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(54) **Two-layer coating systems for wheels and architectural applications.**

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(73) Proprietor: **Akzo Nobel N.V.**
Velperweg 76
NL-6824 BM Arnhem (NL)

(72) Inventor: **Durand, Dominique**
18, Rue des Frères Kennedy
F-91580 Etrechy (FR)

(74) Representative: **Schalkwijk, Pieter Cornelis et al**
AKZO NOBEL N.V.
Patent Department (Dept. APTA)
P.O. Box 9300
NL-6800 SB Arnhem (NL)

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Description

The present invention relates to a coating system consisting of two layers including (a) a pigmented base coat, and (b) a transparent, mica pigment-containing topcoat on the base coat, which is suitable, e.g., for covering wheels for cars or for use in architectural applications, particularly involving aluminum substrates.

Such a coating system is known from EP-A-186 607. The transparent topcoat coating composition disclosed therein comprises a thermoplastic or thermosetting resin material containing low pigment to binder ratio of titanium dioxide encapsulated mica particles. As a result thereof the coated article produces satin finish color effects. A drawback to said known coating system is that use is made therein of a relatively high percentage of organic solvent, which when applied to any of the above substrates, may give rise to many environmental problems.

Known systems are normally based upon at least three coating layers including a first coating layer which provides generally the basic color and opacifying of the substrate, a second liquid layer which provides a metallized effect and, finally, a third liquid clear varnish which provides certain appearance and protective aspects required for the particular end use. The known systems, however, do not always possess a desired combination of the aforementioned properties and, in addition, the application of so many coating layers can result in technical problems.

It is, therefore, an object of the present invention to provide a two-layer coating system of the above type which may be applied at the risk of few if any problems to the environment.

The invention is characterized in that the coating system according to the opening paragraph consists essentially of:

(a) a first coating layer based on an epoxy resin, alkyd resin, polyester resin, melamine-containing resin, polyurethane resin and/or polyacrylate resin; and

(b) a second metallized transparent powder coating layer containing as a binder polyester resins, epoxy resins, acrylate resins and/or polyurethane resins and at least 0.5 % by weight of a mica pigment, based upon the total weight of the second layer.

It must be considered highly surprising that for the application of the second layer use is made of a powder coating. Where in the known coating composition the laminar mica pigment is mainly used to produce satin finish color effects as a result of parallel orientation to the film surface formed by the liquid coating composition, the main reason for using mica in the powder coatings according to the invention is to improve their properties such as total layer thickness, metallic lustre, petrol resistance, corrosion resistance, stone-chipping resistance, and outdoor durability.

It should be added that the use of a powder coating as a topcoat is known per se from DE-A-38 14 853. Said powder coating may contain a coloring agent in an amount which does not substantially impair the transparency of the resulting film. Not the slightest allusion is made in this document to the use of a mica pigment in the top coat.

The first coating layer in accordance with the present invention provides the basic color of the two-layer coating system as well as opacifying of the substrate. Depending on the desired end use, the first coating layer may comprise a cathodic electrodeposition coating layer or a powder coating layer based on an epoxy resin, alkyd resin, polyester resin, melamine-containing resin, polyurethane resin and/or polyacrylate resin, such layers and resins being generally well-known in the art.

The second metallized transparent powder coating layer is based upon any one of a number of polyester resins, epoxy resins, acrylate resins and/or polyurethane resins known for use in powder coatings for producing transparent layers, and optionally a curing agent for that resin. Of these, the polyester resins are particularly preferred.

The polyester resin can be a hydroxylated polyester in combination with a hydroxyl group reactive curing agent, but preferably is a carboxylated polyester in combination with a carboxyl group reactive curing agent. A very suitable powder coating system for the second layer comprises a carboxylated polyester and an epoxy compound as curing agent.

Suitable polyesters can be obtained via customary preparation processes from by preference substantially aromatic polycarboxylic acids and a variety of polyols.

As aromatic polycarboxylic acids may be mentioned phthalic acid, isophthalic acid, terephthalic acid, pyromellitic acid, trimellitic acid, 3,6-dichlorophthalic acid, terechlorophthalic acid and, in so far as available, the anhydrides, acid chlorides and lower alkyl esters thereof.

In addition to the aromatic acids, cycloaliphatic and/or acylic polycarboxylic acids may be utilized in amounts up to 30 mol%, and preferably up to 20 mol%, based upon the total moles of carboxylic acids utilized. As examples of cycloaliphatic and/or acyclic polycarboxylic acids may be mentioned tetrahydrophthalic acid, hexahydroendomethylene tetrahydrophthalic acid, azeleic acid, sebacic acid, decanedicarboxylic acid, dimeric fatty acids, adipic acid, succinic acid and maleic acid. Hydroxycarboxylic acids and/or lactones such as 12-hydroxystearic, ϵ-caprolactone and the hydropivalic acid

ester of neopentyl glycol, as well as monocarboxylic acids such as benzoic acid, tert.-butyl benzoic acid, hexahydrobenzoic acid and saturated aliphatic monocarboxylic acids, can also be utilized in minor amounts.

As suitable polyols may be mentioned aliphatic diols such as ethylene glycol, propane-1,2-diol, propane-1,3-diol, butane-1,2-diol, butane-1,4-diol, butane-1,3-diol, 2,2-dimethyl propane-1,3-diol (neopentyl glycol), hexane-2,5-diol, hexane-1,6-diol and diethylene glycol; and cycloaliphatic and aromatic diols such as 1,4-dimethylol cyclohexane, 2,2-bis(4-hydroxycyclohexyl) propane and 2,2-bis-[4-(2-hydroxyethoxy)phenyl] propane. In addition, smaller amounts of higher functional polyols may also be utilized such as glycerol, hexanetriol, pentaerythritol, sorbitol, trimethylol ethane, trimethylol propane and tris-(2-hydroxy)isocyanurate. Epoxy compounds may also be utilized as polyols. Preferably, the polyol component comprises at least 50 mol% of neopentyl glycol and/or propylene glycol, mol% here being based upon the total moles of polyols utilized.

Using processes known per se the polyesters may be prepared by esterification and/or transesterification, optionally in the presence of customary catalyst such as, for instance, dibutyl tin oxide or tetrabutyltitanate, in which processes, owing to a suitable choice of the preparation conditions and of the COOH/OH ratio, end products are obtained the acid value of which is preferably between 5 and 150 (mg KOH/g resin), and which are preferably carboxyl group terminated.

As indicated above, the preferred curing agent for the carboxylated polyester is an epoxy compound such as triglycidylisocyanurate or a heterocyclic triepoxy compound, such as methyl-substituted triglycidylisocyanurate or 1,2,4-triglycidyltriazolidine-3,5-dion or diglycidyl-terephthalate or an epoxy resin based on bisphenol A and epichlorohydrin, of which triglycidylisocyanurate is preferred. The amount of epoxy compound utilized depends on the acid value of the polyester resin and on the epoxy equivalent weight of the epoxy compound. Preferably, the epoxy compound is utilized in amounts ranging between 0,8 and 1,2 equivalent epoxy per equivalent carboxyl group.

As also indicated above, the second metallized transparent powder coating layer contains a mica pigment which is responsible for the metallization. Mica is a well known class of minerals. Most micas are predominantly aluminium silicates of potassium, iron, lithium or fluorine. Since the chemical compositions are quite variable, mica may range from colorless and transparent to highly coloured, opaque varieties. According to a preferred embodiment of the present invention, the mica comprises platelets of mica coated with titanium dioxide.

The amount of mica utilized in the second layer is at least 0.5 % by weight based upon the total weight of the second layer, and preferably is between 0,5 and 10% by weight based upon the total weight of the second layer.

The preparation of powder coatings based upon carboxylated polyesters and epoxy resins is generally well-known in the art. Preferably, the carboxylated polyesters are mixed via, for example, extrusion and at a temperature of from 110-130 °C, with a polyepoxide, eventually pigments and other additives.

The mica pigment which is responsible for the metallization can be added at different places in the powder coating preparation. The addition can take place as an internal metallization before the extrusion, as an external metallization after grinding or a combination of the external and internal metallization. Peferably the external metallization is used.

Other normal additives such as, for instance, other pigments, fillers, anti-oxidants, colorants, flow-promoting agents, release agents, viscosity agents, levelling agents and UV-stabilizers can be added to the coating systems of the two-layers.

Suitable pigments are, for instance, inorganic pigments such as titanium dioxide, zinc sulphide, iron oxide and chromium oxide, and organic pigments such as azo compounds.

Suitable fillers are, for instance, quartz powder, calcium and magnesium silicates, calcium carbonate, barium sulphate, calcium sulphate and aluminium oxide and mixtures of these optionally with smaller amounts of, e.g., aluminium hydroxide, ammoniumpolyphosphate and the like.

Suitable flow-promoting agents are, for instance, liquid polyacrylates such as, for instance, polybutylacrylate and polyethylacrylate, fluorinated polymers such as, for instance, esters of polyethylene glycol and perfluoroctanoic acid and polymeric siloxanes such as, for instance, polydimethyl siloxane or polymethylphenyl siloxane.

Of course, with respect to the second coating layer these additives should not substantially affect the transparent nature thereof.

The powder coatings utilized for the second coating layer are preferably applied to the first coating layer by electrostatic/tribo spraying and cured at temperatures between 160-200 °C under the influence of a catalyst. During the curing process, the powder coating melts and subsequently flows out to form a smooth, continuous coating film before substantial curing of the components.

Suitable catalysts must guarantee rapid curing of the components but must be substantially inactive in the mixing of the polyester and epoxy resins.

Prior to application of the second coating layer, the first layer can be a cured layer but also a non- or partially cured layer. An advantage of the present two-layer coating system, however, is the possibility to cure both layers in one step, in which case the first layer is applied as a base, over which the second metallized transparent powder coating is applied, after which the total system is cured under the aforementioned conditions.

Preferably the two-layer coating system according to the invention is applied onto an aluminum substrate; however, the system can also be applied on other substrates such as iron, steel, copper, carbon, wood, glass and polymers.

When the two-layer coating system is applied onto wheels for cars, it has been found most advantageous to utilize a cathodic electrodeposition layer as the first layer, especially one based upon an epoxy resin and optional curing agent therefor. Particularly preferred is a cathodic electrodeposition layer based upon an aqueous dispersion or solution of an epoxy resin.

Preferably, the thickness of the cathodic electrodeposition first layer is between 15 and 30 μm, the thickness of the second metallized transparent powder coating layer is between 30 and 100 μm (and more preferably between 40 and 70 μm), and the total thickness of the two-layer system is between 45 and 130 μm (and more preferably between 55 and 100 μm).

When the two-layer coating system is utilized in architectural applications, it has been found most advantageous to utilize as the first layer another powder coating based on an epoxy resin, polyester resin, polyacrylate resin and/or polyurethane resin, and optionally a curing agent therefor.

This first powder coating layer can contain the already mentioned customary additives, and especially a pigment to obtain a color.

Preferably, the thickness of the first powder coating layer is between 30 and 100 μm (and more preferably between 40 and 70 μm), and the thickness of the second metallized transparent powder coating layer is between 30 and 100 μm (and more preferably between 40 and 70 μm).

This system results in an excellent aspect of the powder layer for architectural uses. Furthermore the adhesion between the two layers is very good.

The invention will be further elucidated by means of the following examples, without, however, being limited thereto.

Example

A wheel was provided with a cathodic electrodeposition layer based on an epoxy resin. Next, a powder coating based on a polyester and TGIC (weight ratio polyester: TGIC 93 : 7) and mica ('Mearlin superwhite') was applied in a weight ratio polyester/TGIC: Mica 95 : 5 by tribospraying in a layer thickness of 45 μm.

Curing conditions: 10 minutes, 180 °C, infrared curing.

The coating system resulted in the following characteristics:

- weatherability (according to the Peugeot method; xenon with 500 hours exposure) : loss of gloss 2%
- salt spray resistance (ASTM B 117) 800 hours: disbonding less than 0,5 mm, no blistering
- stone-chipping resistance (Peugeot method) : 1 (1 = excellent, 2 = very good, whereas 10 = very bad).

Claims

1. A coating system consisting of two layers including
   (a) a pigmented base coat, and
   (b) a transparent, mica pigment containing topcoat on the base coat, characterized in that the coating system consists essentially of:
      (a) a first coating layer based on an epoxy resin, alkyd resin, polyester resin, melamine-containing resin, polyurethane resin and/or polyacrylate resin; and
      (b) a second metallized transparent powder coating layer containing as a binder polyester resins, epoxy resins, acrylate resins and/or polyurethane resins and at least 0.5 % by weight of a mica pigment, based upon the total weight of the second layer.

2. The coating system according to claim 1, characterized in that the mica pigment comprises platelets of mica coated with titanium dioxide.

3. The coating system according to any one of claims 1-2, characterized in that the first coating layer is based on an epoxy resin.

4. The coating system according to any one of claims 1-3, characterized in that the second metallized transparent powder coating layer is based upon a polyester resin and a curing agent therefor.

5. The coating system according to claim 4, characterized in that the polyester resin is a carboxylated polyester resin and the curing agent is an epoxy resin.

6. The coating system according to any one of claims 1-5, characterized in that the first coating layer is a cathodic electrodeposition layer.

7. The coating system according to claim 6, characterized in that the first coating layer comprises a thickness between 15 and 30 μm, the second metallized transparent powder coating layer comprises a thickness between 30 and 100 μm, and the two-layer coating system comprises a total thickness between 45 and 130 μm.

8. The coating system according to any one of claims 1-5, characterized in that the first coating layer is a powder coating layer.

9. The coating system according to claim 8, characterized in that the first coating layer comprises a thickness between 30 and 100 μm, and the second metallized transparent powder coating layer comprises a thickness between 30 and 100 μm.

10. A substrate coated with the two-layer coating system according to any one of claims 1-9.

11. The coated substrate according to claim 10, characterized in that the substrate is aluminum.

12. A wheel comprising the coated substrate according to any one of claims 10-11.

13. A method of producing the coated substrate according to any one of claims 10-12, characterized in that the first coating layer is applied onto the substrate, the second metallized transparent powder coating layer is applied onto the first coating layer which has optionally been partially or fully cured, then curing the system.

14. The method according to claim 13, characterized in that the second metallized transparent powder coating layer is applied onto a first coating layer which has not been cured.

Patentansprüche

1. Beschichtungssystem mit zwei Lagen, enthaltend
   (a) eine pigmentierte Grundbeschichtung und
   (b) eine transparente, Glimmerpigment enthaltende Deckschicht auf der Grundbeschichtung, dadurch gekennzeichnet, dass das Beschichtungssystem im wesentlichen besteht aus:
   (a) einer ersten Beschichtungslage auf Basis eines Epoxyharzes, Alkydharzes, Polyesterharzes, Melamin enthaltenden Harzes, Polyurethanharzes und/oder Polyacrylatharzes; und
   (b) einer zweiten metallisierten transparenten Pulverbeschichtungslage, enthaltend Polyesterharze, Epoxyharze, Acrylatharze und/oder Polyurethanharze als Binder und mindestens 0.5 Gew.% eines Glimmerpigmentes, bezogen auf das Gesamtgewicht der zweiten Lage.

2. Beschichtungssystem nach Anspruch 1, dadurch gekennzeichnet, dass das Glimmerpigment Plättchen aus mit Titandioxid beschichtetem Glimmer enthält.

3. Beschichtungssystem nach einem der Ansprüche 1-2, dadurch gekennzeichnet, dass die erste Beschichtungslage eine solche auf Basis eines Epoxyharzes ist.

4. Beschichtungssystem nach einem der Ansprüche 1-3, dadurch gekennzeichnet, dass die zweite metallisierte transparente Pulverbeschichtungslage eine solche auf Basis eines Polyesterharzes und eines Vernetzungsmittels für dieses ist.

5. Beschichtungssystem nach Anspruch 4, dadurch gekennzeichnet, dass das Polyesterharz ein carboxyliertes Polyesterharz und das Vernetzungsmittel ein Epoxyharz ist.

6. Beschichtungssystem nach einem der Ansprüche 1-5, dadurch gekennzeichnet, dass die erste Beschichtungslage eine kathodische Elektrodepositionsschicht ist.

7. Beschichtungssystem nach Anspruch 6, dadurch gekennzeichnet, dass die erste Beschichtungslage eine Dicke zwischen 15 und 30 μm, die zweite metallisierte transparente Pulverbeschichtungslage eine Dicke zwischen 30 und 100 μm und das zweischichtige Beschichtungssystem-eine Gesamtdicke zwischen 45 und 130 μm hat.

8. Beschichtungssystem nach einem der Ansprüche 1-5, dadurch gekennzeichnet, dass die erste Beschichtungslage eine Pulverbeschichtungslage ist.

9. Beschichtungssystem nach Anspruch 8, dadurch gekennzeichnet, dass die erste Beschichtungslage eine Dicke zwischen 30 und 100 μm und die zweite metallisierte transpa-

rente Pulverbeschichtungslage eine Dicke zwischen 30 und 100 µm hat.

10. Substrat, das mit dem Zweilagen-Beschichtungssystem gemäss einem der Ansprüche 1-9 beschichtet ist.

11. Beschichtetes Substrat nach Anspruch 10, dadurch gekennzeichnet, dass das Substrat Aluminium ist.

12. Rad mit dem beschichteten Substrat gemäss einem der Ansprüche 10-11.

13. Verfahren zur Herstellung des beschichteten Substrats gemäss einem der Ansprüche 10-12, dadurch gekennzeichnet, dass die erste Beschichtungslage auf das Substrat aufgetragen wird, die zweite metallisierte transparente Pulverbeschichtungslage auf die erste Beschichtungslage aufgetragen wird, die gewünschtenfalls teilweise oder vollständig gehärtet ist, und das System nachfolgend gehärtet wird.

14. Verfahren nach Anspruch 13, dadurch gekennzeichnet, dass die zweite metallisierte transparente Pulverbeschichtungslage auf eine erste Beschichtungslage aufgetragen wird, die nicht gehärtet ist.

Revendications

1. Un système de revêtement consistant en deux couches comprenant :

(a) une couche de base pigmentée et

(b) une couche supérieure contenant un pigment de mica, transparente, sur la couche de base, caractérisé en ce que le système de revêtement consiste essentiellement en

(a) une première couche de revêtement à base de résine époxy, de résine alkyde, de résine de polyester, de résine contenant de la mélamine, de résine polyuréthane et/ou de résine polyacrylique; et

(b) une seconde couche de revêtement en poudre transparente métallisée contenant en tant que liant des résines de polyester, des résines époxy, des résines acryliques et/ou des résines polyuréthane et au moins 0,5% en poids d'un pigment de mica, exprimé par rapport au poids total de la seconde couche.

2. Le système de revêtement selon la revendication 1, caractérisé en ce que le pigment de mica comprend des lamelles de mica recouvertes de dioxyde de titane.

3. Le système de revêtement selon l'une quelconque des revendications 1 à 2, caractérisé en ce que la première couche de revêtement est à base de résine époxy.

4. Le système de revêtement selon l'une quelconque des revendications 1 à 3, caractérisé en ce que la seconde couche de revêtement en poudre transparente métallisée est à base de résine de polyester et d'un agent de durcissement pour celle-ci.

5. Le système de revêtement selon la revendication 4, caractérisé en ce que la résine de polyester est une résine de polyester carboxylé et l'agent de durcissement est une résine époxy.

6. Le système de revêtement selon l'une quelconque des revendications 1 à 5, caractérisé en ce que la première couche de revêtement est une couche obtenue par électrodéposition cathodique.

7. Le système de revêtement selon la revendication 6, caractérisé en ce que la première couche de revêtement comprend une épaisseur comprise entre 15 et 30 µm, la seconde couche de revêtement en poudre transparente métallisée présente une épaisseur comprise entre 30 et 100 µm et le système de revêtement à deux couches a une épaisseur totale comprise entre 45 et 130 µm.

8. Le système de revêtement selon l'une quelconque des revendications 1 à 5, caractérisé en ce que la première couche de revêtement est une couche de revêtement en poudre.

9. Le système de revêtement selon la revendication 8, caractérisé en ce que la première couche de revêtement a une épaisseur comprise entre 30 et 100 µm, et la seconde couche de revêtement en poudre transparente métallisée a une épaisseur comprise entre 30 et 100µm.

10. Un substrat recouvert d'un système de revêtement à deux couches selon l'une quelconque des revendications 1 à 9.

11. Le substrat recouvert selon la revendication 10, caractérisé en ce que le substrat est de l'aluminium.

12. Une roue comprenant un substrat recouvert selon l'une quelconque des revendications 10-

11.

13. Un procédé d'obtention d'un substrat recouvert selon l'une quelconque des revendications 10 à 12, caractérisé en ce qu'on applique une première couche de revêtement sur le substrat, on applique une seconde couche de revêtement en poudre transparente métallisée sur la première couche de revêtement qui a été éventuellement totalement ou partiellement durcie, puis on durcit le système.

14. Procédé selon la revendication 13, caractérisé en ce que la seconde couche de revêtement en poudre transparente métallisée est appliquée sur une première couche de revêtement non-durcie.