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(54) **LOCAL REPAIR OF COATED SUBSTRATES**

ÖRTLICHE REPARATUR VON BESCHICHTETEN SUBSTRATEN

REPARATION LOCALISEE DE SUBSTRATS REVETUS

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Description

[0001] The present invention relates to a process for repairing coated substrates. Specifically, it relates to the repair of coated substrates that show minor damage in one or more places. For example, there may be a spot, or a small dent, or a scratch in the coated surface, or locally the substrate may be bare instead of coated. In the present context, the term "coated substrate" represents a substrate that is obtainable by applying a layer of a curable coating composition comprising an organic or primarily organic binder material, for instance a lacquer or a paint, on a substrate, followed by curing of that layer.

[0002] In practice, coated substrates are repaired in a different way from non-coated substrates. Non-coated substrates can, for instance, be repaired as described in JP 09 136359. This document describes a complex method for repairing a hole in a non-coated bathtub consisting of resin mould goods, such as fibre-reinforced plastic and artificial marble. The hole is filled with a coloured UV curable resin, followed by the application of a transparent UV curable resin on the filled hole and on the surface of the substrate around the hole. Then a transparent film is placed on the surface. On top of the transparent film a masking material having a cut open portion is laminated. Next, both UV curable resins are irradiated through the film with UV radiation. Subsequently, the mask and the transparent film are released. Finally, the part of the transparent UV curable resin that was covered by the mask, and thus remains uncured, is removed.

[0003] Alternatively, one can repair non-coated substrates as described in DE 42 22 306. This document relates to the repair of non-coated plastic substrates, for instance, dashboards in cars or the plastic protection layer on the inside of a car door. The document discloses that a notch in such a substrate can be repaired by filling it with a filler material, followed by application of a transparent film. Next, the filler material is cured by irradiation through the film using a light source that preferably emits radiation having a wavelength between 400 and 500 nm.

[0004] Another method to repair non-coated substrates is described in JP 77 025851. This document relates to a repair process of non-coated substrates in which minor damage is covered with a plastic or metal film that is larger than the damaged area, using an adhesive agent. Next, a curable liquid or paste is injected through the film into the damaged area using a syringe. Subsequently the curable substance is cured; the document does not specify by what means the curing takes place. Finally the plastic or metal film is peeled off.

[0005] The repair of coated substrates, on the other hand, generally is a cumbersome process. In US 6,020,023, for example, a method is described to repair a defect in a powder-type paint coat on a metal or plastic substrate. The paint defect is hollowed out to form a recess with precisely defined dimensions and defined edge contour. Next, a partially cross-linked filler body is made with dimensions that, after full cure, correspond approximately to the dimensions of the recess. The filler body is connected to the paint outside the recess, preferably by using an adhesive layer and optionally using pressure. Then the filler body is hardened while preferably pressure is applied to the filler body.

[0006] US 2001/00512030 discloses methods for repairing coated glass surfaces. One option that is described concerns re-coating the whole coated surface with the same coating composition, apply a film, and cure the extra coating layer with UV radiation through the film. Another option is to wipe or roll a very thin layer of the same coating material as present on the surface onto a coated glass surface having scratches, apply a film, and cure the thin coating layer with UV radiation through the film. A disadvantage of these two options is that the whole surface needs to be covered with a new coating layer. Still another option disclosed in this US document is to fill a scratch with the same coating material as present on the surface, and subsequently cure the coating material.

[0007] However, after curing the repair needs to be abraded until it conforms to the existing surface. In all these cases the gloss level is controlled with gloss or matting agents. However, matting agents, especially in high amounts, may have a detrimental effect on the coating performance, such as its abrasion resistance. Another disadvantage of the methods described is that the coating composition used comprises a relatively high amount of monomers (up to 40-75 wt%), which gives rise to health and safety concerns.

[0008] As described above, the repair of coated substrates generally is a cumbersome process. This is especially the case when it concerns the repair of coated wooden substrates. For instance, when a plank in a parquet floor has a dent or a scratch, one usually either replaces this plank with another plank or sands and re-coats the whole plank or even the entire floor. However, replacing one plank of a floor may cause damage to the surrounding planks. Further, the new plank may show a colour difference with the rest of the floor. A disadvantage of the above-mentioned alternative is that sanding and re-coating is time consuming and requires, proportionally, an enormous amount of lacquer to repair the minor damage to the coating. Another disadvantage is that the water borne or solvent borne coating compositions generally used in such repair processes, especially in the "do it yourself" environment in which such repairs usually take place, result in a coating having inferior properties compared to the original, industrially applied, coating layer or coating layers.

[0009] During the production of coated parquet flooring, planks showing damage in one or more areas, such as a dent, a scratch, or an uncoated spot, are rejected because of their inferior quality. Where feasible, the damaged areas are filled, after which the planks are sanded over their entire surface and returned for a complete re-coating. This process results in pollution and a waste of coating material, and it is time consuming.

[0010] Substrates that are covered with a layer having a wood-like appearance and, on top of that, a transparent coating, such as furniture and kitchen cabinets, can be repaired as described in US 5,399,373. This US document describes, among other things, a process for repairing a substrate of which only the protective top layer is damaged. In this process the damaged area is removed, for example by sanding, such that a smooth transition is obtained between the damaged and the non-damaged regions. Next, a transparent material is applied, for example by spraying, and the material is dried or cured. A disadvantage of this method is that removal of the damaged area is necessary. This is time consuming, and during the removal of the damaged area the layer(s) underneath the top layer may be damaged. Further, using this method it is hard to control the gloss of the repair coat.

[0011] The present invention relates to a process for repair of a damaged coated substrate wherein first a small excess of a radiation curable coating composition is applied on a damaged area, next a radiation permeable film is placed over the uncured coating composition, and by means of pressure on the film, this surplus of coating material on the damaged area is spread out over a small area around the damaged area. Thereafter the coating is cured by irradiation through the film, and in a subsequent step the radiation permeable film is removed from the coated substrate. During this process, the surface configuration on the side of the film facing the coating layer is imparted to the repair coating.

[0012] This process has various advantages. It requires less coating material and results in less pollution than the processes normally applied to repair coated substrates. Further, minor damage to the coating layer, such as a dent, a scratch, or a bare area, can be repaired in less processing time, with lower energy costs, and without damaging the area around the damaged area. Additionally, this process is very suitable for application both on an industrial scale and in a "do it yourself" environment.

[0013] Another advantage is that, as the surface configuration on the side of the film facing the coating layer is imparted to the repair coating, an almost invisible repair of coated substrates can be obtained with, in principle, any decorative effect. The surface configuration on the side of the film facing the coating layer that is imparted to the repair coating preferably matches with the gloss and/or the surface texture of the original coating. For example, it is possible to repair a high gloss coated substrate by using a high gloss film. Low gloss substrates can be repaired using low gloss films, which has the advantage that it is not necessary to add a matting agent to the coating composition. It is also possible to repair textured coated substrates, for example substrates with a leather- or wood-like structure surface. Preferably, the imparting of the surface configuration is ensured by applying some pressure on the film before and/or during the curing of the coating composition. Such pressure may be applied using for example a pallet knife or a (small) roller.

[0014] Using the current process, one type of repair coating can thus be used to obtain any desired gloss level. And, the gloss level is easier to match with the current process than when the gloss is regulated mainly or solely by using matting agents or gloss agents. This is because, when using the current process, the gloss level is not dependent on the coating layer thickness. When using matting agents or gloss agents, on the other hand, the gloss does depend on the coating thickness and may thus be different in the centre of a damaged area compared to the edge of the damaged area and/or compared to the area around the damaged area that may be covered with a thin layer of the repair coating composition.

[0015] Furthermore, since the radiation curable coating composition is covered with a film during curing, curing takes place under a reduced amount of oxygen. This results in a more durable cured coating with improved (mechanical) properties.

[0016] The process according to the present invention can be used not only to perform an esthetical repair, but also to really restore, or renovate, the coating layer. It is possible to obtain a repaired area which has the same good coating properties as the original coating layer in the surrounding areas. For instance, the substrate can be protected in practically the same way, and a similar chemical resistance and abrasion resistance can be obtained as compared to the original, probably industrially applied, coating layer.

[0017] A very small excess of coating composition is applied on the damaged area that needs to be repaired. Next, by means of pressure on the film, this surplus of coating material on the damaged area is spread out over a small area around the damaged area. This results in a smooth transition between the original surface of the (top) coat and the repaired area. One advantage of this is that it is not necessary to abrade the repair until it conforms to the existing surface. This is especially favourable as the surface configuration imparted to the repair coating would be damaged or even lost by such abrading.

[0018] In general, the type of substrate is not critical when the process of the current invention is used to repair coated substrates. It may be impenetrable or porous, and of any kind of material, for example metal, plastic, or ceramic. The process is especially suitable to repair coated wooden and/or cellulose-containing substrates, regardless whether it for indoor use or outdoor use. Examples of coated wooden substrates are coated solid wood, coated wooden planks, coated wooden flooring, coated parquet planks, coated solid wooden flooring, coated wooden furniture or coated wooden parts of furniture, coated wooden window frames, and coated wooden doors. Examples of coated cellulose-containing substrates are coated veneer of wood and articles comprising a layer of coated veneer of wood, for example parquet flooring, furniture, office furniture, kitchen tables and kitchen cabinets. Other examples of coated cellulose-containing substrates are coated reconstituted wood substrates. Reconstituted wood substrates are substrates produced from wood particles,

fibres, flakes or chips, such as hardboard, medium density fibre board, an oriented strand board also known as a wafer board, flake board, chip board, and particle board. Typical examples of reconstituted wood substrates are hardboard, Medium Density Fibreboard (MDF), High Density Fibreboard (HDF), and chip board.

[0019] The process is also very useful to repair substrates that are covered with a print, for instance a wood grain pattern or a piece of paper with a printed image, and (on top of the print) a transparent coating. Such printed substrates are, for instance, used in furniture, in kitchen cabinets, and in flooring. The printed substrate may itself be of any material. It may, for example, be plastic, e.g. PVC, or a cellulose-containing substrate such as a reconstituted wood substrate.

[0020] Before applying the coating composition to the damaged area, it is in some cases advantageous to clean the damaged area. Cleaning may for example be performed using a brush, a cloth, or a liquid cleaning material. Before applying the coating composition to the damaged area, it is in some cases advantageous to apply an adhesion primer to the damaged area. Such adhesion primer may be of any conventional type. It may be air drying, for example an acrylic comprising air drying primer, or UV curable.

[0021] In the process according to the present invention, the coating composition applied to the damaged area can be a conventional UV curable coating composition, for instance a UV curable coating composition having a low volatile organic content, i.e. less than 450 grams per litre, or preferably less than 420 grams per litre. Preferably, the coating composition comprises less than 40 wt.% volatile organic compounds, more preferably less than 30 wt.%. Most preferred are coating compositions comprising less than 5 wt.% of volatile organic compounds. The composition can also contain up to 40 wt.% water, calculated on the total weight of the coating composition. Most preferred are compositions comprising less than 5 wt.% water.

[0022] If the coating composition comprises a volatile organic compound and/or water, this should be evaporated after the application of the composition to the damaged area, before the film is placed on top of the uncured coating composition. However, as a result of the evaporation the surface of the uncured composition will sink slightly. After curing, the human eye may see such a sunken surface as a surface having a different gloss from the area around it. Consequently, in the process according to the present invention, the coating composition applied most preferably is a so-called 100% solids UV curable coating composition, i.e. a composition comprising less than 3 wt.% volatile organic compounds and less than 2 wt.% water. A 100% solids system hardly shows sinking problems. High solids systems and so-called 100% solid systems usually comprise a reactive diluent. Such a diluent reacts during curing and hardly evaporates. Preferably the coating composition comprises less than 20 wt%, more preferably less than 15 wt% reactive diluent. Highly preferred are compositions that comprise less than 10 wt% or even less than 5 wt% of monomers. On an industrial scale, a hot melt coating composition can be used.

[0023] One advantage of a low amount of reactive diluent or no reactive diluent is that the health and safety issues associated with such monomers are reduced or avoided. This is advantageous during handling the uncured material. And, especially when repairing a wooden and/or cellulose-containing substrate with a bare part, penetration of monomers into the substrate is reduced or even avoided.

[0024] In a process according to the present invention, a two-component coating system can be used. This may be a dual cure system in which a slower secondary curing mechanism takes place that makes it possible to obtain a good through-cure. For instance, a highly viscous isocyanate composition can be added to a UV curable composition. In this case a post cure of the isocyanate groups can take place. Alternatively, a secondary amine can be added to a UV curable composition. After irradiation, the amines can react with the possibly present uncured double bonds. Also peroxy systems can be added to a UV curable composition. In this case the UV curing of acrylates can be the second curing mechanism. Also a system that hardens through both UV curing and oxidative drying, e.g. a system comprising an UV-oil, can be used.

[0025] The coating composition may comprise oligomers or resins with a medium or relatively high molecular weight, for instance radiation curable oligomers or resins having a viscosity in the range of from 15 to 10,000 mPa.s at ambient temperature, i.e. between 5 to 40°C. Preferably, the coating composition comprises about 50 up to 100 wt%, more preferably 85 to 100 wt%, even more preferably 90 to 100 wt% of oligomers or resins having a viscosity in the range of from 15 to 10,000 mPa.s at ambient temperature. Clear coating compositions preferably comprise between 75 and 90, more preferably between 75 and 85 wt% of oligomers or resins. Pigmented coating compositions preferably comprise above 50 wt%, more preferably above 75 wt% of oligomers or resins.

[0026] The viscosity at application of the coating composition preferably is 500-20,000 mPa.s, more preferably 2,000 to 20,000 mPa.s, even more preferably 3,000 to 8,000 mPa.s. In the present invention coating compositions may be used having a viscosity within these ranges at room temperature. Alternatively or additionally, a coating composition with a higher viscosity is used which is then pre-heated before application until it has a viscosity within these ranges. The coating composition used preferably has a viscosity at room temperature of 500 to 1,000,000 mPa.s, more preferably of 500 to 50,000 mPa.s. All viscosities referred to are Brookfield viscosities, which can be determined according to the standard measurement method ISO 2884.

[0027] An advantage of the present invention is that a coated substrate can be repaired with a UV curable coating composition that, after curing, shows less or hardly any yellowing compared to regular UV curable coating compositions. The yellowing of frequently used regular UV curable coating compositions is often caused by the presence of amines.

Normally, amines such as triethanolamine or acrylated amines are added to UV curable coating compositions because they can act as a synergist for the curing reaction. Sometimes amines are added to increase the surface curing. It has now been found that, using the current process, a high gloss coating can be prepared using less or even no amines. When the current process is used, the coatings on the repaired area, whether low or high gloss or having another surface texture, show almost no yellowing. Preferably, the coating composition comprises less than 3 wt.%, more preferably less than 2 wt.%, even more preferably less than 1 wt.% of such amines, based on the total weight of the uncured coating composition.

[0028] Another advantage of a process according to the present invention is that it is possible to apply a low gloss coating to the area that needs to be repaired which shows a better abrasion resistance than regular low gloss coatings. Normally, one or more matting agents are added to a coating composition when a low gloss coating needs to be obtained. However, such matting agents, especially in high amounts, may have a detrimental effect on the coating performance, such as its abrasion resistance. When the process of the invention is used, a damaged area can be repaired with a coating composition that comprises no or only a small amount of matting agent, as the gloss can be controlled by the surface texture of the film used during the repair process. Hence, a damaged area can be repaired with a coating that has a low gloss and shows a good abrasion resistance at the same time. This way it can be ensured that the repaired area has a coating quality equal or similar to that of the original coating of the surrounding area.

[0029] Another advantage of the current process is that a very accurate gloss control can be obtained. The gloss can be adjusted more accurately when the process according to the present invention is used than when a process is used in which the gloss is adjusted by amending the amount of matting agent and/or the processing temperature. Other advantages of the present invention, which will be elaborated on below, are that the process requires a relatively small amount of photoinitiators and a relatively high amount of pigments can be present in the coating composition.

[0030] The coating composition used in the process according to the present invention is radiation curable. Within the framework of the present invention, a radiation curable coating composition is a coating composition which is cured using electromagnetic radiation having a wavelength $\lambda \leq 500$ nm or electron beam radiation. An example of electromagnetic radiation having a wavelength $\lambda \leq 500$ nm is UV radiation. Radiation sources which may be used are those customary for electron beam and UV. For example, UV sources such as high-, medium-, and low-pressure mercury lamps can be used. Also, for instance, gallium and other doped lamps can be used, especially for pigmented coatings. It is also possible to cure the coating composition by means of short light pulses.

[0031] Compared to processes in which a film is absent, it appeared that radiation having a lower energy than that emitted by conventional UV sources can be used to achieve acceptable curing. This effect might be due to the film on top of the coating preventing the initiated radicals from being caught by oxygen in the air. Hence, in one embodiment of the present invention, especially when curing clear coats, the coating composition is cured using low-energy UV sources, i.e. by so-called daylight cure. The intensity of these lamps is lower than that of the aforementioned UV sources. Low-energy UV sources emit hardly any UV C; they predominantly emit UV A, and radiation with a wavelength at the border of UV B and UV A.

[0032] Preferably the coating composition is cured by radiation having a wavelength of $200 \text{ nm} \leq \lambda \leq 500 \text{ nm}$, more preferably $200 \text{ nm} \leq \lambda \leq 450 \text{ nm}$. For some compositions low-energy UV sources emitting radiation having a wavelength of $370 \text{ nm} \leq \lambda \leq 450 \text{ nm}$ may be preferred. One advantage of using a radiation source emitting radiation having a wavelength of $200 \text{ nm} \leq \lambda \leq 500 \text{ nm}$ is that it is safer to use than conventional UV sources, which emit a relatively high amount of UV C and/or UV B. This is especially of importance in a "do it yourself" environment. Another advantage is that daylight cure lamps are cheaper than conventional UV lamps. Commercially available daylight cure lamps are, for instance, solarium-type lamps and specific fluorescent lamps such as TL03, TL05 or TL09 lamps (ex Philips) and BLB UV lamps (ex CLE Design). As an example of a commercially available daylight cure lamp that emits short light pulses may be mentioned the mercury-free UVNIS flash lamps of Xenon.

[0033] Most conventional lamps have an output of between 80 and 120, or up to 240 W/cm. Another type of lamp that is very suitable in a process according to the current invention is a lamp with an output in the range of 20 to 240 W/cm. In the case of a lamp with a large output range, the output, and thus the amount of energy used, can be adjusted with the production speed. Preferred is a lamp with an output in the range of 20-80 W/cm. Especially when using tinted systems in a process according to the invention, the cure can be performed using both a mercury lamp and a gallium lamp. The use of radiation from a gallium lamp has been found to result in a deep cure/good through-cure of systems.

[0034] The coating sandwiched between the substrate and the radiation permeable film is cured by irradiation through the film. If the coating is cured by electron beam, the film material is not critical, since penetration by the electrons can be ensured by selecting a sufficiently high voltage. Consequently, in the case of cure by electron beam, the film can comprise, e.g., aluminium foil or an aluminised layer, for instance an aluminised polyester film, plastic or paper. Curing by electron beam radiation is useful in industry, but not very practical in a "do it yourself" environment.

[0035] If the coating is to be cured by UV radiation, the film has to be sufficiently transparent to the UV radiation. Curing by regular UV radiation is useful in industry, but not very practical in a "do it yourself" environment. In a "do it yourself" environment preferably low-energy UV radiation is used. In that case, the film has to be transparent to low-

energy UV radiation. Consequently, in the case of cure by (low) UV radiation, the film can comprise quartz glass or glass plate or a polymeric material, for example polycarbonate, modified polycarbonate (e.g. plexiglass), polyvinyl chloride, acetate, polyethylene, polyester, an acrylic polymer, polyethylene naphthalate, polyethylene terephthalate or polycarbonate, and co-polymers thereof. The film can be rigid or flexible, and may be of any desired thickness, as long as it permits sufficient transmission of the radiation used to result in a sufficient cure of the coating composition.

[0036] Ideally, a coating is chosen that shows good release properties from the film. When there is good film release, the film can be removed from the coated substrate with the repair coating remaining virtually undamaged. The coating compositions used in a process according to the present invention are suitable to be combined with a wide range of film types, including untreated films. In order to ensure good release properties from the film, the film may be treated. The type of film treatment used should be adjusted to the type of film and the type of coating used in the repair process according to the present invention. The film can for instance be coated with a release coating. Such a release coating may contain silicone or a fluoropolymer such as polytetrafluoroethylene as release agent. US 5,037,668, for instance, describes a silicone-free fluoropolymer comprising an acrylate-type release coating.

[0037] Polyester acrylate oligomers and resins were found to be very suitable for use in the coating composition in the process according to the present invention. Examples of suitable commercially available polyester acrylate resins are: Craynor® UVP-215, Craynor® UVP-220 (both ex Cray Valley), Genomer® 3302, Genomer® 3316 (both ex Rahn), Laromer® PE 44F (ex BASF), Ebecryl® 800, Ebecryl® 810 (both ex UCB), Viaktin® 5979, Viaktin® VTE 5969, and Viaktin® 6164 (100%) (all ex Vianova).

[0038] Epoxy acrylate oligomers and resins were also found to be very useful in the coating composition in the process according to the present invention. Examples of commercially available epoxy acrylate resins are: Craynor® UVE-107 (100%), Craynor® UVE-130, Craynor® UVE-151, CN® 104 (all ex Cray Valley), Photocryl® 201 (ex PC resins), Genomer® 2254, Genomer® 2258, Genomer® 2260, Genomer® 2263 (all ex Rahn), UVP® 6000 (ex Polymer technologies), and Ebecryl® 3500 (ex UCB).

Polyether acrylate resins can also be used in the coating composition in the process according to the present invention. Examples of commercially available polyether acrylate resins are: Genomer® 3456 (ex Rahn), Laromer® PO33F (ex BASF), Viaktin® 5968, Viaktin® 5978, and Viaktin® VTE 6154 (all ex Vianova).

[0039] Urethane acrylate oligomers and resins can also be used in the coating composition in the process according to the present invention. Examples of commercially available urethane acrylate resins are: CN® 934, CN® 976, CN® 981 (all ex Cray Valley), Ebecryl® 210, Ebecryl® 2000, Ebecryl® 8800 (all ex UCB), Genomer® 4258, Genomer® 4652, and Genomer® 4675 (all ex Rahn).

[0040] Other examples of radiation curable oligomers and resins that can be used in the coating composition in the process according to the present invention are cationic UV curable resins, for instance cycloaliphatic epoxide resins such as Uvacure® 1500, Uvacure® 1501, Uvacure® 1502, Uvacure® 1530, Uvacure® 1531, Uvacure® 1532, Uvacure® 1533, and Uvacure® 1534 (all ex UCB Chemicals), Cyracure® UVR-6100; Cyracure® UVR-6105, Cyracure® UVR-6110, and Cyracure® UVR-6128 (all ex Union Carbide), or SarCat® K126 (ex Sartomer), acrylate modified cycloaliphatic epoxides, caprolactone based resins such as SR® 495 (= caprolactone acrylate, ex Sartomer), Tone® 0201, Tone® 0301, Tone® 0305, Tone® 0310 (all caprolactone triols, ex Union Carbide), aliphatic urethane divinyl ether, aromatic vinyl ether oligomer, bis-maleimide, diglycidyl ether of bisphenol A or other glycols, hydroxy-functional acrylic monomer, hydroxy-functional epoxide resin, epoxidised linseed oil, epoxidised polybutadiene, glycidyl ester or partially acrylated bisphenol A epoxy resin, or trimethylol propane oxetane (UVR® 6000, ex Union Carbide).

[0041] Other radiation curable compounds that are suitable to be used in the coating composition in the process according to the present invention are, e.g., vinyl ether-containing compounds, unsaturated polyester resins, acrylated polyetherpolyol compounds, (meth)acrylated epoxidised oils, (meth)acrylated hyperbranched polyesters, silicon acrylates, maleimide-functional compounds, unsaturated imide resins, compounds suitable for use in photo-induced cationic curing, or mixtures thereof.

[0042] In the radiation curable coating composition also use may be made of a radiation curable mixture of (a) photo-induced radical curing resin(s) and (b) photo-induced cationic curing resin(s). Such systems are sometimes called hybrid systems and may comprise, for example, acrylic oligomers as photo-induced radical curing resins, vinyl ethers as photo-induced cationic curing resins, and radical and cationic photoinitiators. In principle, all possible combinations of photo-induced radical curing resins and photo-induced cationic curing resins can be used in such hybrid systems.

[0043] Also non-radiation curable polymers can be incorporated into the coating composition. These polymers may be used to modify the viscosity, tack, adhesion, or film forming properties of the coating formulation and/or to modify the general film properties of the cured coating, such as stain resistance, flexibility or adhesion. Examples are Cellulose Acetate Butyrate (various grades, ex Eastman), Laropal materials, (ex BASF), Paraloid materials, (ex Rohm and Haas), and Ucar materials (ex Union Carbide). In general, the coating composition used in the process according to the present invention comprises 0 to 20 wt.% non-radiation curable polymers.

[0044] Further, the composition can comprise a photoinitiator or a mixture of photoinitiators. Examples of suitable photoinitiators that can be used in the radiation curable composition according to the present invention are benzoin,

benzoin ethers, benzylketals, α,α -dialkoxyacetophenones, α -hydroxyalkylphenones, α -aminoalkylphenones, acylphosphine oxides, benzophenone, thioxanthenes, 1,2-diketones, and mixtures thereof. It is also possible to use copolymerisable bimolecular photoinitiators or maleimide-functional compounds. Co-initiators such as amine based co-initiators can also be present in the radiation curable coating composition. Examples of suitable commercially available photoinitiators are: Esacure[®] KIP 100F and Esacure[®] KIP 150 (both ex Lamberti), Genocure[®] BDK, Genocure[®] CQ, Genocure[®] CQ SE, Genocure[®] EHA, Velsicure[®] BTF, Quantacure[®] BMS, Quantacure[®] EPD (all ex Rahn), Speedcure[®] EDB, Speedcure[®] ITX, Speedcure[®] BKL, Speedcure[®] BMDS, Speedcure[®] PBZ, Speedcure[®] BEDB, Speedcure[®] DETX (all ex Lambson), Cyracure[®] UVI-6990, Cyracure[®] UVI-6974, Cyracure[®] UVI-6976, Cyracure[®] UVI-6992 (all ex Union Carbide), CGI-901, Irgacure[®] 184, Irgacure[®] 369, Irgacure[®] 500, Irgacure[®] 819, Darocur[®] 1000, Darocur[®] 1173 (all ex Ciba Chemicals), and Lucirin[®] TPO (ex BASF).

[0045] However, the presence of a photoinitiator is not necessary. In general, when electron beam radiation is used to cure the composition, it is not necessary to add a photoinitiator. When UV radiation is used, in general a photoinitiator is added, but UV curing can also be performed without a photoinitiator. When present, the total amount of photoinitiator in the composition is not critical; it should be sufficient to achieve acceptable curing of the coating when it is irradiated. However, the amount should not be so large that it affects the properties of the cured composition in a negative way. In general, the composition should comprise between 0 and 10 wt.% of photoinitiator, calculated on the total weight of the composition.

[0046] As a rule, compared to the amount necessary when the coating is applied to a substrate and subsequently cured, in the process according to the present invention a smaller amount of photoinitiator can be used to achieve acceptable curing. This effect might be due to the film on top of the coating, as the film may reduce the amount of initiated radicals caught by oxygen in the air. Most photoinitiators have an unpleasant or strong odour. Therefore, one advantage of using only a small amount of photoinitiator, or no photoinitiator at all, is that the coating composition has a better smell.

[0047] The composition can also contain one or more fillers or additives. The fillers can be any fillers known to those skilled in the art, e.g., barium sulphate, calcium sulphate, calcium carbonate, silicas or silicates (such as talc, feldspar, and china clay). Additives such as aluminium oxide, fumed silica, silicon carbide, for instance carborundum, ceramic particles, glass particles, stabilisers, antioxidants, levelling agents, anti-settling agents, anti-static agents, matting agents, rheology modifiers, surface-active agents, amine synergists, waxes, or adhesion promoters can also be added. In general, the coating composition used in the process according to the present invention comprises 0 to 50 wt.% of fillers and/or additives, calculated on the total weight of the coating composition.

[0048] The radiation curable coating composition used in the process according to the present invention can also contain one or more pigments. In principle, all pigments known to those skilled in the art can be used. However, care should be taken that the pigment does not show a too high absorption of the radiation used to cure the composition. In general, the coating composition comprises 0 to 50 wt.% of pigment, preferably 10-30 wt.% of pigment, calculated on the total weight of the coating composition.

[0049] Because of the film on top of the coating that reduces the amount of initiated radicals being caught by oxygen in the air, acceptable curing of a pigmented coating can be reached even when the coating comprises a relatively large amount of pigments.

[0050] Equipment known to those skilled in the art can be used to apply the coating composition to the damaged area, e.g., a syringe, a rod, or, especially on an industrial scale, a spout. The determination of the gloss of the coating surrounding the damaged area, in order to be able to choose a film with the correct surface texture, can for example be performed with a commercially available portable gloss meter. Equipment known to those skilled in the art can be used to smoothen the coating underneath the film, e.g., a knife, a rod, or, especially on an industrial scale, a roller coater.

[0051] Preferably, the film used in the process is flexible. When repairing relatively large substrates, such as planks for parquet flooring, in which several damaged areas are present, it is possible to use one or more small pieces of film that each cover one or a few damaged areas. An example of such a piece of film on a damaged area is presented in Figure 1. Figure 1 illustrates a cross section of a substrate (1) that is covered with a coating (2). The coating layer has a damaged area (3) that is filled with an uncured coating composition. On top of the damaged area is a film (4). The repair coating composition can be cured by means of UV unit (5).

[0052] Alternatively, a large piece of film that covers several damaged areas or even the entire substrate may be used. The flexible film may be a reel of film that can be reused. Such a reel of film can be useful in a continuous process. After applying the coating composition to the damaged area(s) on several substrates, the substrates can be put into a continuous process in which the film is delivered from a reel to the substrate, and next the coating composition is cured through the film. Such a reel of film may comprise one or more loops. Examples of such reels are presented in Figures 2 and 3. Figure 2 illustrates a cross section of a substrate that is placed on a conveyer belt. The film is delivered from a reel and rewound on another reel. The coating composition on the damaged area or areas is cured by irradiation from the UV lamp while the film is still in contact with the coating. Figure 3 illustrates a cross section of a substrate placed on a conveyer belt, a continuous reel of film, and a UV lamp.

[0053] In one embodiment, during the production of coated parquet flooring, planks having one or more damaged

areas can for instance be repaired as follows. A coating composition is applied to one or more of these damaged areas. Then, the film can be reeled off a roll onto the substrate, for instance onto part of the substrate. After curing of the repair coating, the film is removed from (part of) the substrate and can subsequently be rewound onto a roll. Next, the process can be repeated using the re-reeled film.

[0054] The invention will be elucidated with reference to the following examples. These are intended to illustrate the invention but are not to be construed as limiting in any manner the scope thereof.

Examples

[0055] The following coating compositions proved to be suitable to repair coated substrates in a process according to the present invention. The compositions are especially suitable to repair coated wooden and/or cellulose-containing substrates and printed substrates that are covered with a transparent coating.

Composition 1

[0056]

Component	Amount in wt. %
Epoxy acrylate	82
Filler	15
Diluent	1
Photoinitiator	2

[0057] The viscosity of Composition 1 measured at room temperature is 1,000,000 mPa.s.

Composition 2

[0058]

Component	Amount in wt. %
Polyester acrylate	97
Photoinitiator	3

[0059] The viscosity of Composition 2 measured at room temperature is 45,000 mPa.s.

Composition 3

[0060]

Component	Amount in wt. %
Polyester acrylate	94
Acrylic resin	3
Photoinitiator	3

[0061] The viscosity of Composition 3 measured at room temperature is 35,000 mPa.s.

Composition 4

[0062]

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Component	Amount in wt. %
Polyester acrylate	94
Photoinitiator	6

[0063] The viscosity of Composition 4 measured at room temperature is 45,000 mPa.s.

Composition 5

[0064]

Component	Amount in wt. %
Epoxy acrylate	91
Acrylic resin	3
Photoinitiator	6

[0065] The viscosity of Composition 5 measured at room temperature is 3,000 mPa.s.

Composition 6

[0066]

Component	Amount in wt. %
Urethane acrylate	94
Photoinitiator	6

[0067] The viscosity of Composition 6 measured at room temperature is 60,000 mPa.s.

Composition 7

[0068]

Component	Amount in wt. %
Urethane acrylate	91
Acrylic resin	3
Photoinitiator	6

[0069] The viscosity of Composition 7 measured at room temperature is 50,000 mPa.s.

Composition 8

[0070]

Component	Amount in wt. %
Polyester acrylate	89
Acrylic resin	5
Photoinitiator	6

[0071] The viscosity of Composition 8 measured at room temperature is 50,000 mPa.s.

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Composition 9

[0072]

Component	Amount in wt. %
Polyester acrylate	12
Epoxy acrylate	12
Silica	8
Diluent	27
Photoinitiator	8
Pigment	33

[0073] The viscosity of Composition 9 measured at room temperature is 1,500 mPa.s.

Composition 10

[0074]

Component	Amount in wt. %
Epoxy acrylate	22
Filler	18
Diluent	18
Photoinitiator	3
Pigment	39

[0075] The viscosity of Composition 10 measured at room temperature is 2,500 mPa.s.

[0076] The gloss level of the repair coat was obtained by using a film with an appropriate surface configuration. The gloss levels mentioned in the current examples were determined by measuring the percentage of light that was reflected from the surface at a 60 degrees angle.

Example 1

[0077] Coated parquet planks with an original coating having a gloss of about 20 to 30 were repaired according to the present invention.

[0078] Compositions 1 to 4 and 6 to 8 were pre-heated from to a temperature between 30 and 60 °C to achieve a suitable application viscosity before application. Composition 5 was applied at room temperature. Each composition was applied to one or more damaged areas on a coated parquet plank. Then a polyester film was put over the filled damaged area(s) and some pressure was applied to the film. Subsequently, the uncured coating composition in and slightly around the damaged area(s) was cured using a UVNIS flash lamp.

[0079] As the coating on the parquet planks that was repaired had a gloss of around 20 to 30, the film used in the repair process had a surface configuration matching this semi gloss. This resulted in hardly visible repair.

[0080] All samples were tested for adhesion using a coin. The adhesion to the original coated surface was good for all samples.

Example 2

[0081] Some extra tests were performed on the repaired coated parquet planks that were repaired with Composition 8 in Example 1. The aim was to determine the abrasion resistance and the chemical resistance of the repair coat compared to the original coat.

[0082] The original topcoat was prepared by applying and curing a commercially available UV coating composition for parquet flooring comprising a urethane/polyester acrylate.

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[0083] The abrasion resistance has been measured according to the abrasion resistance test method SIS 923509, a test with classes 1 to 8, in which 8 is the highest value.

Abrasion resistance

[0084]

Original topcoat	4.95 mg/100 rev
Composition 8	4.85 mg/100 rev

[0085] The chemical resistance has been measured according to EN 12720, using water and coffee. Values 1 to 5 can be assigned; 5 is the highest score. Value 5 indicates that no effect has been determined.

Chemical resistance:

[0086]

	Water 24 hours	Coffee 1 hour
Original topcoat	5	5
Composition 8	5	5

Example 3

[0087] Coated MDF boards with an original coating having a white colour and a gloss of more than 80 were repaired according to the present invention.

[0088] Compositions 9 and 10, comprising a white pigment, were applied at room temperature. The compositions were applied to one or more damaged areas on a coated MDF board. Then a polyester film with a high gloss surface configuration was put in place and the coating was cured using a UVNIS flash lamp.

[0089] This experiment shows that the current process is suitable to repair a pigmented coating. All samples were tested for adhesion using a coin. The adhesion to the original coated surface was good for all samples.

Example 4

[0090] Composition 2 was used to repair a small damage on coated parquet flooring.

[0091] First, an adhesion primer based on a styrene maleic anhydride resin was applied to the damaged area and allowed to dry. Next, composition 2 was applied using the same procedure as described for Examples 1.

[0092] The repair process in which the adhesion primer was used resulted in a repair coat with an improved adhesion compared to a repair process in which such adhesion primer was not used. This was determined using a coin.

Example 5

[0093] Composition 1 was used to repair a small damage on a piece of printed furniture board having a topcoat with a gloss level of about 20.

[0094] Composition 1 was applied to a damaged area in the topcoat on the printed board. Then a polyester film was put over the filled damaged area and some pressure was applied to the film. Subsequently, the uncured coating composition in and slightly around the damaged area was cured using a UV/VIS flash lamp.

[0095] The adhesion of the repair coat to the original topcoat was good.

Claims

1. Process for repair of a damaged coated substrate coated with a curable coating composition comprising an organic binder, wherein first a small excess of a radiation curable liquid coating composition is applied on a damaged area, then a radiation permeable film is placed over the uncured coating composition, the surplus of coating material on the damaged area being spread out over a small area around the damaged area by means of pressure on the film,

and the coating is cured by irradiation through the film, and in a subsequent step the radiation permeable film is removed from the coated substrate, in which process the surface configuration on the side of the film facing the coating layer is imparted to the repair coating and matches with the gloss and/or the surface texture of the original coating.

2. A process according to claim 1, **characterised in that** the substrate is a coated wooden and/or cellulose-containing substrate.
3. A process according to claim 1 or 2, **characterised in that** the substrate is covered with a print, and, on top of the print, a transparent coating.
4. A process according to any one of claims 1 to 3, **characterised in that** the coated substrate is flooring or furniture.
5. A process according to any one of claims 1 to 4, wherein the viscosity of the coating composition at application temperature is 500-20,000 mPa.s.
6. A process according to any one of claims 1 to 5, **characterised in that** the coating composition is a coating composition comprising less than 40 wt% volatile organic compounds.
7. A process according to any one of claims 1 to 6, **characterised in that** the coating composition is a coating composition comprising less than 20 wt% reactive diluent.
8. A process according to any one of claims 1 to 7, **characterised in that** a reel of film is used.
9. A process according to any one of claims 1 to 8, **characterised in that** the curing by irradiation is performed using a low-energy UV source or a medium-pressure mercury lamp.
10. A process according to any one of claims 1 to 9, **characterised in that** the irradiation is performed by means of short light pulses.

Patentansprüche

1. Verfahren zur Reparatur eines beschädigten beschichteten Substrats, das mit einer härtbaren Beschichtungszusammensetzung beschichtet ist, die ein organisches Bindemittel umfasst, wobei zuerst ein kleiner Überschuss einer strahlungshärtbaren flüssigen Beschichtungszusammensetzung auf eine beschädigte Fläche aufgetragen wird, dann eine strahlungsdurchlässige Folie auf der ungehärteten Beschichtungszusammensetzung positioniert wird, wobei ein Überschuss an Beschichtungsmaterial auf dem beschädigten Bereich mittels eines auf die Folie ausgeübten Drucks über einen kleinen Bereich um den beschädigten Bereich herum verteilt wird und die Beschichtung durch ein Bestrahlen durch die Folie gehärtet wird und in einem anschließenden Schritt die strahlungshärtbare Folie vom beschichteten Substrat entfernt wird, wobei beim Verfahren die Oberflächenkonfiguration auf derjenigen Seite der Folie, die der Beschichtungsschicht gegenüberliegt, der Reparaturbeschichtung verliehen wird und mit dem Glanz und/oder der Oberflächentextur der ursprünglichen Beschichtung übereinstimmt.
2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** das Substrat ein beschichtetes Holz- und/oder Cellulosehaltiges Substrat ist.
3. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** das Substrat mit einem Aufdruck und auf dem Aufdruck mit einer transparenten Beschichtung bedeckt ist.
4. Verfahren nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** das beschichtete Substrat ein Fußboden oder ein Möbelstück ist.
5. Verfahren nach einem der Ansprüche 1 bis 4, wobei die Viskosität der Beschichtungszusammensetzung bei der Auftragstemperatur 500 - 20 000 mPa.s beträgt.
6. Verfahren nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** die Beschichtungszusammensetzung eine Beschichtungszusammensetzung ist, die weniger als 40 Gew.-% flüchtige organische Verbindungen

umfasst.

7. Verfahren nach einem der Ansprüche 1 bis 6, **dadurch gekennzeichnet, dass** die Beschichtungszusammensetzung eine Beschichtungszusammensetzung ist, die weniger als 20 Gew.-% eines reaktiven Verdünnungsmittels umfasst.
8. Verfahren nach einem der Ansprüche 1 bis 7, **dadurch gekennzeichnet, dass** eine Folienrolle verwendet wird.
9. Verfahren nach einem der Ansprüche 1 bis 8, **dadurch gekennzeichnet, dass** das Härten durch Bestrahlen unter Verwendung einer Niedrigenergie-UV-Quelle oder einer Mitteldruck-Quecksilberlampe erfolgt.
10. Verfahren nach einem der Ansprüche 1 bis 9, **dadurch gekennzeichnet, dass** das Bestrahlen mittels kurzer Lichtimpulse erfolgt.

Revendications

1. Procédé de réparation d'un substrat revêtu endommagé qui est revêtu d'une composition de revêtement durcissable comprenant un liant organique, dans lequel un petit excès d'une composition de revêtement liquide durcissable par irradiation est tout d'abord appliqué sur une zone endommagée, puis un film perméable aux radiations est placé sur la composition de revêtement non durcie, le surplus de matériau de revêtement de la zone endommagée étant étalé sur une petite zone entourant la zone endommagée au moyen d'une pression sur le film, et le revêtement est durci par irradiation à travers le film, et dans lequel, dans une étape ultérieure, le film perméable aux radiations est enlevé du substrat revêtu, procédé dans lequel la configuration superficielle du côté du film orienté vers la couche de revêtement est conférée au revêtement de réparation et correspond au brillant et/ou à la texture superficielle du revêtement original.
2. Procédé selon la revendication 1, **caractérisé en ce que** le substrat est un substrat revêtu en bois et/ou contenant de la cellulose.
3. Procédé selon la revendication 1 ou 2, **caractérisé en ce que** le substrat est recouvert d'une impression, et, en haut de l'impression, d'un revêtement transparent.
4. Procédé selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que** le substrat revêtu est un revêtement de sol ou un meuble.
5. Procédé selon l'une quelconque des revendications 1 à 4, dans lequel la viscosité de la composition de revêtement à la température d'application est de 500 à 20 000 mPa.s.
6. Procédé selon l'une quelconque des revendications 1 à 5, **caractérisé en ce que** la composition de revêtement est une composition de revêtement comprenant moins de 40 % en poids de composés organiques volatiles.
7. Procédé selon l'une quelconque des revendications 1 à 6, **caractérisé en ce que** la composition de revêtement est une composition de revêtement comprenant moins de 20 % en poids de diluant réactif.
8. Procédé selon l'une quelconque des revendications 1 à 7, **caractérisé en ce qu'une** bobine de film est utilisée.
9. Procédé selon l'une quelconque des revendications 1 à 8, **caractérisé en ce que** le durcissement par irradiation est réalisé en utilisant une source d'UV de faible énergie ou une lampe à vapeur de mercure moyenne pression.
10. Procédé selon l'une quelconque des revendications 1 à 9, **caractérisé en ce que** l'irradiation est réalisée au moyen d'impulsions lumineuses de courte durée.

Figure 1

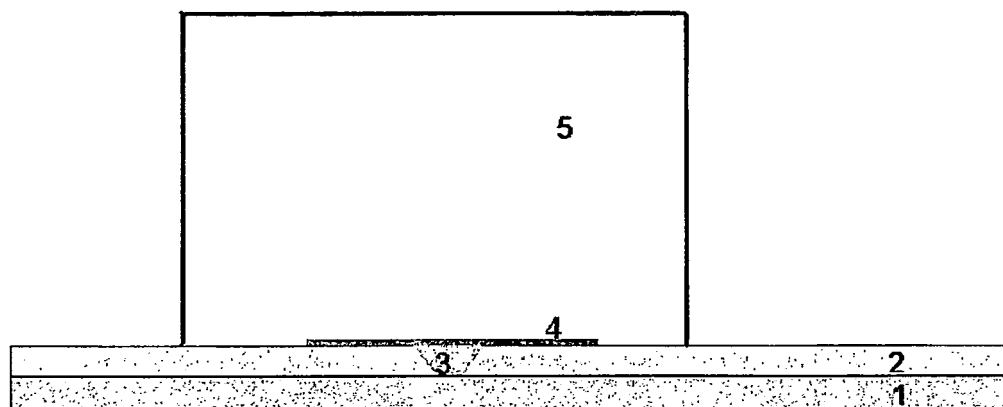


Figure 2

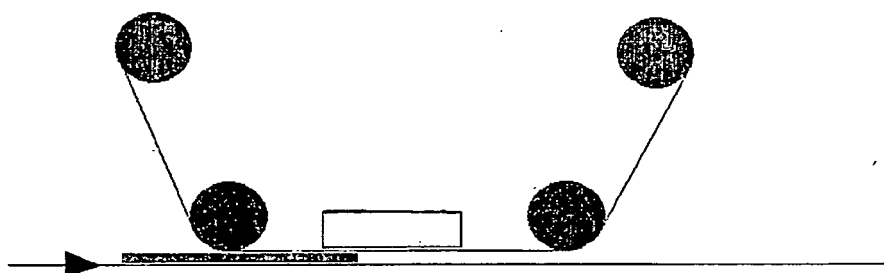
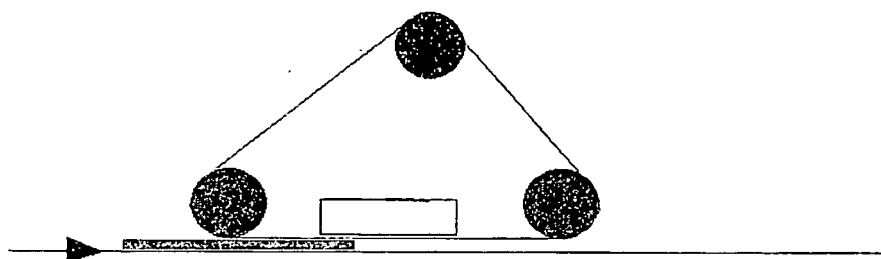


Figure 3



REFERENCES CITED IN THE DESCRIPTION

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