene sulfide-based polymers, vinyl alcohol-based polymers, vinylidene chloride-based polymers, vinyl butyral-based polymers, arylate-based polymers, polyoxymethylene-based polymers, epoxy-based polymers, and the like. A substrate film composed of a blend of two or more of the above-mentioned polymers may be used.

[0018]

As the substrate film, a plastic film made of a transparent thermoplastic resin material can be preferably employed. Among the plastic films, it is a more preferable embodiment to use a polyester film. Here, the polyester film is mainly composed of a polyester-based polymer material (polyester resin) as a main resin component having a main skeleton based on an ester bond, such as polyethylene terephthalate (PET), polyethylene naphthalate (PEN), and polybutylene terephthalate. Such polyester film has desirable characteristics as a substrate film of a surface protective film, such as excellent optical characteristics and dimensional stability.

[0019]

If necessary, various additives such as an antioxidant, an ultraviolet light absorber, a plasticizer, a colorant (pigment, dye, etc.) may be blended in the resin material constituting the substrate film. For example,

known or common surface treatments such as corona discharge treatment, plasma treatment, ultraviolet irradiation treatment, acid treatment, alkali treatment, and application of an undercoating agent may be implemented on the resin material. Such a surface treatment can be a treatment for improving the adhesiveness between the substrate film and the pressure-sensitive adhesive layer, in other words, for improving the anchoring property of the pressure-sensitive adhesive layer to the substrate film.

[0020]

It is also possible to use, as the substrate film, a plastic film subjected to an antistatic treatment. Since the charge of surface protective film itself at the time of peeling is suppressed, it is preferable to use such a film subjected to an antistatic treatment. Further, when the substrate film is a plastic film, the plastic film is subjected to an antistatic treatment to reduce electrification of the surface protective film itself and to obtain an excellent antistatic ability to an adherend. In addition, there is no particular limitation as a method of providing an antistatic function, and a conventionally well-known method can be used. For example, a method for applying an antistatic resin comprising an antistatic agent and a resin component, or applying a conductive resin containing a conductive polymer or a conductive substance,

a method for depositing or plating a conductive substance, a method for kneading an antistatic agent etc., and the like can be mentioned.

[0021]

The thickness of the substrate film is generally 5 to 200 μm , preferably about 10 to 100 μm . It is preferable for the thickness of the substrate film to be in the above-mentioned range, because bonding workability to an adherend, and peelability and workability from the adherend are excellent.

[0022]

The surface protective film disclosed herein may be embodied in an aspect including other layers in addition to the substrate film, the pressure-sensitive adhesive layer, and the separator. As the other layer, an undercoat layer (anchor layer) etc. which improve the anchoring property of an antistatic layer and a pressure-sensitive adhesive layer are mentioned.

[0023]

<Pressure-Sensitive Adhesive Layer>

The pressure-sensitive adhesive layer used in the present invention can be used without particular limitation as long as it is formed from a pressure-sensitive adhesive composition containing a pressure-sensitive adhesive polymer having adherability. As the pressure-sensitive

adhesive composition, for example, acrylic pressure-sensitive adhesives, urethane-based pressure-sensitive adhesives, synthetic rubber-based pressure-sensitive adhesives, natural rubber-based pressure-sensitive adhesives, silicone-based pressure-sensitive adhesives, polyester-based pressure-sensitive adhesives, etc. can be used. Among them, it is preferable to contain one selected from the group consisting of acrylic pressure-sensitive adhesives, urethane-based pressure-sensitive adhesives, and silicone-based pressure-sensitive adhesives. It is a particularly preferred embodiment to use a pressure-sensitive adhesive composition (acrylic pressure-sensitive adhesive) containing a (meth)acrylic polymer which is the pressure-sensitive adhesive polymer.

[0024]

When the pressure-sensitive adhesive layer uses an acrylic pressure-sensitive adhesive, a (meth)acrylic polymer which is a pressure-sensitive adhesive polymer constituting the acrylic pressure-sensitive adhesive can use, as a main monomer, a (meth)acrylic monomer having an alkyl group of 1 to 14 carbon atoms as a raw material monomer constituting the (meth)acrylic polymer. One or more kinds of the (meth)acrylic monomers can be used. By using the (meth)acrylic monomer having an alkyl group of 1 to 14 carbon atoms, it becomes easy to control the peeling

strength (adhesive strength) to an adherend (an object to be protected) at a low level, thereby to obtain a surface protective film excellent in light peelability and removability. The (meth)acrylic polymer in the present invention refers to an acrylic polymer and/or a methacrylic polymer, and the (meth)acrylate refers to an acrylate and/or a methacrylate.

[0025]

Specific examples of the (meth)acrylic monomer having an alkyl group of 1 to 14 carbon atoms include methyl (meth)acrylate, ethyl (meth)acrylate, n-butyl (meth)acrylate, s-butyl (meth)acrylate, t-butyl (meth)acrylate, isobutyl (meth)acrylate, hexyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, n-octyl (meth)acrylate, isooctyl (meth)acrylate, n-nonyl (meth)acrylate, isononyl (meth)acrylate, n-decyl (meth)acrylate, isodecyl (meth)acrylate, n-dodecyl (meth)acrylate, n-tridecyl (meth)acrylate, n-tetradecyl, (meth)acrylate, and the like.

[0026]

Among them, in the case of a surface protective film it is particularly preferable to use a (meth)acrylic monomer having an alkyl group of 4 to 14 carbon atoms, such as n-butyl (meth)acrylate, hexyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, n-octyl (meth)acrylate, isooctyl

(meth)acrylate, n-nonyl (meth)acrylate, isononyl (meth)acrylate, n-decyl (meth)acrylate, isodecyl (meth)acrylate, n-dodecyl (meth)acrylate, n-tridecyl (meth)acrylate, and n-tetradecyl (meth)acrylate. In particular, by using a (meth)acrylic monomer having an alkyl group of 4 to 14 carbon atoms, it becomes easy to control the peeling strength (adhesive strength) of the surface protective film to an adherend to a low level, and such a protective film has excellent removability.

[0027]

In particular, it is preferable to contain 65% by weight or more of a (meth)acrylic monomer having an alkyl group of 1 to 14 carbon atoms, more preferably 75% by weight or more, still more preferably 85 to 99.9% by weight, most preferably 90 to 99% by weight, with respect to 100% by weight of the total amount of monomer components constituting the (meth)acrylic polymer. If the amount of the (meth)acrylic monomer having an alkyl group of 1 to 14 carbon atoms is less than 50% by weight, appropriate wettability and cohesive strength of the pressure-sensitive adhesive layer are deteriorated, and this is not preferable.

[0028]

Moreover, the (meth)acrylic polymer can use a hydroxyl group-containing (meth)acrylic monomer as a raw

material monomer. As the hydroxyl group-containing (meth)acrylic monomer, one or two or more kinds of such monomers can be used. By using the hydroxyl group-containing (meth)acrylic monomer, it becomes easier to control the crosslinking of a pressure-sensitive adhesive composition and furthermore control the balance between improvement of wettability by flow and reduction of peeling strength (adhesive strength) in peeling.

[0029]

Examples of the hydroxyl group-containing (meth)acrylic monomer include 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 4-hydroxybutyl (meth)acrylate, 6-hydroxyhexyl (meth)acrylate, 8-hydroxyoctyl (meth)acrylate, 10-hydroxydecyl (meth)acrylate, 12-hydroxylauryl (meth)acrylate, (4-hydroxymethylcyclohexyl)methyl acrylate, N-methylol (meth)acrylamide, and the like.

[0030]

The content of the hydroxyl group-containing (meth)acrylic monomer is preferably 25% by weight or less, more preferably 15% by weight or less, still more preferably 0.1 to 10% by weight, with respect to 100% by weight of the total amount of monomer components constituting the (meth)acrylic polymer. If the content of the hydroxyl group-containing (meth)acrylic monomer is

within the above range, the balance between wettability of the pressure-sensitive adhesive composition and cohesive strength of the pressure-sensitive adhesive layer to be obtained can be easily controlled, which is preferable.

[0031]

In addition, as other polymerizable monomer components, for the reason that it is easier to balance the adhesive performance so that T_g should be 0°C or less (usually -100°C or more), a polymerizable monomer or the like for adjusting the glass transition temperature and peelability can be used as long as the effect of the present invention is not impaired.

[0032]

Moreover, the (meth)acrylic polymer can use a carboxyl group-containing (meth)acrylic monomer as a raw material monomer. By using the carboxyl group-containing (meth)acrylic monomer, it is possible to suppress the increase in adhesive strength of the pressure-sensitive adhesive layer (surface protective film) over time, and the removability, preventing property of an increase in adhesive strength, and workability are excellent. In addition to the excellent cohesive strength of the pressure-sensitive adhesive layer, it is preferable that such adhesive layer is also excellent in shearing force.

[0033]

Examples of the carboxyl group-containing (meth)acrylic monomer include (meth)acrylic acid, carboxylethyl (meth)acrylate, carboxylpentyl (meth)acrylate, and the like.

[0034]

The content of the carboxyl group-containing (meth)acrylic monomer is preferably 10% by weight or less, more preferably 0 to 8% by weight, still more preferably 0 to 6% by weight, with respect to 100% by weight of the total amount of monomer components constituting the (meth)acrylic polymer. If the content of the carboxyl group-containing (meth)acrylic monomer is within the above range, it is preferable that the balance between the wettability of the pressure-sensitive adhesive composition and the cohesive strength of the pressure-sensitive adhesive layer to be obtained can be easily controlled.

[0035]

Furthermore, as the (meth)acrylic polymer, other polymerizable monomers other than the raw material monomer can be used without particular limitation as long as the characteristics of the present invention are not impaired. For example, as the other polymerizable monomers, cohesive strength/heat resistance improving components such as cyano group-containing monomers, vinyl ester monomers and aromatic vinyl monomers, and components having a functional

group capable of improving the peeling strength (adhesive strength) and acting as a crosslinking base point, such as amide group-containing monomers, imide group-containing monomers, amino group-containing monomers, epoxy group-containing monomers, N-acryloyl morpholine, and vinyl ether monomers, can be appropriately used. Among them, it is preferable to use a nitrogen-containing monomer such as a cyano group-containing monomer, an amide group-containing monomer, an imide group-containing monomer, an amino group-containing monomer, and N-acryloyl morpholine. By using a nitrogen-containing monomer, it is possible to secure an adequate peeling force (adhesive force) that does not cause floating or peeling, and further to obtain a surface protection film excellent in shearing force, which is useful. These polymerizable monomers may be used singly or in combination of two or more thereof.

[0036]

Examples of the cyano group-containing monomer include acrylonitrile and methacrylonitrile.

[0037]

Examples of the amide group-containing monomer include acrylamide, methacrylamide, diethylacrylamide, N-vinylpyrrolidone, N,N-dimethylacrylamide, N,N-dimethylmethacrylamide, N,N-diethylacrylamide, N,N-diethylmethacrylamide, N,N'-methylenebisacrylamide, N,N-

dimethylaminopropylacrylamide, N,N-dimethylaminopropylmethacrylamide, diacetone acrylamide, and the like.

[0038]

Examples of the imide group-containing monomer include cyclohexyl maleimide, isopropyl maleimide, N-cyclohexyl maleimide, itaconimide, and the like.

[0039]

Examples of the amino group-containing monomer include aminoethyl (meth)acrylate, N,N-dimethylaminoethyl (meth)acrylate, N,N-dimethylaminopropyl (meth)acrylate, and the like.

[0040]

Examples of the vinyl ester monomer include vinyl acetate, vinyl propionate, vinyl laurate, and the like.

[0041]

Examples of the aromatic vinyl monomer include styrene, chlorostyrene, chloromethylstyrene, α -methylstyrene, and other substituted styrenes.

[0042]

Examples of the epoxy group-containing monomer include glycidyl (meth)acrylate, methyl glycidyl (meth)acrylate, allyl glycidyl ether, and the like.

[0043]

Examples of the vinyl ether monomer include methyl

vinyl ether, ethyl vinyl ether, isobutyl vinyl ether, and the like.

[0044]

In the present invention, the content of other polymerizable monomer is preferably from 0 to 30% by weight, more preferably from 0 to 10% by weight, with respect to 100% by weight of the total amount of monomer components constituting the (meth)acrylic polymer. The other polymerizable monomer can be appropriately adjusted in order to obtain desired characteristics.

[0045]

The (meth)acrylic polymer may further contain an alkylene oxide group-containing reactive monomer as a monomer component.

[0046]

The average addition molar number of the oxyalkylene unit of the alkylene oxide group-containing reactive monomer is preferably from 1 to 40, more preferably from 3 to 40, still more preferably from 4 to 35, particularly preferably from 5 to 30, from the viewpoint of compatibility with an oxyalkylene group-containing compound. When the average addition molar number is 1 or more, there is a tendency to efficiently obtain a contamination reducing effect of an adherend (an object to be protected). Also, when the average addition molar

number is more than 40, the interaction with an oxyalkylene group-containing compound is large, and the viscosity of the pressure-sensitive adhesive composition tends to increase, making it difficult to apply a coating because of increased viscosity of the pressure-sensitive adhesive composition. Thus, such an average addition molar number of more than 40 is not preferable. The terminal of the oxyalkylene chain may be the hydroxyl group as it is or may be substituted with other functional groups.

[0047]

The alkylene oxide group-containing reactive monomer may be used alone, or two or more kinds thereof may be used by mixing, but the total content of the alkylene oxide group-containing reactive monomer is preferably from 0 to 20% by weight, more preferably from 0 to 10% by weight, with respect to the total amount of monomer components of the (meth)acrylic polymer. When the content of the alkylene oxide group-containing reactive monomer exceeds 20% by weight, the staining property of the adherend is deteriorated. Thus, such a content of the reactive monomer exceeding 20% by weight is not preferable.

[0048]

The oxyalkylene unit of the alkylene oxide group-containing reactive monomer includes those having an alkylene group of 1 to 6 carbon atoms, and examples thereof

include an oxymethylene group, an oxyethylene group, an oxypropylene group, an oxybutylene group, and the like. The hydrocarbon group of the oxyalkylene chain may be linear or branched.

[0049]

Further, it is more preferable that the alkylene oxide group-containing reactive monomer is a reactive monomer having an ethylene oxide group. By using, as a base polymer, a reactive monomer-containing (meth)acrylic polymer having an ethylene oxide group, the compatibility between the base polymer and the oxyalkylene group-containing compound is improved, so that bleeding to an adherend is suitably suppressed, and as a result, a pressure-sensitive adhesive composition with less-staining property is obtained.

[0050]

Examples of the alkylene oxide group-containing reactive monomer include a (meth)acrylic acid alkylene oxide adduct and a reactive surfactant having, in the molecule, a reactive substituent such as acryloyl group, methacryloyl group or allyl group.

[0051]

Specific examples of the (meth)acrylic acid alkylene oxide adduct include polyethylene glycol (meth)acrylate, polypropylene glycol (meth)acrylate, polyethylene glycol-

polypropylene glycol (meth)acrylate, polyethylene glycol-polybutylene glycol (meth)acrylate, polypropylene glycol-polybutylene glycol (meth)acrylate, methoxypolyethylene glycol (meth)acrylate, ethoxypolyethylene glycol (meth)acrylate, butoxypolyethylene glycol (meth)acrylate, octoxypolyethylene glycol (meth)acrylate, lauroxypolyethylene glycol (meth)acrylate, stearoxypolyethylene glycol (meth)acrylate, phenoxypolyethylene glycol (meth)acrylate, methoxypolypropylene glycol (meth)acrylate, octoxypolyethylene glycol-polypropylene glycol (meth)acrylate, and the like.

[0052]

Also, specific examples of the reactive surfactant include an anionic reactive surfactant, a nonionic reactive surfactant, and a cationic reactive surfactant, having a (meth)acryloyl group or an allyl group.

[0053]

The weight average molecular weight (M_w) of the (meth)acrylic polymer is preferably from 100,000 to 5,000,000, more preferably from 200,000 to 4,000,000, still more preferably from 300,000 to 3,000,000, most preferably from 300,000 to 1,200,000. If the weight average molecular weight of the (meth)acrylic polymer is less than 100,000, the cohesive strength of the pressure-sensitive adhesive

layer is reduced to tend to cause adhesive residue. On the other hand, when such weight average molecular weight exceeds 5,000,000, the fluidity of the polymer is lowered and the wetting of an adherend (for example, a polarizing plate) becomes insufficient, resulting in a tendency to cause blistering which occurs between the adherend and the pressure-sensitive adhesive layer of the surface protective film. The weight average molecular weight refers to a value obtained by the measurement through GPC (gel permeation chromatography).

[0054]

The glass transition temperature (T_g) of the (meth)acrylic polymer is preferably 0°C or less, more preferably -10°C or less (usually -100°C or more). When the glass transition temperature is higher than 0°C , the polymer hardly flows, for example, the wetting to a polarizing plate which is an optical member becomes insufficient, and there is a tendency to cause blistering that occurs between the polarizing plate and the pressure-sensitive adhesive layer of the surface protective film. Especially, a pressure-sensitive adhesive layer excellent in wettability to a polarizing plate and in light peelability is easily obtained when the glass transition temperature is set to -70°C or less. Incidentally, the glass transition temperature of the (meth)acrylic polymer

can be adjusted within the above range by suitably changing the monomer component and the composition ratio to be used.

[0055]

The polymerization method for obtaining the (meth)acrylic polymer is not particularly limited, and the (meth)acrylic polymer can be obtained by polymerization using a known method such as solution polymerization, emulsion polymerization, bulk polymerization, and suspension polymerization. In particular, from the viewpoints of workability and characteristics such as less-staining property to an adherend (an object to be protected), solution polymerization is a more preferable embodiment. Further, the obtained polymer may be any of a random copolymer, a block copolymer, an alternate copolymer, a graft copolymer, and the like.

[0056]

When a urethane-based pressure-sensitive adhesive is used for the pressure-sensitive adhesive layer, any suitable urethane-based pressure-sensitive adhesive can be adopted. As such a urethane-based pressure-sensitive adhesive, a pressure-sensitive adhesive comprising a urethane-based polymer obtained by reacting a polyol with a polyisocyanate compound can be preferably mentioned. As the polyol, for example, polyether polyol, polyester polyol, polycarbonate polyol, polycaprolactone polyol and

the like can be mentioned. Examples of the polyisocyanate compound include diphenylmethane diisocyanate, tolylene diisocyanate, hexamethylene diisocyanate, and the like.

[0057]

When a silicone-based pressure-sensitive adhesive is used for the pressure-sensitive adhesive layer, any appropriate silicone-based pressure-sensitive adhesive can be adopted. As such a silicone-based pressure-sensitive adhesive, an adhesive obtained by blending or coagulating a silicone-based polymer can be preferably adopted.

[0058]

Examples of the silicone-based pressure-sensitive adhesive include an addition reaction-curable silicone-based pressure-sensitive adhesive and a peroxide-curable silicone-based pressure-sensitive adhesive. Among these silicone-based pressure-sensitive adhesives, an addition reaction-curable silicone-based pressure-sensitive adhesive is preferable because no peroxide (such as benzoyl peroxide) is used and no decomposition products are generated.

[0059]

As a curing reaction of the addition reaction-curable silicone-based pressure-sensitive adhesive, for example, in the case of obtaining a polyalkylsilicone-based pressure-sensitive adhesive, a method of curing a polyalkylhydrogen-

siloxane composition with a platinum catalyst is generally exemplified.

[0060]

<Oxyalkylene Group-Containing Compound>

The pressure-sensitive adhesive composition used in the present invention can also contain an oxyalkylene group-containing compound. By containing an oxyalkylene group-containing compound, it is possible to further develop light peelability. Examples of the oxyalkylene group-containing compound include an organopolysiloxane having an oxyalkylene chain and an oxyalkylene group-containing compound not containing an organopolysiloxane.

[0061]

Specific examples of the organopolysiloxane having an oxyalkylene chain as a main chain include commercially available products including trade names X-22-4952, X-22-4272, X-22-6266, KF-6004 and KF-889 (all manufactured by Shin-Etsu Chemical Co., Ltd.); BY16-201 and SF8427 (all manufactured by Dow Corning Toray Co., Ltd.); and IM22 (manufactured by Wacker Asahikasei Silicone Co., Ltd.). Further, specific examples of the organosiloxane having an oxyalkylene chain in the side chain include commercially available products including trade names KF-351A, KF-352A, KF-353, KF-354L, KF-355A, KF-615A, KF-945, KF-640, KF-642, KF-643, KF-6022, X-22-6191, X-22-4515, KF-6011, KF-6012,

KF-6015, KF-6017, and X-22-2516 (all manufactured by Shin-Etsu Chemical Co., Ltd.); SF8428, FZ-2162, SH3749, FZ-77, L-7001, FZ-2104, FZ-2110, L-7002, FZ-2122, FZ-2164, FZ-2203, FZ-7001, SH8400, SH8700, SF8410, and SF8422 (all manufactured by Dow Corning Toray Co., Ltd.); TSF-4440, TSF-4441, TSF-4445, TSF-4450, TSF-4446, TSF-4452, and TSF-4460 (manufactured by Momentive Performance Materials Inc.); and BYK-333, BYK-307, BYK-377, BYK-UV3500, and BYK-UV3570 (manufactured by BYK Japan KK). These compounds may be used singly or in the form of a mixture of two or more kinds of them.

[0062]

Specific examples of the oxyalkylene group-containing compound containing no organopolysiloxane described above include nonionic surfactants such as polyoxyalkylene alkylamine, polyoxyalkylene diamine, polyoxyalkylene fatty acid ester, polyoxyalkylene sorbitan fatty acid ester, polyoxyalkylene alkyl phenyl ether, polyoxyalkylene alkyl ether, polyoxyalkylene alkyl allyl ether, and polyoxyalkylene alkyl phenyl allyl ether; anionic surfactants such as polyoxyalkylene alkyl ether sulfuric acid ester salt, polyoxyalkylene alkyl ether phosphoric acid ester salt, polyoxyalkylene alkyl phenyl ether sulfuric acid ester salt, and polyoxyalkylene alkyl phenyl ether phosphoric acid ester salt; and others such as

cationic surfactants and amphoteric surfactants having a polyoxyalkylene chain (polyalkylene oxide chain), polyether-based compounds having a polyoxyalkylene chain (including derivatives thereof), and acrylic compounds having a polyoxyalkylene chain (including derivatives thereof), and the like. Further, a polyoxyalkylene chain-containing monomer may be added as a polyoxyalkylene chain-containing compound to the pressure-sensitive adhesive composition. These polyoxyalkylene chain-containing compounds may be used singly or in combination of two or more of them.

[0063]

Specific examples of the polyether-based compound (polyether component) having a polyoxyalkylene chain include a polypropylene glycol (PPG)-polyethylene glycol (PEG) block copolymer, a PPG-PEG-PPG block copolymer, and a PEG-PPG-PEG block copolymer. Examples of the polyether compound derivative having a polyoxyalkylene chain include a terminal-etherified oxypropylene group-containing compound (PPG monoalkyl ether, PEG-PPG monoalkyl ether, etc.), a terminal-acetylated oxypropylene group-containing compound (terminal-acetylated PPG, etc.), and the like.

[0064]

Moreover, specific examples of the acrylic compound having a polyoxyalkylene chain include a (meth)acrylate

polymer containing an oxyalkylene group. The oxyalkylene group has an addition mole number of an oxyalkylene unit of preferably 1 to 50, more preferably 2 to 30, and still more preferably 2 to 20. The terminal of the oxyalkylene chain may be a hydroxyl group as it is or may be substituted with an alkyl group, a phenyl group, or the like.

[0065]

The (meth)acrylate polymer having an oxyalkylene group is preferably a polymer containing a (meth)acrylic acid alkylene oxide as a monomer component, and specific examples of the (meth)acrylic acid alkylene oxide include, as an ethylene glycol group-containing (meth)acrylate, methoxy-polyethylene glycol (meth)acrylate type such as methoxy-diethylene glycol (meth)acrylate and methoxy-triethylene glycol (meth)acrylate; ethoxy-polyethylene glycol (meth)acrylate type such as ethoxy-diethylene glycol (meth)acrylate and ethoxy-triethylene glycol (meth)acrylate; butoxy-polyethylene glycol (meth)acrylate type such as butoxy-diethylene glycol (meth)acrylate and butoxy-triethylene glycol (meth)acrylate; phenoxy-polyethylene glycol (meth)acrylate type such as phenoxy-diethylene glycol (meth)acrylate and phenoxy-triethylene glycol (meth)acrylate; 2-ethylhexyl-polyethylene glycol (meth)acrylate; nonylphenol-polyethylene glycol (meth)acrylate type; methoxy-polypropylene glycol

(meth)acrylate type such as methoxy-dipropylene glycol (meth)acrylate; and the like.

[0066]

Further, as the monomer component, other monomer components other than the (meth)acrylic acid alkylene oxide can also be used. Specific examples of the other monomer components include acrylates and/or methacrylates each containing an alkyl group of 1 to 14 carbon atoms, such as methyl (meth)acrylate, ethyl (meth)acrylate, n-butyl (meth)acrylate, sec-butyl (meth)acrylate, tert-butyl (meth)acrylate, isobutyl (meth)acrylate, hexyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, n-octyl (meth)acrylate, isooctyl (meth)acrylate, n-nonyl (meth)acrylate, isononyl (meth)acrylate, n-decyl (meth)acrylate, isodecyl (meth)acrylate, n-dodecyl (meth)acrylate, n-tridecyl (meth)acrylate, n-tetradecyl (meth)acrylate, and the like.

[0067]

Furthermore, as other monomer components other than the (meth)acrylic acid alkylene oxide, it is also possible to appropriately use a carboxyl group-containing (meth)acrylate, a phosphoric acid group-containing (meth)acrylate, a cyano group-containing (meth)acrylate, vinyl esters, an aromatic vinyl compound, an acid anhydride group-containing (meth)acrylate, a hydroxyl group-

containing (meth)acrylate, an amide group-containing (meth)acrylate, an amino group-containing (meth)acrylate, an epoxy group-containing (meth)acrylate, N-acryloylmorpholine, vinyl ethers, etc.

[0068]

In a more preferred embodiment, the polyoxyalkylene chain-containing compound containing no organopolysiloxane is a compound having a (poly)ethylene oxide chain at least in part. By adding the (poly)ethylene oxide chain-containing compound, compatibility with the base polymer is improved and bleeding to an adherend is suitably suppressed, so that a pressure-sensitive adhesive composition with less-staining properties can be obtained. In particular, in the case of using a PPG-PEG-PPG block copolymer, a pressure-sensitive adhesive with excellent less-staining properties is obtained. In the polyethylene oxide chain-containing compound, the weight ratio of the (poly)ethylene oxide chain to the total weight of the polyoxyalkylene chain-containing compound containing no organopolysiloxane is preferably 5 to 90% by weight, more preferably 5 to 85% by weight, still more preferably 5 to 80% by weight, and most preferably 5 to 75% by weight.

[0069]

Moreover, specific examples of the polyoxyalkylene chain-containing compounds containing no organopolysiloxane

include, as commercially available products, ADEKA Pluronic 17R-4 and ADEKA Pluronic 25R-2 (both manufactured by ADEKA CORPORATION); LATEMUL PD-420, LATEMUL PD-420, LATEMUL PD-450, EMULGEN 120 (all manufactured by Kao Corporation), AQUALON HS-10, KH-10, NOIGEN EA-87, EA-137, EA-157, EA-167, EA-177 (all manufactured by Dai-ichi Kogyo Seiyaku Co., Ltd.).

[0070]

The content of the oxyalkylene group-containing compound is preferably 0.01 to 5.0 parts by weight, more preferably 0.02 to 2 parts by weight, still more preferably 0.03 to 1.6 parts by weight, most preferably 0.1 to 0.8 parts by weight, with respect to 100 parts by weight of a pressure-sensitive adhesive polymer (main polymer, for example, (meth)acrylic polymer, urethane-based polymer, silicone-based polymer, etc.) constituting the pressure-sensitive adhesive composition. When the content of the oxyalkylene group-containing compound is within the above range, such a range is preferable because light peelability (removability) of the surface protective film of the present invention is easily developed.

[0071]

<Crosslinking Agent>

In the surface protective film of the present invention, it is preferable that the pressure-sensitive

adhesive composition contains a crosslinking agent. Further, in the present invention, a pressure-sensitive adhesive layer can be formed by using the pressure-sensitive adhesive composition. For example, when the pressure-sensitive adhesive composition is an acrylic pressure-sensitive adhesive containing the (meth)acrylic polymer, crosslinking is carried out by appropriately adjusting the constitutional unit and constitutional ratio of the (meth)acrylic polymer, and the selection and addition ratio of the crosslinking agent, thereby making it possible to obtain a pressure-sensitive adhesive layer (surface protective film) having more excellent heat resistance.

[0072]

As the crosslinking agent used in the present invention, an isocyanate compound, an epoxy compound, a melamine-based resin, an aziridine derivative, a metal chelate compound or the like may be used, and in particular, the use of an isocyanate compound or an epoxy compound is a preferred embodiment. These compounds may be used singly or in combination of two or more thereof.

[0073]

Examples of the isocyanate compound include aliphatic polyisocyanates such as trimethylene diisocyanate, butylene diisocyanate, hexamethylene diisocyanate (HDI), and dimer

acid diisocyanate; alicyclic isocyanates such as cyclopentylene diisocyanate, cyclohexylene diisocyanate, isophorone diisocyanate (IPDI), and 1,3-bis(isocyanatomethyl) cyclohexane; aromatic isocyanates such as 2,4-tolylene diisocyanate, 4,4'-diphenylmethane diisocyanate, and xylylene diisocyanate (XDI); and modified polyisocyanates obtained by modifying the isocyanate compounds with allophanate bonding, biuret bonding, isocyanurate bonding, uretdione bonding, urea bonding, carbodiimide bonding, uretonimine bonding, oxadiazinetriene bonding, etc. Examples of such isocyanate compounds as commercially available products include trade names TAKENATE 300S, TAKENATE 500, TAKENATE 600, TAKENATE D165N, and TAKENATE D178N (all manufactured by Takeda Pharmaceutical Co., Ltd.), SUMIDUR T80, SUMIDUR L, and DESMODUR N3400 (all manufactured by Sumitomo Bayer Urethane Co., Ltd.); and MILLIONATE MR, MILLIONATE MT, CORONATE L, CORONATE HL, and CORONATE HX (all manufactured by Nippon Polyurethane Industry Co., Ltd.). These isocyanate compounds may be used singly or in the form of a mixture of two or more of them, and it is also possible to use a difunctional isocyanate compound and a tri or higher functional isocyanate compound in combination. The combination use of the crosslinking agents makes it possible to satisfy both adherability and repulsion

resistance (adhesion property to a curved surface) and to obtain a pressure-sensitive adhesive layer (surface protective film) more excellent in adhesion reliability.

[0074]

Examples of the epoxy compound include N,N,N',N'-tetraglycidyl-m-xylenediamine (trade name TETRAD-X manufactured by Mitsubishi Gas Chemical Company, Inc.), 1,3-bis(N,N-diglycidylaminomethyl)cyclohexane (trade name TETRAD-C manufactured by Mitsubishi Gas Chemical Company Inc.), and the like.

[0075]

Examples of the melamine-based resin include hexamethylol melamine and the like. Examples of the aziridine derivative as commercially available products include trade names HDU, TAZM, and TAZO (all manufactured by Sogo Pharmaceutical Co., Ltd.), and the like.

[0076]

Examples of the metal chelate compound include aluminum, iron, tin, titanium, nickel and the like as a metal component, and acetylene, methyl acetoacetate, ethyl lactate and the like as a chelate component.

[0077]

The content of the crosslinking agent to be used in the present invention is preferably from 0.01 to 20 parts by weight, more preferably from 0.1 to 15 parts by weight,

still more preferably from 0.5 to 10 parts by weight, and most preferably from 1 to 8 parts by weight, with respect to 100 parts by weight of the (meth)acrylic polymer. If the content of the crosslinking agent is less than 0.01 parts by weight, the crosslinking agent may insufficiently form crosslinking, so that the cohesive strength of the pressure-sensitive adhesive layer may be low, which may result in obtaining insufficient heat resistance or tends to cause adhesive residue. On the other hand, if the content of the crosslinking agent exceeds 20 parts by weight, the polymer may have high cohesive strength to reduce fluidity, so that the wettability to an adherend (e.g. a polarizing plate) may be insufficient, which tends to cause blisters between the adherend and the pressure-sensitive adhesive layer (pressure-sensitive adhesive composition layer). In addition, these crosslinking agents may be used singly or in the form of a mixture of two or more of them.

[0078]

<Crosslinking Catalyst>

The pressure-sensitive adhesive composition may further contain a crosslinking catalyst for more effectively promoting any of the above-mentioned crosslinking reactions. Examples of the crosslinking catalyst that can be used include tin-based catalysts such

as dibutyltin dilaurate and dioctyltin dilaurate; and iron-based catalysts such as tris(acetylacetonato)iron, tris(hexane-2,4-dionato)iron, tris(heptane-2,4-dionato)iron, tris(heptane-3,5-dionato)iron, tris(5-methylhexane-2,4-dionato)iron, tris(octane-2,4-dionato)iron, tris(6-methylheptane-2,4-dionato)iron, tris(2,6-dimethylheptane-3,5-dionato)iron, tris(nonane-2,4-dionato)iron, tris(nonane-4,6-dionato)iron, tris(2,2,6,6-tetramethylheptane-3,5-dionato)iron, tris(tridecane-6,8-dionato)iron, tris(1-phenylbutane-1,3-dionato)iron, tris(hexafluoroacetylacetonato)iron, tris(acetoacetic acid ethyl)iron, tris(acetoacetic acid n-propyl)iron, tris(acetoacetic acid isopropyl)iron, tris(acetoacetic acid n-butyl)iron, tris(acetoacetic acid sec-butyl)iron, tris(acetoacetic acid tert-butyl)iron, tris(propionylacetic acid methyl)iron, tris(propionylacetic acid ethyl)iron, tris(propionylacetic acid n-propyl)iron, tris(propionylacetic acid isopropyl)iron, tris(propionylacetic acid n-butyl)iron, tris(propionylacetic acid sec-butyl)iron, tris(propionylacetic acid tert-butyl)iron, tris(acetoacetic acid benzyl)iron, tris(malonic acid dimethyl)iron, tris(malonic acid diethyl)iron, trimethoxyiron, triethoxyiron, tri-isopropoxyiron, ferric chloride, and the like. These crosslinking catalysts may be used singly or

in combination of two or more of them.

[0079]

The content of the crosslinking catalyst is not particularly limited but is preferably about 0.0001 to 1 part by weight, more preferably about 0.001 to 0.5 parts by weight, with respect to 100 parts by weight of the (meth)acrylic polymer. If the content of the crosslinking catalyst is within the above range, the speed of the crosslinking reaction is high when forming the pressure-sensitive adhesive layer, and the pot life of the pressure sensitive adhesive composition also becomes longer, which is a preferable embodiment.

[0080]

Further, the pressure-sensitive adhesive composition may contain other publicly-known additives, for example, powders such as lubricants, colorants, and pigments, plasticizers, tackifiers, low molecular weight polymers, surface lubricants, leveling agents, antioxidants, corrosion inhibitors, light stabilizers, UV absorbers, polymerization inhibitors, silane coupling agents, antistatic agents, inorganic or organic fillers, metal powders, particles, foils, and the like may be appropriately added depending on their use.

[0081]

<Separator Attached Optical Surface Protective Film>

The separator attached optical surface protective film (surface protective film) of the present invention is formed by forming the pressure-sensitive adhesive layer on at least one surface of a substrate film, wherein crosslinking of the pressure-sensitive adhesive composition is generally carried out after the application of the pressure-sensitive adhesive composition. However, it is also possible to transfer a pressure-sensitive adhesive layer comprising the pressure-sensitive adhesive composition after crosslinking, onto a substrate film or the like.

[0082]

Moreover, although methods of forming a pressure-sensitive adhesive layer on a substrate film are not particularly limited, but, for example, the pressure-sensitive adhesive composition (solution) is applied to a substrate film, and the polymerization solvent etc. are removed by drying, thereby to form a pressure-sensitive adhesive layer on a substrate film. Thereafter, curing may be performed for the purpose of adjustment of component transfer of the pressure-sensitive adhesive layer or adjustment of the crosslinking reaction. Moreover, when applying a pressure-sensitive adhesive composition on a substrate film to produce a surface protective film, one or more kinds of solvents other than a polymerization solvent

may be newly added to the pressure-sensitive adhesive composition so that a uniform application can be achieved on the substrate film.

[0083]

Moreover, as a formation method of the pressure-sensitive adhesive layer at the time of manufacturing the surface protective film of the present invention, known methods employed for producing pressure-sensitive adhesive tapes are used. Specific examples thereof include roll coating, gravure coating, reverse coating, roll blush, spray coating, air knife coating, extrusion coating using a die coater, and the like.

[0084]

The surface protective film of the present invention is usually produced such that the thickness of the pressure-sensitive adhesive layer is about 3 to 100 μm , preferably about 5 to 50 μm . When the thickness of the pressure-sensitive adhesive layer is in the above-mentioned range, an appropriate balance of removability and adhesion property is easily obtained, which is preferable.

[0085]

The surface protective film of the present invention has a total thickness of preferably from 8 to 300 μm , more preferably from 10 to 200 μm , most preferably from 20 to 100 μm . If the total thickness falls within the above

range, the adhesive properties (removability, adhesion property, etc.), workability, and appearance properties can be excellent, and this is a preferable embodiment. The total thickness means a total of the thicknesses of all layers including the substrate film, the pressure-sensitive adhesive layer, the separator, and other layers.

[0086]

<Separator>

The surface protective film of the present invention is a separator attached optical surface protective film comprising an optical surface protective film comprising a pressure-sensitive adhesive layer on at least one surface of a substrate film, and a separator on the surface of the pressure-sensitive adhesive layer opposite from the surface of the substrate film contacting the pressure-sensitive adhesive layer, wherein the separator comprises a release layer and a polyester-based substrate, and the polyester-based substrate comprises voids and a specific gravity of 1.2g/cm^3 or less. The separator is to be attached to the surface of the pressure-sensitive adhesive layer for the purpose of protecting the pressure-sensitive adhesive surface of the pressure-sensitive adhesive layer. In particular, the weight of the separator itself can be suppressed low because the polyester-based substrate has voids. Thus, the workability is excellent, and cushioning

properties due to the voids can be imparted, so that adhesive dents and the like that may occur after coating with the pressure-sensitive adhesive can be prevented, which is a preferable embodiment.

[0087]

<Polyester-Based Material>

The polyester-based substrate (sometimes referred to simply as "substrate") is not particularly limited as long as it can protect the pressure-sensitive adhesive layer and is a polyester-based film having voids. Examples of the polyester-based film include a polyethylene terephthalate film, a polyethylene naphthalate film, a polybutylene terephthalate film, etc.

[0088]

The thickness of the polyester-based substrate has usually a thickness of about 5 to 200 μm , preferably about 10 to 100 μm . When the thickness of the polyester-based substrate is in the above range, such a thickness is preferable because of excellent bonding workability to the pressure-sensitive adhesive layer and excellent peelability and workability to the pressure-sensitive adhesive layer.

[0089]

The surface of the polyester-based substrate can be subjected to various surface treatments such as corona discharge treatment, and various surface processing such as

embossing, as necessary. In addition, if necessary, various additives such as fillers (inorganic fillers, organic fillers, etc.), anti-aging agents, antioxidants, ultraviolet light absorbers, antistatic agents, lubricants, plasticizers, coloring agents (pigments, dyes, etc.), etc. may be blended with the polyester-based substrate.

[0090]

The specific gravity of the polyester-based substrate is 1.2 g/cm^3 or less, preferably from 0.7 to 1.2 g/cm^3 , and more preferably from 0.9 to 1.1 g/cm^3 . If the specific gravity of the substrate is within the above range, the weight of the separator including the substrate can be lightly suppressed, and even if the separator is thick, the weight can be suppressed, so that the workability is excellent. This is a preferable embodiment.

[0091]

The void ratio is preferably 15% (volume%) or more, more preferably 18% or more, still more preferably 20% or more, with respect to the volume of the polyester-based substrate. When the void ratio is 15% or more, the cushioning property of the separator is improved to absorb an unevenness due to fillers (for example, polyethylene terephthalate (PET) filler) contained in the substrate film constituting an optical surface protective film and in the polyester-based substrate constituting a separator, so that

the generation of adhesive dents and the like due to the separator and the like can be suppressed. From the viewpoint of the strength and the like of the separator, the void ratio is preferably 40% or less, and more preferably 30% or less.

[0092]

The shape of the voids of the polyester-based substrate is a sphere, an oval sphere, a thread, or the like, and such substrate takes preferably a dispersed form. The dispersion diameter is preferably from 0.01 to 100 μm , and more preferably from 0.05 to 30 μm . If the thickness is within the above range, such a thickness is a preferable embodiment because the strength of the separator is high, and the cushioning properties are excellent. The shape of the void can be observed from the cross section of the substrate by a scanning electron microscope.

[0093]

<Release Layer>

The release layer has adhesiveness to the polyester-based substrate and a peelability to the pressure-sensitive adhesive layer and can be formed from a release agent composition. The release agent composition is not particularly limited, but for example, silicone compounds such as dimethylsiloxane and diphenylsiloxane, long chain alkyl-based compounds such as silicone resin, fluorocarbon

resin, and Ashioresin can be used as such a release agent composition.

[0094]

Furthermore, the release agent composition may contain other known additives. For example, powders such as antistatic agents, colorants, pigments, etc., surfactants, plasticizers, tackifiers, low molecular weight polymers, surface lubricants, leveling agents, antioxidants, corrosion inhibitors, light stabilizers, ultraviolet light absorbers, polymerization inhibitors, silane coupling agents, inorganic or organic fillers, metal powders, particles, etc. may be added as appropriate depending on the intended use.

[0095]

<Preparation of Separator>

The separator is formed by using the release agent composition on the polyester-based substrate.

[0096]

Although the method of forming a release layer on the polyester-based substrate is not particularly limited, for example, a solution of the release agent composition is applied to the substrate, and the polymerization solvent and the like are removed by drying to form a release layer on the substrate. Thereafter, curing may be performed for the purpose of adjustment of component transfer of the

release layer. In addition, when a release agent composition is applied onto a substrate to produce a release layer, one or more kinds of components other than the polymerization solvent may be newly added to the release agent composition so as to be uniformly applied onto the substrate.

[0097]

Moreover, as a method for forming the release layer, a known method used for producing a release layer is used. Specific examples thereof include roll coating, gravure coating, reverse coating, roll brushing, spray coating, air knife coating, and extrusion coating using a die coater.

[0098]

The thickness of the release layer is typically from 1 to 200 nm, preferably from 5 to 100 nm, more preferably from 10 to 50 nm. If the thickness of the release layer is too small, it may be difficult to separate the separator, which may make it difficult to attach an optical surface protective film. On the other hand, if the thickness of the release layer is too thick, the staining property of a pressure-sensitive adhesive layer of an optical surface protective film may be affected.

[0099]

Examples of commercially available separators include Crisper K 7211-50 μm , Crisper K 7211-38 μm (all

manufactured by Toyobo Co., Ltd.), PET 50 (K2411) PAT1 8LK, PET 50 (K2411) PAT1 9K (all manufactured by Lintec Corporation).

[0100]

<Bonding of Optical Surface Protective Film to Separator>

The separator attached optical surface protective film of the present invention takes a form formed by bonding the pressure-sensitive adhesive layer of the optical surface protective film to the release layer of the separator. A known method is used for such bonding.

[0101]

<Optical Member>

In the present invention, an optical surface protective film obtained by peeling the separator from the surface of the pressure-sensitive adhesive layer of the separator attached optical surface protective film is bonded to an optical member so that the optical member can be protected. The separator is particularly excellent in cushioning properties, so that dents are less likely to occur, and the optical surface protective film is excellent in appearance quality (appearance), and thus can be used in surface-protective applications (surface protective film) at the time of processing, transportation, shipping, etc. Thus, such a film is useful to protect the surface of the optical member (such as a polarizing plate).

EXAMPLES

[0102]

Several Examples relating to the present invention will be described below, but the present invention is not intended to be limited to these specific Examples. In the following description, "parts" and "%" are on a weight basis unless otherwise specified. Also, the blending amount (addition amount) is shown in the table.

[0103]

In addition, each characteristic in the following explanation was measured or evaluated as follows.

[0104]

<Measurement of Specific Gravity of Polyester-Based Substrate Constituting Separator>

In the measurement of a specific gravity of a polyester-based substrate, the substrate was cut into a 10 cm × 10 cm square, the thickness was measured at 50 points, the average thickness was defined as t [cm], and the weight thereof was measured to 0.1 mg and defined as w (unit: g). The specific gravity was calculated by the following equation.

Specific gravity of polyester-based substrate (g/cm^3)
 $= w / (t \times 10 \times 10)$

[0105]

<Measurement of Void Ratio of Polyester-Based Substrate Constituting Separator>

A cross section of a polyester-based substrate was photographed with a scanning electron microscope, and then voids of the cross sectional area were traced to a tracing film, and the filled figure was subjected to image processing by an image analysis device, and a void ratio (%) was determined as an area ratio. This value was directly displayed as the void ratio (volume%).

Scanning electron microscope used: S-510 scanning electron microscope manufactured by Hitachi, Ltd.

Image analysis processor used: Luzex IID manufactured by Nireco Corporation.

[0106]

<Measurement of Separator Thickness>

A thickness of a separator (separator thickness) is a total thickness of a polyester-based substrate and a release layer and was measured using R1-205 manufactured by Ozaki Mfg. Co., Ltd.

[0107]

<Measurement of Separator Weight>

A weight of a separator is a total weight of a polyester-based substrate and a release layer and was measured using TW223N manufactured by Shimadzu Corporation.

[0108]

<Measurement of Glass Transition Temperature (Tg) of
(Meth)acrylic Polymer>

A glass transition temperature (Tg) (°C) was determined by the following equation using the following literature values as a glass transition temperature Tgn (°C) of a homopolymer of each monomer.

$$\text{Equation: } 1/(T_g + 273) = \sum [W_n/(T_{gn} + 273)]$$

wherein Tg(°C) is a glass transition temperature of a copolymer, Wn(-) is a weight fraction of each monomer, Tgn (°C) is a glass transition temperature of a homopolymer of each monomer, and n is a kind of each monomer.

Literature value:

2-Ethylhexyl acrylate (2EHA): -70°C

Butyl acrylate (BA): -55°C

2-Hydroxyethyl acrylate (HEA): -15°C

Acrylic acid (AA): 106°C

For the literature values, reference was made to "Synthesis/Design of Acrylic Resins and Development of New Applications (in Japanese)" (published by Publishing Department of Chuo Keiei Kaihatsu Center).

[0109]

<Measurement of Weight Average Molecular Weight (Mw) of
(Meth)acrylic Polymer>

A weight average molecular weight (Mw) of a (meth)acrylic polymer to be used was measured using a GPC

apparatus (HLC-8220 GPC) manufactured by Tosoh Corporation.

The measurement conditions are as follows.

Sample concentration: 0.2% by weight (THF solution)

Sample injection volume: 10 μ l

Eluent: THF

Flow rate: 0.6 ml/min

Measurement temperature: 40°C

Column:

Sample column; TSK guard column Super HZ-H (one column) +
TSK gel Super HZM-H (two columns)

Reference column; TSK gel Super H-RC (one column)

Detector: Differential Refractometer (RI)

In addition, the weight average molecular weight was determined in terms of polystyrene. Moreover, when measuring a number average molecular weight (M_n), the M_n was measured similarly to a weight average molecular weight (M_w).

[0110]

<Presence or Absence of Dent on Surface of Pressure-Sensitive Adhesive Layer>

Under a fluorescent lamp in a dark room, a separator was peeled off from the surface of a pressure-sensitive adhesive layer of an optical surface protective film, light was reflected on the surface of the pressure-sensitive adhesive layer, and the presence or absence of a dent was visually confirmed. The case where there was no dent was

expressed as o, and the case where there was a dent was expressed as x.

[0111]

<Preparation of (Meth)acrylic Polymer (A)>

A four-necked flask equipped with a stirring blade, a thermometer, a nitrogen gas-introducing tube, and a condenser was charged with 100 parts by weight of 2-ethylhexyl acrylate (2EHA), 4 parts by weight of 2-hydroxyethyl acrylate (HEA), 0.2 parts by weight of 2,2'-azobisisobutyronitrile (AIBN) as a polymerization initiator, and 205 parts by weight of ethyl acetate. Nitrogen gas was introduced into the flask while the mixture was gently stirred, and polymerization reaction was performed for 4 hours while the temperature of the liquid in the flask was kept at about 63°C, thereby to prepare a solution (about 35% by weight) of a (meth)acrylic polymer (A). The (meth)acrylic polymer (A) had a weight average molecular weight (Mw) of 650,000 and a Tg of -68°C.

[0112]

<Preparation of (Meth)acrylic Polymer (B)>

A four-necked flask equipped with a stirring blade, a thermometer, a nitrogen gas-introducing tube, and a condenser was charged with 95 parts by weight of butyl acrylate (BA), 5 parts by weight of acrylic acid (AA), 0.1 parts by weight of 2,2'-azobisisobutyronitrile as a

polymerization initiator, and 234 parts by weight of ethyl acetate. Nitrogen gas was introduced into the flask while the mixture was gently stirred, and polymerization reaction was performed for 6 hours while the temperature of the liquid in the flask was kept at about 65°C, thereby to prepare a solution (30% by weight) of a (meth)acrylic polymer (B). The (meth)acrylic polymer (B) had a weight average molecular weight (Mw) of 1,100,000 and a glass transition temperature (Tg) of -47°C.

[0113]

[Preparation of Acrylic Pressure-Sensitive Adhesive (1) Solution]

The acrylic polymer (A) solution (35% by weight) was diluted to 29% by weight with ethyl acetate, and to 500 parts by weight (solid content: 100 parts by weight) of this diluted solution were added 4 parts by weight (solid content: 4 parts by weight) of an isocyanurate of hexamethylene diisocyanate, which is a trifunctional isocyanate compound (Coronate HX: C/HX, manufactured by Nippon Polyurethane Industry Co., Ltd.) as a crosslinking agent, and 1.5 parts by weight (solid content: 0.015 parts by weight) of dibutyltin dilaurate ([Sn] in Table 2, 1% by weight ethyl acetate solution) as a crosslinking catalyst. The resulting mixture was stirred for about 1 minute while maintaining the mixture at around 25°C to prepare an

acrylic pressure-sensitive adhesive (1) solution.

[0114]

[Preparation of Acrylic Pressure-Sensitive Adhesive (2)
Solution]

The acrylic polymer (A) solution (35% by weight) was diluted to 29% by weight with ethyl acetate, and 500 parts by weight (solid content: 100 parts by weight) of this solution were mixed with 5 parts by weight (solid content: 5 parts by weight) of an isocyanate-based crosslinking agent (an isocyanurate of hexamethylene diisocyanate (trade name: "Coronate HX": C/HX, manufactured by Nippon Polyurethane Industry Co., Ltd.) as a crosslinking agent, 3 parts by weight (solid content: 0.03 parts by weight) of dibutyltin dilaurate (1% by weight ethyl acetate solution) as a crosslinking catalyst, and 0.3 parts by weight (solid content 0.3 parts by weight) of a polyoxyalkylene chain-containing compound not containing organopolysiloxane as an additive (Aqualon HS-10, manufactured by Dai-ichi Kogyo Seiyaku Co., Ltd.). The resulting mixture was stirred to prepare an acrylic pressure-sensitive adhesive (2) solution.

[0115]

[Preparation of Acrylic Pressure-Sensitive Adhesive (3)
Solution]

The (meth)acrylic polymer (B) solution (30% by

weight) was diluted to 29% by weight with ethyl acetate, and to 500 parts by weight of this diluted solution (solid content: 100 parts by weight) were added 6 parts by weight (solid content: 6 parts by weight) of an epoxy-based crosslinking agent (1,3-bis(N,N-diglycidylamino-methyl)cyclohexane, epoxy equivalent: 110, number of functional groups: 4, trade name "TETRAD-C": T/C, manufactured by Mitsubishi Gas Chemical Company, Inc.). The resulting mixture was stirred to prepare an acrylic pressure-sensitive adhesive (3) solution.

[0116]

[Preparation of Urethane-based Pressure-Sensitive Adhesive (4) Solution]

A urethane-based pressure-sensitive adhesive (4) solution was obtained by mixing 85 parts by weight of PREMINOL S3011 (manufactured by ASAHI GLASS CO., LTD., Mn=10,000) as a polyol having 3 hydroxyl groups, 13 parts by weight of SANNIX GP3000 (manufactured by Sanyo Chemical Industries, Ltd., Mn=3,000) as a polyol having 3 hydroxyl groups, 2 parts by weight of SANNIX GP1000 (manufactured by Sanyo Chemical Industries, Ltd., Mn=1,000) as a polyol having 3 hydroxyl groups, 18 parts by weight of an isocyanurate of hexamethylene diisocyanate which is a trifunctional isocyanate compound (CORONATE HX: C/HX, manufactured by Nippon Polyurethane Co., Ltd.) as a

crosslinking agent, 0.04 parts by weight of iron (III) acetylacetonate (tris(acetylacetonato)iron, "Fe" in Table 3, manufactured by Tokyo Chemical Industry Co., Ltd.) as a catalyst, 30 parts by weight of isopropyl myristate (EXCEPAL IPM, manufactured by Kao Corporation) as a wettability improver, 0.5 parts by weight of Irganox 1010 (manufactured by BASF) as an antioxidant, and 210 parts by weight of ethyl acetate as a diluting solvent.

[0117]

[Preparation of Silicone-Based Pressure-Sensitive Adhesive (5) Solution]

One hundred parts by weight of solid content of "X-40-3229" (solid content 60% by weight, manufactured by Shin-Etsu Chemical Co., Ltd.) as a silicone-based pressure-sensitive adhesive, 0.5 parts by weight of "CAT-PL-50T" (manufactured by Shin-Etsu Chemical Co., Ltd.) as a platinum catalyst, and 100 parts by weight of toluene as a solvent were mixed together to obtain a silicone-based pressure-sensitive adhesive (5) solution.

[0118]

<Example 1>

[Production of Antistatic-Treated Film]

An antistatic agent solution was prepared by diluting 10 parts by weight of an antistatic agent (Microsolver RMd-142, manufactured by Solvex Co., Ltd., containing, as main

components, tin oxide and a polyester resin) with a mixed solvent containing 30 parts by weight of water and 70 parts by weight of methanol.

The resulting antistatic agent solution was applied to a polyethylene terephthalate (PET) film having a thickness of 38 μm as a substrate film using a Meyer bar, and dried at 130°C for one minute to remove the solvent to form an antistatic layer (thickness: 0.2 μm), thereby to prepare an antistatic-treated film.

[0119]

[Production of Separator Attached Optical Surface
Protective Film]

The acrylic pressure-sensitive adhesive (1) solution was applied to the surface opposite to the antistatic-treated surface of the above antistatic-treated film and heated at 130°C for 2 minutes to form a pressure-sensitive adhesive layer with a thickness of 15 μm . Then, a silicon-treated surface of Crisper K 7211-50 μm (manufactured by Toyobo Co., Ltd., specific gravity of polyester-based substrate: 1.1 g/cm³, void ratio of polyester-based substrate: 20%, thickness: 50 μm), which is a separator having one surface subjected to silicone treatment, was attached to the surface of the pressure-sensitive adhesive layer to prepare a separator attached optical surface protective film.

[0120]

<Examples 2 and 3>

As shown in Table 2, a separator attached optical surface protective film was prepared in the same manner as in Example 1 except that the acrylic pressure-sensitive adhesive (2) solution or the acrylic pressure-sensitive adhesive (3) solution was used instead of the acrylic pressure-sensitive adhesive (1) solution used in Example 1.

[0121]

<Examples 4 and 5>

As shown in Tables 3 and 4, a separator attached optical surface protective film with adjusted heating conditions etc. and thickness of the obtained pressure-sensitive adhesive layer was prepared in the same manner as in Example 1 except that the urethane-based pressure-sensitive adhesive (4) solution or the silicone-based pressure-sensitive adhesive (5) solution was used instead of the acrylic pressure-sensitive adhesive (1) solution used in Example 1.

[0122]

<Example 6>

A separator attached optical surface protective film was prepared in the same manner as in Example 1 except that the separator described in Table 5 was used instead of the separator used in Example 1.

[0123]

<Comparative Examples 1 and 2>

A separator attached optical surface protective film was prepared in the same manner as in Example 1 except that the separator described in Table 5 was used instead of the separator used in Example 1.

[0124]

The blending contents described above, and the results of various measurements and evaluations of the separator attached optical surface protective films according to Examples and Comparative Examples are shown in Tables 1 to 5. In addition, the blending amounts in Tables show amounts of active components.

[0125]

[Table 1]

(Meth)acrylic polymer	Monomer component (part by weight)				Mw	Tg (°C)
	2EHA	BA	HEA	AA		
(A)	100	-	4	-	0.65 million	-68
(B)	-	95	-	5	1.1 million	-47

[0126]

[Table 2]

Blending content (part by weight)	(Meth)acrylic polymer		Crosslinking agent		Catalyst		Additive	
	Kind	Addition amount	Kind	Addition amount	Kind	Addition amount	Kind	Addition amount
Acrylic	(A)	100	C/HX	4	Sn	0.015	-	-

pressure-sensitive adhesive (1)								
Acrylic pressure-sensitive adhesive (2)	(A)	100	C/HX	5	Sn	0.03	AQUALON HS-10	0.3
Acrylic pressure-sensitive adhesive (3)	(B)	100	T/C	6	-	-	-	-

[0127]

[Table 3]

Blending content (part by weight)	Polyol component constituting urethane-based polymer (addition amount)			Crosslinking agent		Catalyst		Wettability improver		Antioxidant	
	S3011	GP3000	GP1000	Kind	Addition amount	Kind	Addition amount	Kind	Addition amount	Kind	Addition amount
Urethane-based pressure-sensitive adhesive (4)	85	13	2	C/HX	18	Fe	0.04	IPM	30	Irganox 1010	0.5

[0128]

[Table 4]

Blending content (part by weight)	Silicone component		Catalyst	
	Kind	Addition amount	Kind	Addition amount
Silicone-based pressure-sensitive adhesive (5)	X-40-3229	100	CAT-PL-50T	0.5

[0129]

[Table 5]

	Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Comparative Example 1	Comparative Example 2
Pressure-sensitive adhesive used	Acrylic pressure-sensitive adhesive (1)	Acrylic pressure-sensitive adhesive (2)	Acrylic pressure-sensitive adhesive (3)	Urethane-based pressure-sensitive adhesive (4)	Silicone-based pressure-sensitive adhesive (5)	Acrylic pressure-sensitive adhesive (1)	Acrylic pressure-sensitive adhesive (1)	Acrylic pressure-sensitive adhesive (1)
Separator	1.1	1.1	1.1	1.1	1.1	1.1	1.4	1.4
	20	20	20	20	20	20	0	0
	50	50	50	50	50	38	50	38
Separator weight (kg) for 1000 mm x 1000 m product	55	55	55	55	55	31	70	53.2
Dent	o	o	o	o	o	o	o	x

[0130]

From Table 5 above, in all Examples, by setting a void ratio of a polyester-based substrate constituting a separator to a desired range, the weight of the separator can be kept low, and after peeling the separator from a surface of the pressure-sensitive adhesive layer, it has been confirmed that the weight of the separator waste can be reduced, the bonding workability to the surface of the pressure-sensitive adhesive layer of the optical surface protective film as well as the workability when discarding the separator is excellent, and further the generation of dents can be prevented. On the other hand, in Comparative Example 1, since the void ratio of the polyester-based substrate constituting the separator is not included in the desired range, the weight of the separator is increased, and the bonding workability of the optical surface protective film to the pressure-sensitive adhesive layer surface, as well as the workability when discarding the separator is poor. In Comparative Example 2, the void ratio of the polyester-based substrate constituting the separator is not included in the desired range, but the weight of the separator could be suppressed by reducing the thickness of the polyester-based substrate. However, it was confirmed that the generation of dents could not be suppressed because of inferior cushioning property of the

separator.

INDUSTRIAL APPLICABILITY

[0131]

The separator attached optical surface protective film disclosed here is suitable as a surface protective film for protecting an optical member used as a component of liquid crystal display panel, plasma display panel (PDP), organic electroluminescence (EL) display, etc. at the time of manufacture, transportation, or the like of the optical member. In particular, such surface protective film is useful as an optical surface protective film applied to optical members such as a polarizing plate (polarizing film), a wavelength plate, a retardation plate, an optical compensation film, a brightness enhancement film, a light diffusion sheet, and a reflection sheet for liquid crystal display panels.

DESCRIPTION OF REFERENCE SIGNS

[0132]

- | | |
|----|--|
| 1 | Separator |
| 2 | Optical surface protective film |
| 3 | Separator attached optical surface protective film |
| 11 | Substrate (polyester-based substrate) |

- 12 Release layer
- 21 Pressure-sensitive adhesive layer
- 22 Substrate film

CLAIMS

1. A separator attached optical surface protective film, which comprises an optical surface protective film comprising a pressure-sensitive adhesive layer on at least one surface of a substrate film, and a separator on the surface of the pressure-sensitive adhesive layer opposite from the surface of the substrate film contacting the pressure-sensitive adhesive layer,

wherein

the separator comprises a release layer and a polyester-based substrate,

the separator comprises voids in the polyester-based substrate, and

a specific gravity of the polyester-based substrate is 1.2 g/cm³ or less.

2. The separator attached optical surface protective film according to claim 1, wherein a void ratio is 15% or more with respect to a volume of the polyester-based substrate.

3. The separator attached optical surface protective film according to claim 1 or 2, wherein the substrate film is a polyester film.

4. The separator attached optical surface protective film according to any one of claims 1 to 3, wherein the pressure-sensitive adhesive layer is formed from a pressure-sensitive adhesive composition containing at least one selected from an acrylic pressure-sensitive adhesive, a urethane-based pressure-sensitive adhesive, and a silicone-based pressure-sensitive adhesive.