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(54) **Process for mass-production coating**

(57) A process for the topcoating of substrates within a mass-production coating line, comprising the following successive steps:
a) applying a topcoat layer onto the substrates from only one powder coating composition curable by high-energy radiation and suitable for producing high-gloss topcoat,
b) supplying thermal energy to said topcoat to produce a molten coating layer, and
c) forming a finished topcoat layer by curing the molten

coating layer with high-energy radiation,

wherein the substrates comprise substrates A and substrates B and
wherein only the substrates A undergo an additional step a') arranged between steps a) and b) in which the substrates A are irradiated with UV radiation.

EP 1 886 738 A1

Description

Field of the Invention

[0001] The present invention relates to a process for mass-production coating in which substrates are provided with topcoats having different gloss levels (degrees of gloss).

Description of Related Art

[0002] In the automotive sector, a high-gloss base coat/clear coat two-layer topcoat is standard. The desire has recently arisen to provide automobiles with a base coat/clear coat two-layer topcoat with a lower gloss level, for example, with a mat-gloss or silk-gloss clear coat layer. Design and/or practical considerations may be at the root of this desire; mat surfaces are, for example, less susceptible to fingerprints. They are also less sensitive, for example, with regard to apparently lower scratch sensitivity, as the human eye perceives wear marks such as scratches better on high-gloss coatings than on coatings with a lower gloss level.

[0003] It is in itself no problem to apply topcoats with reduced gloss because it is known to adjust the gloss level by using matting agents in coating compositions, for example, from WO 03/102048, U.S. 2003/0134978, EP-A 1129788 and EP-A 0947254. Examples of such agents are waxes, silica, glass pearls, and crystalline resins.

[0004] The situation is, in contrast, complicated if topcoats of a different gloss level, for example, clear topcoats of a different gloss level, are to be applied onto substrates in one and the same coating booth of a mass-production coating line. It would be necessary to provide in the coating booth a dedicated circulating line installation with storage tank and material changeover devices for each topcoating composition of a different gloss level; even in case of clear topcoating said effort would be necessary. Moreover, buffer zones permitting at least short cleaning breaks would have to be arranged between the substrates to be coated with the topcoating compositions of different gloss level, for example, corresponding clear coat compositions of different gloss level. Such cleaning breaks in each case mean an at least brief interruption of the per se continuous coating process. Even in the event of elaborate cleaning, compatibility problems perceptible as defects in the finished colored or clear topcoat layer must be expected. Moreover, direct recycling of overspray would also not be possible.

[0005] It is known from WO 2005/123848 to UV-irradiate powder coatings curable by irradiation with high-energy radiation, after application but still before thermal melting and subsequent actual high-energy radiation curing, and to establish a desired gloss level in the finished coating by the level of the UV dose (ultraviolet radiation dose) used during said initial UV-irradiation.

[0006] As a further development of the invention

known from WO 2005/123848, the present invention makes it possible to provide equal or different substrates with topcoats of a different gloss level, optionally even with a different gloss level on individual substrates, although application of the powder topcoat is performed within one and the same coating booth of a mass-production coating line, in particular, an automotive mass-production coating line using one and the same powder coating composition. The complexity described above in connection with the use of two or more coating compositions differing with regard to the gloss level achievable therewith as well as the further disadvantages may be avoided. In automotive original coating applications, it is for example even possible, to provide a topcoat finish on two or more different vehicle models with its own gloss level differing from that of another model without having to provide a dedicated topcoat booth for each model series.

Summary of the Invention

[0007] The invention relates to a process for the topcoating of equal or different substrates within a mass-production coating line, comprising the following successive steps:

- a) applying a topcoat layer onto the substrates from only one powder coating composition curable by high-energy radiation and suitable for producing high-gloss topcoat,
- b) supplying thermal energy to said topcoat to produce a molten coating layer, and
- c) forming a finished topcoat by curing the molten coating layer with high-energy radiation,

wherein the substrates comprise substrates A and substrates B, wherein only the substrates A undergo an additional step a') arranged between steps a) and b) in which at least one subzone of the surface of the substrates A provided with the pulverulent topcoat layer is irradiated with UV radiation.

Detailed Description of the Invention

[0008] In the process according to the invention, equal or different substrates A and B are topcoated with a powder coating in a mass-production coating process, in particular an industrial mass-production coating process. The actual powder application of step a) is performed within one, i.e. within one and the same, coating booth. To avoid misunderstandings, it is irrelevant whether the mass-production coating line comprises only one or two or more topcoating booths; step a) of the process of the invention must be understood with regard to what happens in said one topcoating booth. Thus, the topcoating booth may here be the only one or one of two or more coating booths of the mass-production coating line. Typically, the substrates are here supplied in succession to

the powder coating application apparatus by using an automatic conveying apparatus, for example, a conveyor belt. While the phrase "equal substrates" means same kind of articles, the phrase "different substrates" means that the substrates to be topcoated are supplied to the powder coating application apparatus in succession in any desired order, for example also combined in two or more different, successive groups of in each case equal substrates. Different groups may here be repeated in a regular or irregular sequence. In order to avoid any misunderstanding, it should be noted that both in the case of equal substrates and in the case of different substrates, both kinds of substrates A and B are involved. In the case of different substrates, for example, two different kinds of articles to be topcoated, one kind may comprise substrates A and the other substrates B; it is, however, also possible for one or each of the two kinds of articles to comprise both kinds of substrates, namely substrates A and B.

[0009] The substrates to be coated comprise articles, in particular industrially produced articles which are uncoated or provided with a single layer or multilayer pre-coating, said articles being made for example from metal, wood, derived timber products, plastics or fiber-reinforced plastics. The substrates may, for example, comprise appliance casings, computer cases, automotive bodies, automotive body parts or automotive body fittings which may in each case in particular be precoated. The process according to the invention is preferably used to produce a clear topcoat, in particular, a powder clear coat layer on substrates which are typically colored as such or precoated with a color-imparting and or special effect-imparting finish. In the case of automotive substrates, they preferably comprise automotive bodies, automotive body parts or automotive body fittings precoated with a conventional color- and/or special effect-imparting base coat layer. The base coat layer may here be completely dried or cured or incompletely dried or cured, for example, only flashed off.

[0010] In step a) of the process according to the invention, the powder topcoat material is applied onto the substrates within said one coating booth and using only one powder coating composition curable by high-energy radiation and suitable for producing high-gloss topcoat. The term "only one powder coating composition curable by high-energy radiation" means that, in the case of, for example, powder clear coating, only one single powder clear coat composition is used, thus requiring, for example, only one storage tank and only one circulating line for the powder clear coat material. If, for whatever reason, more than one powder clear coat, i.e. fundamentally different powder clear coats shall be employed, for example, two or more powder clear coat compositions of in each case fundamentally different formula, there is no need for an additional employment of different gloss level variants per clear coat composition of fundamentally different formula. The same principle applies in the case of colored powder topcoating, i.e. only one single colored

powder coating composition is used. If the colored powder topcoat is applied in two or more color shades, only one colored powder coating composition is used per color shade. The powder coating material is applied using conventional methods, preferably by electrostatic spraying.

[0011] The powder coating composition(s) applied in step a) are suitable for producing high-gloss topcoat. The gloss of the topcoats prepared according to the process of the invention can be measured at 60° according to DIN 67530. Typically, a high-gloss topcoat has a gloss in the range of 70 to 95 units, a low-gloss topcoat has a gloss in the range of 40 to below 70 units and a mat topcoat has a gloss in the range of 1 to below 40 units.

[0012] The powder coating composition(s) applied in step a) are conventional powder coatings which can be cured by irradiation with high-energy radiation, for example, electron-beam or, in particular, UV radiation. Such powder coatings are well-known to the person skilled in the art and the application and curing thereof have been disclosed in the patent literature many times, for example, in US 2005/0100685 A1, WO 2005/080463, WO 2006/024037 and WO 2006/044506.

[0013] Typically, said powder coatings comprise a resin solids content which comprises one or more binder resins with olefinically unsaturated groups and, in case of UV-radiation curable powder coatings, at least one photoinitiator to initiate the free-radical polymerization curing. Typically, the curing of high-energy radiation curable powder coatings comprises two successive steps, the heating to cause the powder particles to fuse, to melt and flow out, and the irradiation with high-energy radiation to crosslink the molten coating by free-radical polymerization.

[0014] Powder coating binders with olefinically unsaturated, free-radically polymerizable groups are known to the skilled person; they can be prepolymers, such as polymers and oligomers, containing, per molecule, one or more, free-radically polymerizable olefinic double bonds. The olefinic double bonds may, for example, be present in the form of (meth)acryloyl, vinyl, allyl, maleate and/or fumarate groups. The free-radically polymerizable olefinic double bonds are preferably present in the form of (meth)acryloyl groups.

[0015] The term "(meth)acryl" is intended to mean acryl and/or methacryl.

[0016] Examples of said prepolymers with free-radically polymerizable olefinic double bonds include (meth)acryloyl-functional (meth)acrylic copolymers, polyurethane (meth)acrylates, polyester (meth)acrylates, unsaturated polyesters, polyether (meth)acrylates, silicone (meth)acrylates, amino (meth)acrylates and melamine (meth)acrylates. The number average molar mass M_n of these compounds may, for example, be from about 500 to about 10,000 g/mol, preferably from about 500 to about 5000 g/mol.

[0017] The powder coating binders may be used in combination with one or more reactive diluents, i.e. free-radically polymerizable low molecular weight compounds

with a molar mass of below 500 g/mol. The reactive diluents may be mono-, di- or polyunsaturated. Examples of monounsaturated reactive diluents are (meth)acrylic acid and the esters thereof, maleic acid and the semi-esters thereof, vinyl acetate, vinyl ethers, substituted vinyl ureas, styrene, vinyltoluene. Examples of diunsaturated reactive diluents are di(meth)acrylates, such as polyethylene glycol di(meth)acrylate, 1,3-butanediol di(meth)acrylate, vinyl (meth)acrylate, allyl (meth)acrylate, divinylbenzene, dipropylene glycol di(meth)acrylate, hexanediol di(meth)acrylate. Examples of polyunsaturated reactive diluents are glycerol tri(meth)acrylate, trimethylolpropane tri(meth)acrylate, pentaerythritol tri- and tetra(meth)acrylate. The reactive diluents are not counted as part of the resin solids content.

[0018] The powder coating compositions may comprise one or more photoinitiators. Suitable photoinitiators include, for example, those which absorb in the wavelength range from about 190 to about 600 nm. Examples of photoinitiators for free-radically curable systems are benzoin and derivatives, acetophenone and derivatives, benzophenone and derivatives, thioxanthone and derivatives, anthraquinone, organo phosphorus compounds, such as for example, acyl phosphine oxides.

[0019] The photoinitiator(s) is/are used, for example, in quantities of about 0.1 to about 7 weight percent, relative to the total of resin solids and photoinitiator(s).

[0020] The powder coating compositions may comprise pigmented or unpigmented powder coatings. They may comprise transparent, color-imparting and/or special effect-imparting pigments and/or fillers (extenders). Suitable color-imparting pigments are any conventional organic or inorganic coating pigments. Examples of color-imparting pigments are titanium dioxide, micronized titanium dioxide, carbon black, azopigments, and phthalocyanine pigments. Examples of special effect-imparting pigments are metal pigments, for example, made from aluminum, copper or other metals, interference pigments, such as metal oxide coated metal pigments and coated mica. Examples of usable fillers are silicon dioxide, aluminum silicate, barium sulfate, and calcium carbonate. Powder clear coating compositions comprise either no pigments and extenders or only transparent pigments and/or extenders.

[0021] The powder coatings may comprise one or more additives that are conventional in powder coating compositions. Examples of such additives include light stabilizers, UV absorbers, defoamers, wetting agents, anticratering agents, catalysts, antioxidants, flow additives and dyes. The additives are used in conventional amounts known to the person skilled in the art.

[0022] The powder coatings may comprise dual cure powder coatings. The latter are distinguished (i) by the fact that the free-radically polymerizable binders already mentioned above comprise additional functional groups that can be cross-linked by a thermal curing mechanism, for example, by condensation and/or addition reactions and/or (ii) by the fact that their resins solids content, in

addition to the free-radically polymerizable binders, comprises binders or binder/cross-linker combinations curable by conventional thermal curing mechanisms, for example, by condensation and/or addition reactions as are conventional in the paint and coatings technology.

[0023] The powder coatings may be produced using the conventional methods known to the person skilled in the art, for example, by extruding the powder coating material, which has already been completely formulated by dry mixing of all the required components, in the form of a pasty melt, cooling the melt, performing coarse comminution, fine grinding and then sieving to the desired grain fineness, for example, to average particle sizes (mean particle diameters) of 10 to 50 μm .

[0024] The substrates B only undergo steps a), b) and c) of the process according to the invention, whereas in the case of substrates A, an additional step a') proceeds after step a) in that at least one subzone of the surface of the substrates A provided with the pulverulent topcoat layer is irradiated with UV radiation. Whether this step a') does or does not proceed is thus determined depending on the substrate type (substrates A with step a') and substrates B without step a')). In other words, if the powder coating composition which is applied in step a) permits the production of a finished topcoat layer with a high gloss of, for example, x units in the aforementioned range from 70 to 95 units; only the substrates A are UV-irradiated, i.e. only those substrates, for which, after completion of step c), a gloss level of the finished topcoat layer is desired which is below the gloss level achievable were step a') omitted, namely in the present example a gloss level of < x units. Here, the gloss level of x units represents the maximum gloss that can be achieved with the powder coating composition, when step a') is omitted. The final result of the process according to the invention is, that substrates A having a topcoat with a gloss level of < x units and substrates B having a topcoat with a gloss level of x units leave the mass-production coating line although both substrates A and B have been coated with one and the same powder coating composition in one and the same coating booth. In still other words, it is the merit of the invention to use the teaching from the aforementioned WO 2005/123848 in a smart manner, i.e. using it as a part of the process according to the invention. To be more precise, the present invention is the use of step a') in a process for the topcoating of substrates A and B only in case of substrates A and to work with only one powder coating composition within one and the same coating booth but to obtain substrates A having a topcoat with a gloss level of < x units and substrates B having a topcoat with a gloss level of x units as the products of said topcoating process. Therefore the invention relates also to the use of a process step a') of UV-irradiation of at least one subzone of the surface only of substrates A provided with a pulverulent topcoat layer arranged between the process steps a) and b) of a process for the topcoating of equal or different substrates within a mass-production coating line, comprising the following succes-

sive steps:

- a) applying a topcoat layer onto the substrates from only one powder coating composition curable by high-energy radiation and suitable for producing high-gloss topcoat,
- b) supplying thermal energy to said topcoat to produce a molten coating layer, and
- c) forming a finished topcoat layer by curing the molten coating layer with high-energy radiation,

wherein the substrates comprise substrates A and substrates B.

[0025] UV radiation sources which may be used in step a') are the same devices as are described in greater detail below in connection with process step c).

[0026] The UV-irradiation of the substrates A which proceeds in step a') is, with regard to the UV dose to be applied, adapted to the desired gloss level to be achieved for the finished topcoat layer of the substrates A on completion of step c). In other words, the individual gloss level of a particular subzone of the finished topcoat layer after completion of step c) or of the entire finished topcoat layer after completion of step c) of an individual substrate A may be adjusted by varying the duration and/or intensity of the UV-irradiation. To achieve different gloss levels the UV dose can be varied from low to high dose. In principle, lower gloss topcoat layers on substrates A are achieved by a higher UV dose in step a') whereas higher gloss topcoat layers on substrates A are obtained by a lower UV dose in step a'). The UV doses used in step a') of the process according to the invention are in the range of, for example, about 1 to about 300 mJ/cm², preferably about 5 to about 50 mJ/cm².

[0027] It is expedient for the substrates or means associated with the substrates to bear an identification feature, for example, a barcode, which is read automatically, for example, after step a). In addition to information as to whether step a') is (substrates A) or is not (substrates B) to be performed for a substrate, the identification feature may, in the affirmative case, for example, also comprise information regarding the UV dose to be applied and then preferably simultaneously also comprise corresponding data for controlling the UV radiation sources.

[0028] The term "at least one subzone of the surface of the substrates A provided with the pulverulent topcoat layer" means that, if it is not the entire surface of the substrates A, but instead only one or more subzones of the finished topcoated surface of the substrates A after completion of step c) which is/are intended to receive a gloss level which is lower than that achievable were step a') omitted, it is not the entire surface of the substrates A, but instead only said subzone(s) which is/are irradiated with UV radiation. In the case of UV-irradiation of subzones, the subzone(s) which is/are not to be irradiated may be directly excluded from UV-irradiation by simply not being irradiated. For example, a UV laser, which may be controlled by image data, may be used as the UV

radiation source, with which the subzone(s) to be irradiated is/are irradiated sharply divided from the subzone(s) which is/are not to be irradiated. It is, however, also possible indirectly to exclude the subzone(s) which is/are not to be irradiated from UV-irradiation by masking, for example, by using stencils which are opaque to UV radiation. The masking may provide a sharp delimitation or a feathered transition between zones with high gloss and lower gloss. Stencils with an appropriate shape may, for example, be used for this purpose, said stencils allowing UV radiation to pass through only to the zone with desired low gloss or permitting passage of the UV radiation in the transition zone with decreasing intensity towards the high-gloss zone.

[0029] The concept of UV-irradiating only subzones is further disclosed using the example of automotive bodies provided with a pulverulent topcoat. Thus, for design purposes, for example, the roof or the roof zone may be UV-irradiated with the result that, after completion of the process according to the invention, a per se high-gloss coated automotive body is obtained with a mat-gloss roof (zone). Another example, in particular if an image data controlled UV laser is used, is the possibility of producing per se high-gloss topcoated automotive bodies with mat-gloss images, for example, logos or lettering, within the high-gloss topcoat layer. It goes without saying that the principle may also be reversed, resulting in automotive bodies with high-gloss images in a topcoat layer of lower gloss.

[0030] If the emphasis is on practical considerations, it may be expedient to UV-irradiate specifically such areas on automotive bodies which are particularly at risk of scratching in service, for example, areas around the locks, door handles, loading edges, door openings and sills. Further examples of areas of an automotive body which are at risk of scratching are areas which are suitable for accommodating external loads, for example, the roof or hatchback.

[0031] The UV-irradiation of step a') proceeds while the coating is still pulverulent, i.e. the powder particles are neither softened and tacky nor molten; for example the air temperature in the coating booth and the object temperature is in the range from about 15°C to below about 60°C, preferably about 20°C to about 30°C.

[0032] After completion of step a) or, in case step a') is performed, after the completion of the latter, step b) of supply of thermal energy to the pulverulent topcoat layer is performed in order to convert it into a molten coating layer. Step b) serves to fuse and melt the powder coating particles finally resulting in a molten coating. The supply of thermal energy can be done, for example, by IR-radiation, IR-radiation combined with hot-air convection, or hot-air convection alone. IR radiation includes also Near-Infrared radiation (NIR). Typically IR radiation comprises wavelengths in the range of 0.76 μm to 1 mm whereas NIR radiation comprises wavelengths in the range of 0.76 to 1.2 μm. The melting temperature, may be, for example, in the range of about 80°C to about 200°C, preferably of

about 100°C to about 160°C, measured as object temperature.

[0033] Following step b) the molten coating layer is cured by exposure to high-energy radiation in step c). UV radiation or electron beam radiation may be used as high-energy radiation. UV radiation is preferred. The UV-irradiation may proceed continuously or discontinuously, that means in cycles. UV-irradiation may be carried out, for example, in a belt unit fitted with one or more static or moving UV radiation sources. In principle the duration of irradiation, the distance from the object and/or the radiation output of the UV radiation source may be varied during UV-irradiation.

The UV radiation sources comprise UV radiation emitters emitting in the wavelength range from, for example, about 180 to about 420 nm, in particular from about 200 to about 400 nm. Examples of UV radiation sources are optionally doped high, medium and low pressure mercury vapor emitters and gas discharge tubes, such as, for example, low pressure xenon lamps and UV lasers. Apart from these continuously operating UV radiation sources, however, it is also possible to use discontinuous UV radiation sources, for example, so-called high-energy flash devices (UV flash lamps for short). The UV flash lamps may contain a plurality of flash tubes, for example, quartz tubes filled with inert gas, such as xenon.

[0034] The distance between the UV radiation sources and the substrate surface to be irradiated may be, for example, about 5 to about 100 cm.

[0035] UV-irradiation may proceed in one or more irradiation steps. In other words, the energy to be applied by UV-irradiation may be supplied completely in a single irradiation step or in portions in two or more irradiation steps. The UV doses used in step c) of the process according to the invention are in the range of, for example, about 300 to about 2500 mJ/cm², preferably about 500 to about 1500 mJ/cm². The UV doses applied in an individual case of a specific substrate A in steps a') and c) are orders of magnitude higher in step c) than in step a'), for example, 5 to 500 times higher, preferably 5 to 300 times higher.

[0036] The preferred ranges stated in the present description with respect to UV doses applied in steps a') and c) as well as to the preferred relation between them apply in particular to the topcoating of automotive substrates, such as, automotive bodies, automotive body parts or automotive body fittings.

[0037] It is possible to supply thermal energy during and/or after the high-energy irradiation of step c). Supply of thermal energy during and/or after the high-energy irradiation of step c) may be expedient in particular in case of the aforementioned dual cure powder coatings.

Examples

Example 1 (Preparation of a high-gloss multi-layer coating on an automotive body):

a) Production of a polyurethane diacrylate:

[0038] 547 pbw (parts by weight) of 1,6-hexane diisocyanate (HDI) were initially introduced into a 2 litre, four-necked flask equipped with a stirrer, thermometer and column and 0.1 pbw of methylhydroquinone and 0.1 pbw of dibutyltin dilaurate were added. The reaction mixture was heated to 60°C. 186.2 pbw of neopentyl glycol were then added in such a manner that the temperature did not exceed 80°C. The reaction mixture was stirred at 80°C until an NCO content of < 16.8% was reached. Once the NCO content had been reached, the mixture was first cooled back down to 65°C and then 188.9 pbw of hydroxyethyl acrylate were added in such a manner that a temperature 60 to 80°C was maintained. The temperature was then maintained at 80°C until an NCO content of < 5.9% was reached. Once the NCO content had been reached, the mixture was heated to 90°C. 76.9 pbw of 1,6-hexanediol were then added in such a manner that a temperature of 85-100°C was maintained. The reaction mixture was stirred at 100°C until an NCO content of < 0.1 % had been reached. The hot melt was then discharged and allowed to cool.

b) Production of a powder clear coating composition:

[0039] A comminuted mixture of the following components was premixed and extruded:

96.7 pbw of the polyurethane diacrylate from step a),
1.0 pbw of Irgacure® 2959 (photoinitiator from Ciba),
0.3 pbw of Powdermate® 486 CFL (levelling additive from Troy Chemical Company),
1.0 pbw of Tinuvin® 144 (HALS light stabilizer from Ciba) and
1.0 pbw of Tinuvin® 405 (UV absorber from Ciba)

to produce, after cooling, crushing, grinding and sieving, a powder clear coating composition.

c) Application and curing of the powder clear coating:

[0040] The powder clear coating composition was applied to a film thickness of 60 µm onto an automotive body which had been provided with a coating structure comprising electrodeposition coating, filler and water-borne base coat.

[0041] The automotive body was placed in a baking oven, where the powder clear coating was exposed to an oven temperature of 140°C for 10 minutes and melted. Curing was then performed by means of UV radiation. The body was passed before stationarily mounted UV radiation emitters (UV portal for curing vehicle bodies, adapted to the body outline) in such a manner that a radiation dose for the outer body skin in the range of 500

to 1500 mJ/cm² was obtained at all points. A gloss of 86 units of the topcoat was measured at 60° according to DIN 67530.

Example 2 (Preparation of a mat multi-layer coating on an automotive body):

[0042] Example 1 was repeated with the difference, that after powder clear coat application but prior to placing the automotive body in the baking oven the automotive body was irradiated with UV radiation. To this end, the body was passed before stationarily mounted UV radiation emitters (UV portal for curing vehicle bodies, adapted to the body outline) in such a manner that a radiation dose for the outer body skin in the range of 15 to 45 mJ/cm² was obtained at all points. The mat topcoat so obtained had a gloss in the range of 20 to 30 units (determined at 60° according to DIN 67530).

Example 3 (Preparation of a glossy/mat multi-layer coating on a car door):

[0043] The powder clear coating composition of Example 1 was applied to a film thickness of 60 μm on a car door which had been provided with a coating structure comprising electrodeposition coating, filler and water-borne base coat.

[0044] After the powder clear coat application but prior to placing the car door in a baking oven the lower half of the car door was irradiated with UV radiation. To this end a steel panel was positioned in front of the upper half of the powder clear coated car door at a distance of about 1 cm. Then the UV irradiation was performed in such a manner that a radiation dose in the range of 20 to 30 mJ/cm² was obtained at all points of the lower half of the car door.

[0045] After UV irradiation of its lower half the car door was placed in a baking oven, where the powder clear coating was exposed to an oven temperature of 140°C for 10 minutes and melted. Curing was then performed by UV irradiation in such a manner that a radiation dose in the range of 800 to 1000 mJ/cm² was obtained at all points of the door surface. A gloss of 87 units on the upper half and in the range of 20 to 30 units on the lower half of the car door was determined at 60° according to DIN 67530.

Claims

1. A process for the topcoating of equal or different substrates using a mass production coating line, said process comprises the successive steps:

a) applying a topcoat layer onto the substrates from only one powder coating composition curable by high-energy radiation and suitable for producing high-gloss topcoat,

b) supplying thermal energy to said topcoat to produce a molten coating layer, and
c) forming a finished topcoat by curing the molten coating layer with high-energy radiation,

wherein the substrates comprise substrates A and substrates B, wherein only the substrates A undergo an additional step a') arranged between steps a) and b) in which at least one subzone of the surface of the substrates A provided with the pulverulent topcoat layer is irradiated with UV radiation.

2. The process of claim 1, wherein the substrates comprise articles selected from the group consisting of uncoated articles, articles provided with a single layer precoat and articles provided with a multilayer precoat.
3. The process of claim 1, wherein the substrates are selected from the group consisting of appliance casings, computer casings, automotive bodies, automotive body parts and automotive body fittings.
4. The process of any one of the preceding claims, wherein the topcoat is a clear coat.
5. The process of any one of the preceding claims, wherein the UV dose used in step a') is in the range of 1 to 300 mJ/cm².
6. The process of any one of the preceding claims, wherein the entire surface of substrates A provided with the pulverulent topcoat layer is irradiated with UV radiation in step a').
7. The process of any one of claims 1 to 5, wherein only one or more subzones of the surface of the substrates A provided with the pulverulent topcoat layer are irradiated with UV radiation in step a').
8. The process of any one of the preceding claims, wherein the melting temperature in step b) lies in the range of about 80 to about 200°C, measured as object temperature.
9. The process of any one of the preceding claims, wherein the high-energy radiation used in step c) is UV radiation and the UV doses used in step c) are in the range of about 300 to about 2500 mJ/cm².
10. The process of claim 9, wherein the UV dose used in step c) is about 5 to about 500 times higher than the UV dose used in step a').



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 01 0611

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
D,X	WO 2005/123848 A (DU PONT [US]; BLOM HELENE [SE]; WILKENHOENER UWE [DE]; WULF MARTIN [DE] 29 December 2005 (2005-12-29) * the whole document * -----	1-10	INV. B05D3/02 B05D3/06
			TECHNICAL FIELDS SEARCHED (IPC)
			B05D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 30 November 2007	Examiner BROTHIER, J
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2

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