LAMINATE FILM FOR ATTACHING TO A WINDOW

FIELD

The present invention relates to a laminate film with a plastic film layer and a silicone rubber layer for attaching to a window made of glass or acrylic or the like.

BACKGROUND

Films for attaching to windows are used on building windows or the like in order to shield sunlight and to prevent shattering of glass. Recently, there are films that can shield infrared light or the like and experience minimal color change due to sunlight, and films for attaching to windows that have an adhesive that can be applied to window glass and then peeled off without leaving adhesive residue.

Such window films are known in the prior art. Japanese Unexamined Patent Application Publication No. H10-250004, for example, discloses a film for attaching to a window wherein a coating layer containing a film forming resin primarily containing an acrylic-based resin (A) and a saturated polyester-based resin (B) and 5 to 40 weight parts of an ultraviolet light absorber (C) in 100 weight parts of the film forming resin is formed on one surface of a biaxially oriented polyester film, and an adhesive layer is formed on the other surface.

Japanese Unexamined Patent Application Publication No. 2000-96009 discloses a laminate film for attaching to a window containing an adhesive layer (B) on at least one surface of a plastic film (A), wherein the properties when the surface of the adhesive layer side of the laminate film is overlaid on a glass plate satisfy all of the following conditions:

(1) the ordinary adhesive strength is 300 g/cm or higher;

(2) when measuring the retention force under conditions of 1 kg of load and a

temperature of 80°C, shifting is 3 mm or less after 1 hour;

(3) the adhesive strength is 20% or more of the normal adhesive strength after having been applied to a glass plate after water spraying for 6 hours;

(4) when peeled off after being applied to a glass plate and maintained for 1 week at a temperature of 70°C, the number of adhesive residue spots with a size of 1 mm^2 or larger that adheres onto the glass plate is 1 or lower per 100 cm^2.

Japanese Unexamined Patent Application Publication No. 2000-117918 discloses a heat ray reflective film suitable for outdoor use, containing a laminate film with a biaxially oriented polyester film with weather resisting properties as a base material (A), a heat ray reflective layer (B) on at least one surface of the base material, and a surface protective layer (C), wherein the visible light transmissivity of the laminate film is 50% or higher, the near infrared reflectivity is 50% or higher, and the haze value is 5% or less.

SUMMARY OF THE INVENTION

The industry is always seeking improved window films. Existing window films suffer from certain drawbacks and shortcomings. For example, known adhesive films for a glass window have sufficient adhesion to the window glass in order to provide a function of preventing shattering of window glass, so peeling from the glass was not possible, or peeling could not be performed without using a special chemical agent, and therefore handling was difficult. Furthermore, even with a type of film that uses adhesive, applying the film without leaving air bubbles and removing the film without leaving adhesive is difficult for a standard consumer because of the high adhesive strength required for the function of preventing shattering of the window glass or the like.

The present invention provides a laminate film for applying to a window that can easily be made to apply to a window of a building or the like by a standard consumer that

is not a specialist or the like, such as a do-it-yourself end-user, where gas bubbles can easily be removed by rubbing the film with a finger or the like even if gas bubbles occur during application, that can easily be peeled from the window without leaving an residue or marks, and that has high weather resistance.

The present inventors have discovered that the aforementioned problems can be resolved by providing a laminate film that can be secured to the window without having adhesion or tackiness, and thus the present invention was achieved.

The present invention provides a laminate film for applying to a window, containing a plastic film layer and a silicone rubber layer that has a surface that adsorbs to the window.

With the laminate film of the present invention, the silicone rubber layer in the laminate film secures or adsorbs to the window without adhesion or tackiness. Thus, the laminate film can easily be removed from the window without silicone rubber layer adsorption residue or adsorption marks, and that has high weather resistance because of the use of a silicone rubber layer.

In the present specification, the terms shown below have the following definitions.

"Adsorption" means that an attached object is detachably integrated with the subject of attachment without adhesion or tackiness, and after removal of the attached object, the attached object does not experience cohesive failure.

"Tackiness" refers to pressure sensitive adhesion, and can be included in adhesion.

"Transparent" means that the light transmissivity is 90% or higher for visible light, or in other words in the wavelength range from 380 nm to 780 nm.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a laminate film according to the present disclosure.

FIG. 2 shows a laminate film according to the present disclosure wherein a metal layer is provided on the silicone rubber layer side of the plastic film layer.

FIG. 3 shows a laminate film according to the present disclosure, wherein a printing layer is provided on the silicone rubber layer side of the plastic film layer.

FIG. 4 shows a laminate film according to the present disclosure, wherein a printing layer is provided on the opposite side as the silicone rubber layer side of the plastic film layer.

DETAILED DESCRIPTION

A detailed disclosure for the purpose of illustrating representative embodiments of the present invention are given below, but the present invention should not be construed as being limited by these embodiments.

The laminate film for attaching to a window according to the present invention generally includes a plastic film layer with a layer a silicone rubber for securing the laminate film to a window.

In one embodiment, the present disclosure provides a laminate film for attaching to a window containing a plastic film layer and a silicone rubber layer having a surface for securing or "adsorbing" to a window, wherein the laminate film further includes a metal layer laminated between the plastic film layer and the silicone rubber layer.

In accordance with one aspect of the invention, the laminate film does not have adhesion or tackiness, and therefore even if gas bubbles are trapped between the laminate film and the window, for example during the application process, the gas bubbles can easily be eliminated by rubbing with a finger or the like. Furthermore, the laminate film

does not have adhesion or tackiness even when peeled from the window, and therefore a laminate film can be obtained that can be easily peeled from a window without leaving either residue of the silicone rubber layer or adsorption marks.

Referring now to the drawings, FIG. 1 is a cross section view of a laminate film for applying to a window according to one embodiment of the present disclosure. A silicone rubber layer 2 with a window adsorption surface 21 is provided on one side of the plastic film layer 1, and can adsorb onto the window via the adsorption surface 21.

FIG. 2 is a cross section view of a laminate film for applying to a window according to a second embodiment of the invention. The laminate film includes a metal layer 3 provided on the silicone rubber layer 2 side on the plastic film layer 1, and then a silicone rubber layer 2 with a surface 21 for adsorbing to a window is provided thereon.

FIG. 3 is a cross sectional view of yet another laminate film for applying to a window according to the present disclosure. A printing layer 4 is laminated onto the silicone rubber layer 2 side on the plastic film layer 1, and then a silicone rubber layer 2 with a surface 21 for adsorbing to a window is laminated thereon.

FIG. 4 is a cross section view of yet another laminate film for applying to a window according to the present disclosure. A silicone rubber layer 2 with a surface 21 for adsorbing to a window is laminated on one side of a plastic film layer 1, and a printing layer 4 is laminated on the surface of the plastic film layer 1 on the opposite side as the silicone rubber layer 2.

The silicone rubber layer of the present invention is not particularly restricted, and any commonly known silicone rubber can be used. In particular, if a silicone rubber layer obtained by blending a silicone main component containing reactive polydimethylsiloxane or the like with a cross-linking agent in the presence of a catalyst and hardening on a plastic film layer is used, sufficient adhesive force will be present

between the plastic film layer and the silicone rubber layer, and the silicone rubber layer can easily be obtained. Three types of combinations of the silicone main component, cross-linking agent, and catalyst can be suggested, namely: (i) condensation type (humidity hardening type) using polydimethylsiloxane containing a terminal hydroxyl group and/or a copolymer of polydimethylsiloxane and polydiphenylsiloxane as the silicone main component, multifunctional $-Si(OCH_3)_3$ type cross-linking agent and the like as the cross-linking agent, and dibutyl tin dilaurate as the catalyst; (ii) additive type using polydimethylsiloxane containing a vinyl group and/or a copolymer of polydimethylsiloxane and polydiphenylsiloxane and the like as the silicone main component, a siloxane-based cross-linking agent containing Si-H or the like as the cross-linking agent, and a platinum catalyst or the like as the catalyst; and (iii) a silicone polyurea type using polydimethylsiloxane containing a terminal amine group and/or a copolymer of polydimethylsiloxane and polydiphenylsiloxane as the silicone main component, a cross-linking agent containing a polyisocyanate group or the like as the cross-linking agent, and dibutyl tin dilaurate or the like as the catalyst.

The weighted average molecular weight of the silicone main component is not particularly restricted, and can be approximately 50,000 or higher, approximately 100,000 or higher, approximately 200,000 or higher, or approximately 300,000 or higher, and can be approximately 2 million or lower, approximately 1 million or lower, approximately 500,000 or lower, or approximately 400,000 or lower. In one embodiment, the weighted average molecular weight of the silicone main component may be approximately 300,000 or higher and approximately 500,000 or lower, for ease of application.

The molar weight of the cross-linking agent that is used for 1 mol of reactive groups in the silicone main component, or in other words terminal hydroxyl groups for condensation type, vinyl groups for additive type, and terminal amino groups for silicone

polyurea type, is not particularly restricted so long as the adsorption is not hindered after hardening, but the molar weight can be approximately 0.5 or higher, approximately 1.0 or higher, or approximately 1.5 or higher, and approximately 3.0 or lower, or approximately 2.0 or lower.

The molar weight of the cross-linking agent for one mole of silicone main component is preferably from approximately 0.5 to approximately 3.0 for the condensation type and the additive type, and from approximately 0.5 to approximately 1.5 for the silicone polyurea type, in order to prevent unreacted residual silicone main component and cross-linking agent and the like from remaining after hardening. The molar weight of the cross-linking agent for 1 mol of silicone main component is preferably approximately 1.0, as this is the stoichiometric amount.

The degree of cross-linking between the silicone main component and the cross-linking agent can be expressed by the gel ratio of the silicone rubber layer after hardening, as described below in detail.

Note, if the silicone rubber layer contains a tackifier as described below, the gel ratio does not include the amount of tackifier added.

The gel ratio can be approximately 90% or higher, approximately 95% or higher, or approximately 98% or higher, and approximately 90% or higher is suitable because adsorption marks and the like will not remain on the surface of the glass after removing, and approximately 95% or higher is even more preferable.

If necessary, a catalyst can be used in the cross-linking reaction between the silicone main components and the cross-linking agent. In this case, the amount of catalyst to silicone main component and cross-linking agent can be approximately 0.0001% or higher, approximately 0.00015% or higher, or approximately 0.001% or higher; or can be approximately 3.0% or lower, approximately 2.0% or lower, or

approximately 1.0% or lower, by weight, for the condensation type and the silicone polyurea type, and can be approximately 1.0 ppm or higher, approximately 2.0 ppm or higher, or approximately 5.0 ppm or higher, and approximately 100 ppm or lower, approximately 90 ppm or lower, or approximately 80 ppm or lower, by weight, for the additive type.

The amount of catalyst in the silicone main component and the cross-linking agent is suitably from 0.0001 to 3.0% by weight for the condensation type or the silicone polyurea type, and from 1 to 100 ppm for the additive type, and so long as the reaction proceeds sufficiently, there is no change over time, and the properties of the silicone rubber layer are not lost after hardening.

The silicone rubber layer will adsorb, or bond, to any window material such as glass or plastic or the like, and when applied to glass being used as window glass and measured as a laminate film for attaching to a window, the silicone rubber layer can have an adsorbent force of approximately 0.01 N/m or higher, approximately 0.05 N/m or higher, or approximately 0.1 N/m or higher as measured in a 90° peel test performed accordance with JIS K6854-1 standards as described below in the measurement details. On the other hand, the silicone rubber layer can have an adsorbent force of approximately 15 N/m or lower, approximately 10 N/m or lower, or approximately 5 N/m or lower.

The thickness of the silicone rubber layer is not particularly restricted so long as peeling or the like does not occur due to its own weight after adsorbing, and the thickness after hardening can be approximately 30 μm or lower, approximately 25 μm or lower, or approximately 20 μm or lower, but on the other hand, in order to form a smooth silicone rubber layer on a surface with waves or ridges and valleys, the thickness can be approximately 2.0 μm or higher, approximately 3.0 μm or higher, or approximately 5.0 μm or higher.

The silicone rubber layer basically does not contain other additives, but the additives described in the following sections on the plastic film layer and the metal layer may be optionally included if desired.

The silicone rubber layer of the present invention essentially does not contain a tackifier known to one skilled in the art, or in other words, essentially does not contain a substance that increases anchor effect and following properties to intricate surfaces of glass by reducing the modulus of elasticity at room temperature, for example.

However, a tackifier that is commonly used can be added without restrictions in particular so long as the weather resistance and the adsorbing properties of the silicone rubber layer are not lost. Specifically, MQ resin can be suggested as a tackifier.

MQ resins have a structure with R_3SiO-(M unit) and SiO_4-(Q unit) in the molecule for example, and is normally a solid resin with a weighted average molecular weight from 10,000 to 15,000, and from 0.7 to 1.1 mol of M units are used for 1 mol of Q units. The MQ resin can be used by blending and dissolving in the silicone main component or the like, and then hardening.

The amount of tackifier in the silicone rubber layer of the present invention can be approximately 15% or less, approximately 10% or less, or approximately 5% or less, by weight, and can be approximately 0.1% or higher, or approximately 1% or higher. Note, commercially available standard adhesives are known to normally contain 50 weight% or more of tackifiers such as MQ resins.

Even if the silicone rubber layer contains a tackifier, the thickness and adhesive strength and the like of the silicone rubber can be adjusted to the range shown in the section on the silicone rubber layer without the aforementioned tackifier.

Normally the silicone rubber layer is protected by a protective sheet or liner, or the like as shown below in order to prevent material such as dust and scraps from adhering,

and thus the silicone rubber layer can adsorb favorably to the window. However, if necessary, it is possible to apply water, a solvent, or a surfactant or the like to the window, or to the silicone rubber layer by spraying or the like.

The material of the plastic film layer of the present invention is not particularly restricted, and for example, can be a film made of polyester, polyamide, polyolefin, polyvinyl chloride, polycarbonate, acrylic-based resin, or fluorine-based resin, or the like.

Furthermore, the structure of the plastic film layer can be a laminate structure with an arbitrary number of layers formed by coextruding or the like in order to suppress the reflectivity if necessary.

Of these materials, polyester, polycarbonate, acrylic-based resins, and polyolefins are suitable from the perspective of transparency, dimensional stability, and economics and the like. More particularly, a polyester film is suitable from the perspective of transparency, economics, weather resistance, heat resistance, and mechanical properties and the like. The polyester film is not particularly restricted, and depending on the application, can be a uniaxially stretched polyester film, biaxially stretched polyester film, or an unstretched polyester film or the like.

The thickness of the plastic film layer is not particularly restricted so long as there are no problems with the flexibility or the like, and the thickness can be approximately 200 μm or lower, approximately 100 μm or lower, or approximately 50 μm or lower, and can be approximately 10 μm or higher, approximately 20 μm or higher, or approximately 30 μm or higher. The thickness of the plastic film layer is suitably approximately 30 μm or higher and approximately 100 μm or lower, because the handling will be easy when adsorbing to the window.

If necessary, the plastic film layer may contain without restriction in particular antistatic agents, stabilizers, lubricants, cross-linking agents, anti-blocking agents,

antioxidants, ultraviolet light absorbers, infrared light absorbers, light blocking agents, colorants to provide design or the like, and slip agents in order to enhance handling during processes such as vapor deposition or the like.

The infrared light and ultraviolet light transmissivity of the plastic film layer can be reduced without reducing the visible light transmissivity by the combined use of an infrared light absorber and an ultraviolet light absorber. Furthermore, it is also possible to combine an infrared light absorber and an ultraviolet light absorber with a laminate structure plastic film layer that reduces the surface reflectivity for example, in order to increase the visible light transmissivity while decreasing only the infrared light and ultraviolet light transmissivity.

The laminate film of the present invention can have a metal layer and/or metal compound layer in order to reflect infrared light, ultraviolet light, and visible light and the like on at least one surface of the plastic film layer. When a metal layer is used, the transmissivity will be flat in all regions from infrared light to ultraviolet light, and having absorption of a specific wavelength is commonly known, so a wide range of various types of metal layers can be used, for example, depending on the application. The metal compound that forms the metal layer can be a metal such as Au, Ag, Cu, or Al or the like, or an alloy. Aluminum and alloys thereof are preferable from the perspective of cost and reflectivity. In addition, commonly known ITO (a blend of several % of indium oxide and tin oxide) or the like can also be used as a metal compound that composes the metal layer. Note, if necessary, two or more types of metal substances can be used in combination.

In particular, as shown in FIG. 2, if a metal layer is provided between the plastic film layer and the silicone rubber layer, protection from abrasion or the like will be favorable. Furthermore, an anti-rust coating layer can be provided on the opposite side

as the plastic film layer side of the metal layer, in order to prevent oxidation of the metal layer.

The light transmissivity of the metal layer can be approximately 1% or higher, approximately 10% or higher, or approximately 20% or higher, and can be approximately 90% or lower, approximately 80% or lower, or approximately 60% or lower, but normally a range of 25% to 35% or 35% to 50% is suitable.

The processing method of the metal layer is not particularly restricted, and for example can be performed by a commonly used method for producing thin metal films, such as a vapor deposition method, spattering method, or plasma CVD method or the like. Furthermore, metal foil lamination can also be used if necessary to provide styling or the like.

The laminate film can contain one layer or a plurality of layers of printing layers either on the silicone rubber layer side and/or the opposite side of the plastic film layer in order to provide decoration as shown in FIG. 3 and FIG. 4.

The printing layer can be formed by a commonly known method such as screen printing, gravure printing, offset printing, ink jet printing, or electrostatic painting or the like. Screen printing can be used from the perspective of using a large variety of commercially available weather resistant inks. If the printing layer is suitably located between the plastic and the metal layer, then color loss due to abrasion will be minimal.

Conversely, if the printing layer is provided on the opposite side as the silicone rubber layer, for example, then printing can be performed immediately before applying the laminate film to the window, and freely printing or decorating with advertisements or product pricing or the like in a timely manner can be performed.

Furthermore, instead of printing on the plastic film layer, a colorant can be included in order to form patterns or the like in the plastic film layer.

Except when a colorant or the like is added, the entire laminate film can have a visible light transmissivity of approximately 10% or higher, approximately 30% or higher, or approximately 40% or higher, and can have a visible light transmissivity of approximately 99.9% or lower, approximately 90% or lower, approximately 80% or lower, or approximately 60% or lower.

The laminate film can have a coating layer between the silicone rubber layer and the plastic layer or the like in order to increase the adhesive strength between the silicone rubber layer and the plastic layer and the like. Furthermore, chemical processing or electric discharge processing can be performed on the plastic film layer or the like before application in order to improve the compatibility or adhesion between the silicone rubber layer and the plastic film layer and the like.

In order to improve scratch resistant properties and/or dirt prevention properties in the outermost surface layer of the laminate film, a scratch resistant layer and/or a dirt prevention layer may be provided the outermost layer of the plastic film layer and the printing layer or the like on the plastic film layer. The resin that forms the scratch resistant layer and/or dirt prevention layer can be a thermoplastic resin or a thermoset resin with excellent weather resistance applied for example by the aforementioned methods or the like on to the silicone rubber layer, and examples of these resins include fluorine resin, acrylic resin, polyvinyl alcohol resin, epoxy resin, unsaturated polyester resin, urethane resin, melamine resin, silicone resin, and acrylic silicone resin and the like.

The scratch resistant layer and/or dirt prevention layer can be a plastic film layer with a scratch resistant layer and/or dirt preventing layer provided on the surface beforehand instead of providing by application.

A protective sheet may be laminated onto the adsorbing surface of the silicone rubber layer. In the storage condition of the laminate film that is applied to windows, the

adsorbing surface is protected so that dust and scraps or the like will not easily adhere, and thus a dust preventing or dirt preventing function or the like is provided. The protective sheet is not particularly restricted, and can be commercially available PET or PP or the like as a standard product having a thickness that will not cause problems with flexibility or the like.

Furthermore, the silicone rubber layer of the present invention is an adsorbing layer, and the protective sheet is not particularly required to have properties such as peeling properties, so instead of using a protective sheet, the outermost layer itself, e.g. the plastic film layer or the like, can be used as the protective sheet by rolling the laminate film itself into a rolled condition.

The method of processing the silicone rubber layer can be a commonly known method as described above. In particular, the silicone main component and the hardening agent can easily be formed on the plastic film layer using a catalyst by hardening either at room temperature or with heating.

The silicone rubber can be applied to the plastic film layer in arbitrary steps. If the viscosity of the silicone main component is high, the viscosity can be adjusted using a soluble organic solvent that is commonly used such as ethyl acetate or toluene or the like, without restrictions in particular, so long as a negative effect is not caused by a reaction between the silicone main component and the cross-linking agent.

The method of applying the silicone solution containing the silicone main component, cross-linking agent, and catalyst can be any commonly known method, such as a rod coating method, comma knife coating method, roll coating method, blade coating method, spray coating method, air knife coating method, dip coating method, kiss coating method, bar coating method, die coating method, reverse roll coating method, offset gravure coating method, Mayer bar coating method, gravure coating method, reverse

gravure coating method, roll brush method, impregnation method, spin coating method, and curtain coating method and the like, and these methods can be used individually or in combination.

When applying a silicone solution containing the silicone main component onto the plastic film layer, if necessary, a physical surface treatment such as flame treatment, corona discharge treatment, or plasma discharge treatment or the like can be performed on the surface of the plastic film layer as a pretreatment in order to increase the adhesion and application properties, or the adhesion between the silicone rubber layer and the plastic film layer can be strengthened by applying primer or the like.

Application of the silicone solution containing the silicone main component, cross-linking agent, and catalyst can be performed by applying directly to the film using one of the aforementioned application methods, or can first be applied to the protective sheet, and after drying to a certain degree, overlaying the protective sheet and the plastic film layer together such that the silicone rubber layer adheres to the plastic film layer. The hardening temperature and hardening time are preferably such that sufficient hardening of the silicone rubber can be achieved.

Examples

Measurement of laminate film 90° peel: performed in accordance with JIS K6854-1 standards. Specifically, the laminate film cut to a rectangle 200 mm long and 25 mm wide was made to adsorb onto a clean glass plate for windows with the same dimensions as the laminate film at room temperature and room humidity, and then a 2 kg rubber roller was moved back-and-forth one cycle thereon in order to make the entire surface of the laminate film adhere. Next, the sample was mounted in a tensile tester (manufacturer's name: Orientec Co., Ltd., product number: RTG-1225), and one end of the

laminate film was pulled in a 90° direction from the film surface at a speed of 50 mm per minute, and the average value of 5 tensile tests was taken as the adsorption force or the adhesion force.

Gel ratio measurement: a test sample weight to an accuracy of 0.5 g (W0 (g)) was immersed for 24 hours in 200 cc of toluene at room temperature and room humidity, and after toluene dissolved component was eluted from the test sample, the undissolved portion was removed and washed with acetone. Then the undissolved portion was dried for 1 hour at a pressure of 0.1 MPa in a vacuum dryer (manufacturer's name: Yamato Scientific Co. Ltd., model number: DP 32) set to 100°C and the weight of the undissolved portion was accurately weighed (W1 (g)), and the gel ratio was calculated by the formula: Gel ratio (%) = (W1/W0) x 100.

Object for adsorbing: In the present embodiment, glass for windows with a size larger than the sample (dimensions: 220 mm square, thickness: 3 mm, manufacturer's name: Asahi Glass Co. Ltd., product number: FL3) and acrylic for windows (dimensions: 220 mm square, thickness 3 mm, manufacturer's name: Mitsubishi Rayon Co., Ltd., model: Acryllite) was used.

Tackifier: As the tackifier, MQ resin (manufacturer's name: Dow Corning Toray, model number: BY15-701A) was used.

Laminate film manufacturing method: At room temperature and room humidity, silicone main components (Dow Corning Toray, SD7226 (30 weight% solution of silicone resin in toluene)), cross-linking agent containing catalyst for hardening silicone (Dow Corning Toray, SRX 212), and ethyl acetate (Godo Co., Ltd, industrial grade) as a diluting agent for ease of coating were blended at a ratio of 100:0.6:100 (weight ratio) to obtain a 15 weight% silicone coating solution. Next, this solution was placed in a solvent coater and applied onto the plastic film layer at a coating speed of 30 m/minute, for 10 minutes at

100 °C, while evaporating off the solvent and hardening to obtain a laminate film with a silicone rubber layer. Next, a protective sheet was applied onto the silicone rubber layer (30 μm thick OPP (Toray Co., Ltd, Trefane 30-2500)). The laminate film with protective sheet attached was cut to 200 mm x 200 mm and 25 mm x 200 mm for use in the peel test.

The following materials were used as laminate films for comparative examples.

A) Scotchtint (registered trademark) manufactured by 3M, part number: RE87CLIS. Film with metal oxide coated onto a PET surface, commercially available product for preventing shattering of glass with a sunlight shielding function with an acrylic-based adhesive layer to which an ultraviolet light absorber has been added, on a metal oxide layer. This film had an adhesive strength of 500 N/m in the 90° peel test, the gel ratio was 95%, and the visible light transmissivity was 85%.

B) Scotchtint (registered trademark) manufactured by 3M, model number: RE80CLIS. Manufactured similar to RE87CLIS. This film is a commercial product for preventing glass shattering with a sunlight reflection shielding function and a visible light transmissivity of 81%.

C) Scotchtint (registered trademark) manufactured by 3M, model number: RE18SIAR. Film with aluminum vapor deposited onto a PET surface. A commercially available product for preventing shattering of glass with a sunlight shielding function with visible light transmissivity of 18%, with an acrylic-based adhesive layer to which an ultraviolet light absorber has been added, on an Al vapor deposited film. This film had an adhesive strength of 500 N/m in a 90° peel test, and the gel ratio was 95%.

Working Example 1

In accordance with the manufacturing method for the laminate film, a 50 μm thick PET film (Lumilar 50 S10 (Toray Co., Ltd.) was used as the plastic film layer, and

laminate films with a silicone rubber layer with a thickness of 1.4 μm, 2.0 μm, 2.5 μm, 5.0 μm, 25 μm, 30 μm, and 35 μm were used. These laminate films had adsorption strengths of 0.3 N/m, 0.3 N/m, 0.3 N/m, 0.4 N/m, 0.7 N/m, 0.7 N/m, and 0.7 N/m, respectively, and the gel ratios were essentially equal for all samples at 95%.

The samples with a dimension of 200 mm square were made to adsorb to an acrylic window and a glass window, and the gas bubbles that occurred at the interface with the window in samples with a silicone rubber layer thickness of 2.0 μm to 30 μm could easily be removed by rubbing with a finger. There was essentially no effect on appearance, and the adsorption was favorable. Reapplication was performed 10 times, but similarly to the first time, there were essentially no appearance defects, and the adsorption was favorable. Later, when the laminate film was peeled off and inspected visually, adsorption residue and adsorption marks and the like did not remain on either the acrylic or the glass, but peeled cleanly off. When a sample with a silicone rubber layer thickness of 1.4 μm was exposed to an environment with air temperature of 50 °C and humidity of 85%, partial peeling from the glass occurred at 168 hours. The sample with a thickness of 35 μm did not have sufficient solvent evaporation, and partial peeling between the plastic film layer and the silicone rubber layer occurred when the protective sheet was peeled off.

Working Example 2

A laminate film obtained using the same procedures as working example 1 was manufactured except that the silicone rubber layer was 5 μm, and a PET film with an aluminum vapor deposition layer having a visible light transmissivity of 18% (50 Tetolight T = 18 T (Oike and Co., Ltd.)) was used. A sample with dimensions of 200 mm square was made to adsorb to a glass window, and a thermometer was placed 10 cm away from

the test sample at the center region of the test sample in an environment at 20°C and room relative humidity and left under sunlight for 15 min. When the temperature was measured, the temperature was 22 °C.

Working Example 3

A laminate film was obtained by the same procedures as working example 1, except that the thickness of the silicone rubber layer was 5 μm and a tackifier was added to make 10%, 15%, or 20% by weight during manufacturing. These laminate films had the same gel ratio as a working example 1, and in the 90° field test, demonstrated adsorption force of 12 N/m, 18 N/m, and 20 N/m, respectively. When an applying and peeling test was performed on acrylic windows and glass windows similar to working example 1, favorable results were obtained similar to working example 1 in the samples containing 10 weight % and 15 weight % of a tackifier, but adhesion marks were visually confirmed with the 20 weight % sample.

Comparative Example 1

When the aforementioned films of A) through C) with a dimension of 200 mm square were on the applied to the glass window, gas bubbles and wrinkles were formed, and applying with a favorable appearance was not possible. When applying and peeling was attempted, a portion of the adhesive layer experienced cohesive failure, and adhesive remained on the window glass surface.

Comparative Example 2

A thermometer was placed 10 cm away from a window at the center of a window in a room temperature of 20°C and room humidity environment without attaching a

laminate film for attaching to a window to a glass window, and after setting under sunlight for 15 minutes, the temperature was measured by the same procedure as working example 1. The temperature was 36°C.

The aforementioned films A) through C) with a dimension of 200 mm square were attached to a glass window, and a thermometer was placed in a position 10 cm away from the test sample at the center of the test sample in an environment at a room temperature of 20°C and room humidity, and after leaving under sunlight for 15 min., the temperature was measured by the same procedures as a working example 1. The temperatures for A) RE87CLIS and B) RE80CLIS which have infrared light absorbing layers were 34°C and 32°C, respectively, and the temperature for RE18SIAR, which has an infrared absorbing layer, was 24°C.

As can be seen from the foregoing, the laminate film for attaching to a window according to the present aspects shown in the working examples could easily adsorb onto a window, and not only provided favorable adsorption and peeling properties, but after peeling, there was an excellent effect in that the silicone rubber layer did not remain and there were no adsorption marks.

The claims defining the invention are as follows:

1. A laminate film for attaching to a window comprising:

a plastic film layer; and

a silicone rubber layer having an adsorbing surface, wherein the silicone rubber layer is configured such that the adsorbing surface detachably secures to a glass window by adsorption and without adhesion or tackiness and is removable from the glass window.

2. The laminate film for attaching to a window of claim 1, wherein the silicone rubber layer contains a tackifier of 15 wt % or less.

3. The laminate film for attaching to a window of claim 1, wherein the silicone rubber layer has a gel ratio of at least 90 %.

4. The laminate film for attaching to a window of claim 1, wherein the thickness of the silicone rubber layer is from about 2 microns to about 30 microns.

5. The laminate film for attaching to a window of claim 1, wherein the silicone rubber layer has an adsorption strength to glass of about 0.01 N/m to about 15 N/m of adsorption strength in a 90°stripping test according to JIS K6854 - 1.

6. The laminate film for attaching to a window of claim 1, comprising an infrared reflection layer or infrared reflection layers.

7. The laminate film for attaching to a window of claim 1, comprising a printing layer or printing layers.