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Scratch-resistant coating composition

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<p>(21) International Application Number: PCT/US96/05950 (22) International Filing Date: 29 April 1996 (29.04.96) (30) Priority Data: 08/433,284 2 May 1995 (02.05.95) US (60) Parent Application or Grant (63) Related by Continuation US 08/433,284 (CON) Filed on 2 May 1995 (02.05.95) (71) Applicant (for all designated States except US): E.I. DU PONT DE NEMOURS AND COMPANY [US/US]; 1007 Market Street, Wilmington, DE 19898 (US). (72) Inventors; and (75) Inventors/Applicants (for US only): HUYBRECHTS, Jozef [BE/BE]; Korenbloemstraat 39, B-2360 Oud-Turnhout (BE). KERNAGHAN, Stuart, Alexander [GB/DE]; Hinter Hoben 145, D-53129 Bonn (DE). VERVOORT, Robert [BE/BE]; Ruggeveldlaan 751, B4, B-2100 Deurne-Antwerpen (BE).</p>	<p>(74) Agent: COSTELLO, James, A.; E.I. du Pont de Nemours and Company, Legal/Patent Records Center, 1007 Market Street, Wilmington, DE 19898 (US). (81) Designated States: AU, BR, CA, CN, JP, KR, MX, US, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p>	

(54) Title: SCRATCH-RESISTANT COATING COMPOSITION

(57) Abstract

A coating composition comprising a crosslinkable binder in an organic solvent, the binder composed of acrylic and polyester polyols plus a crosslinking agent, the polyester polyol containing a component derived from one or both of: a residue of dimer fatty acid and polyol, or residue of a polyacid and dimer alcohol, the composition being useful for coating metallic substrates.

TITLE

SCRATCH-RESISTANT COATING COMPOSITION

BACKGROUND OF THE INVENTION5 FIELD OF THE INVENTION

This invention concerns a metal-coating composition containing acrylic polyol(s), polyester polyol(s) and a crosslinking agent.

STATE OF THE ART

10 The coating composition of this invention is useful primarily on metallic-substrates, particularly on vehicles such as automobiles and trucks. Such coating will protect the substrate and provide an attractive aesthetic finish. A typical vehicle has several coating layers. The substrate is typically first coated with
15 an inorganic rust-proofing zinc or iron phosphate layer over which is applied an electrocoated primer or repair primer. Optionally, a primer surfacer can be employed for better appearance and improved adhesion. A pigmented basecoat or colorcoat is next applied over the primer. A typical basecoat or colorcoat may
20 contain metallic flakes to provide a metallic finish. To protect and preserve the aesthetic qualities of the color finish, a clear (unpigmented) topcoat is often applied over the pigmented basecoat to protect the basecoat even on prolonged weathering. Clearcoats are predominantly based on a technology where the
25 binders are hydroxy functional acrylics crosslinked with alkoxyated melamine formaldehyde adducts. The coatings are typically baked at $\pm 130^{\circ}\text{C}$ after application wet-on-wet on a basecoat. Because of severe field complaints, the automobile coating industry is asking for improved scratch resistance of the
30 clearcoats.

The composition of this invention has been found to provide particularly desirable scratch-resistance to the metallic substrate coating art. This improvement is in addition to attributes of good weatherability, chemical-resistance, water-resistance, etch-
35 resistance and mechanical characteristics. This improved package of properties derives from the interrelationship of the selected acrylic and polyester polyols and the crosslinker selected for use therewith. Most particularly, the improved properties are derived

from the dimer acid/alcohol component of the polyester polyol as will be described in more detail hereafter.

SUMMARY OF THE INVENTION

5 The coating composition of this invention is a crosslinkable binder in an organic solvent, the binder comprising the following components based on total weight of binder:

 i) about 15 to 70 percent of an acrylic polyol having a weight average molecular weight of about 2,500 to 40,000; a
10 hydroxyl value of about 50 to 180 mg KOH/g; and a glass transition temperature of between -30 to 70°C;

 ii) about 5 to 60 percent of an optionally substituted polyester polyol having a weight average molecular weight of about
15 2,000 to 80,000; and a hydroxyl value of about 50 to 220 mg KOH/g;

 the polyol comprising at least about 10 percent by weight of the hydrogenated reaction product of at least one of:

 a) dimer fatty acid and polyol,
 b) polyacid and dimer alcohol, and
20 c) dimer fatty acid and dimer alcohol,

 the reaction product having at least two groups selected from acid and alcohol functionalities; and

 iii) about 10 to 60 percent of a crosslinking agent selected from at least one of an alkoxyated melamine formaldehyde adduct
25 and a polyisocyanate (which may be blocked).

 Preferred compositions are those in which the acrylic polyol has a molecular weight of 3,000 to 10,000; a hydroxyl value of 80 to 150; and a glass transition temperature of -10 to 50°C. Also preferred are compositions in which the acrylic polyol contains at
30 least one trialkoxysilyl or urethane group; in which the polyester polyol has a molecular weight of 2,500 to 15,000; a hydroxyl value of 100 to 170; and about 30 to 60 percent, by weight of polyester polyol, of hydrogenated reaction product selected from a), b) and c); in which the polyester polyol contains substituents selected
35 from at least one member of the group trialkoxysilyl and urethane; in which the binder comprises about 20 to 85 percent by weight of the solvent plus binder; and in which the polyester polyol comprises at least 10 percent of hydrogenated reaction product.

Most preferred are compositions comprising acrylic and polyester polyols and alkoxyated melamine formaldehyde adducts in a one-package system. Such a system may contain a blocked polyisocyanate. Other compositions are two-package systems comprising the acrylic and polyester polyols in one package and an unblocked polyisocyanate in the second package. The coatings of this invention are useful in topcoats for metallic substrates that include vehicles and outdoor structures. The topcoats can be clear (without pigment) or they can contain pigment.

Each of the dimer fatty acid and dimer alcohols described in a), b) and c) have at least 34 carbon atoms. In addition, the hydrogenated reaction product of each of a), b) and c) can contain significant amounts of polyacids and polyalcohols such as trimer acids and trimer alcohols as will be appreciated by one skilled in the art.

DETAILS OF THE INVENTION

The binders described herein improve clearcoat elasticity without negative impact on appearance and other properties. Appearance of a final colorcoat-clearcoat finish depends a great deal on attack by the clearcoat binders on the basecoat. It is known that polyester resins can attack basecoats much more than acrylics. This attack results in redissolution of the basecoat giving surface roughness, lower gloss and lower clarity of the final finish. This negative effect is more pronounced for oligomers due to low Mw and high hydroxyl values. Such hydroxylated polyesters, however, do increase the elasticity of the final crosslinked formulation which results in improved scratch resistance. The binders employed in the coatings described herein effect improved appearance (less basecoat attack) without negative impact on other clearcoat properties.

The Acrylic Polyol (i)

The acrylic polyols can be obtained by copolymerizing hydroxyl-containing monomers such as hydroxyethyl acrylate, hydroxyethyl methacrylate, hydroxypropyl acrylate, hydroxypropyl methacrylate, hydroxybutyl acrylate, and the like, with other

monomers typically employed in the synthesis of acrylic coating resins such as:

acrylic esters of C₁₋₁₈ monohydric alcohols such as methylacrylate, butylacrylate, 2-ethyl hexyl acrylate;

5 methacrylic esters of C₁₋₁₈ monohydric alcohols such as methyl methacrylate, butyl methacrylate, 2-ethyl hexyl methacrylate;

acrylic and methacrylic esters of cycloaliphatic monoalcohols such as cyclohexyl methacrylate, isobornyl methacrylate,
10 trimethylcyclohexyl acrylate;

acrylic and methacrylic esters of aromatic monoalcohols such as phenyl methacrylate, benzyl acrylate;

vinylaromatics such as styrene, vinyl toluene, t-butylstyrene; nitrile monomers such as acrylonitrile;

15 acid functional monomers such as itaconic acid, acrylic acid; amide functional monomers such as methacrylamide, N-butoxymethyl methacrylamide;

silane functional monomers such as gamma-methacryloxypropyltriethoxysilane;

20 glycidyl functional monomers such as glycidyl methacrylate; and

other functional comonomers including acetoacetoxyethylmethacrylate, methacryloxyethyl phosphoric acid, perfluoroalkylacrylates, methacrylates, and the like.

25 The acrylic polyol is prepared by conventional free radical-initiated polymerization in a solvent or solvent blend in the temperature range of 60° to 180°C. Typical solvents are aromatics, aliphatics, acetates, ketones, alcohols and ethers such as xylene, n-butanol, mineral spirits, methylethylketone, methyl isobutyl
30 ketone, and the like.

Azo or peroxy initiators can be employed as polymerization initiators. Examples of azo initiators are the products sold under the trade name VAZO® (DuPont) including VAZO® 67, VAZO® 88 and the like. Examples of peroxy initiators are peroxyethers,
35 peroxyesters such as di-t-butylperoxide, t-butylperacetate, t-butyl peroxy, 2-ethylhexanoate, t-butylperoxy pivalate, di-t-amylperoxide, t-amylperacetate and the like. Chain transfer agents can be utilized to control molecular weight. Examples of

chain transfer agents are halogen and sulfur derivatives as 2-mercaptoethanol, tetrachloromethane, dodecylmercaptan and the like.

The acrylic copolymers can be prepared in batch or feed
5 processes. In feed processes the monomers, initiators and chain transfer agents can be fed simultaneously or in multifeed (skewfeed) type additions. The acrylic copolymer can be modified by the chemical grafting of derivatives on the backbone binder. Examples are the reactions of lactones, mono epoxyethers, mono
10 epoxyesters, anhydrides, and mono acids with hydroxy, acid and epoxy functional groups; specifically ϵ -caprolactone, valerolactone with hydroxy functional groups; mono epoxyesters such as versatic acid mono epoxyester, pivalic acid mono epoxyester with acid functional groups; anhydrides such as maleic anhydride, phthalic
15 anhydride with hydroxy functional groups, mono acids such as myristic acid, oleic acid, isononanoic acid with epoxy functional groups. These reactions can be accomplished during the polymerization. Another way of modifying the copolymer is by reaction of the functional monomer with the modifying compounds
20 and further copolymerization with the other monomer mixture. For example, hydroxyethyl acrylate can be reacted with ϵ -caprolactone before copolymerization.

Polyester Polyol (ii)

25 The polyester polyol can be prepared by reacting polybasic acids and polyhydric alcohols as main reactants and subjecting them to condensation reaction.

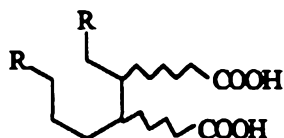
Examples of mono- and polybasic acids are aromatic acids and anhydrides, aliphatic acids and anhydrides, cycloaliphatic
30 acids and anhydrides. Representative thereof are: phthalic anhydride, isophthalic acid, hexahydrophthalic anhydride, methylcyclohexyl anhydride, trimellitic anhydride, isononanoic acid, natural monoacids such as tall oil fatty acid, adipic acid, dodecane dioic acid, 1,4-cyclohexanedicarboxyl acid, and the like.

35 Examples of polyhydric alcohols are: glycerine, neopentylglycol, 1,6-hexane diol, 2,2-ethylbutyl propane diol, trimethylolpropane, monopentaerytritol, cyclohexane dimethanol, ethylene glycol and the like.

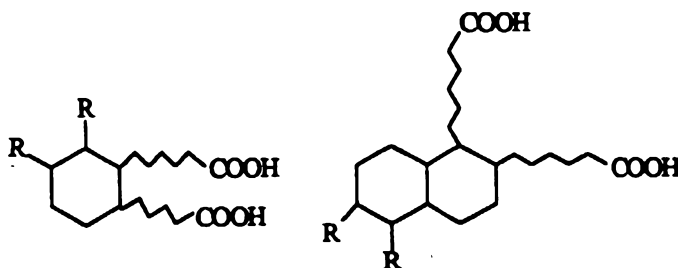
- A typical structure of a long chain diacid or diol is composed of a mixture of linear, cyclic and aromatic dimers and can be drawn as follows. It will be appreciated that significant amounts of acid and/or alcohol trimers can be included without adversely affecting the coatings.

Typical Useful Diacids

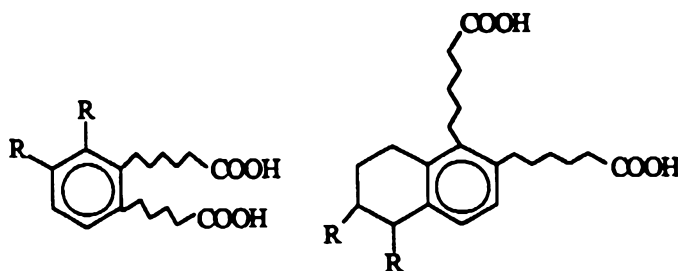
linear dimer



cyclic dimers



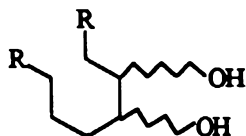
aromatic dimers

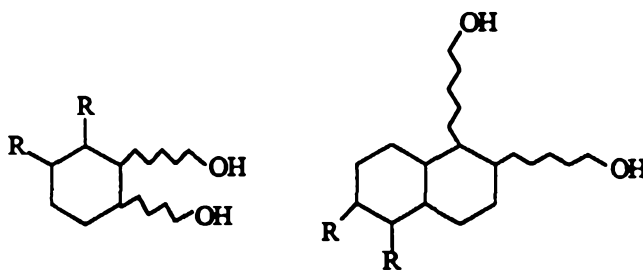
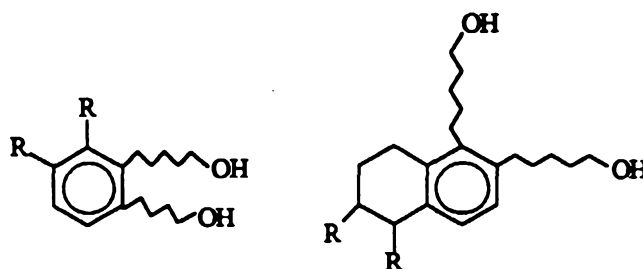


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Typical Useful Diols

linear dimer



cyclic dimersaromatic dimers

The polyester resin can be further modified with epoxyesters, epoxyethers, silane derivatives, isocyanates and the like.

The Crosslinking Agent (iii)5 Coating Formulation

The clearcoat formulation is preferably crosslinked with alkoxyated melamine formaldehyde resins. Such crosslinkers are prepared from melamine, formaldehyde and alcohol in various molar ratios and molecular weights. Typical alcohols are
10 methanol, isobutanol and n-butanol. Alkoxyated melamine formaldehyde resins are commercially available.

The clearcoat formulation can also contain other crosslinkers such as blocked polyisocyanates to improve acid etch resistance. Blocked polyisocyanates are commercially available.
15 Preferably, the methylethylketoxime blocked trimer of isophorone diisocyanate is used as auxiliary crosslinker.

In the clearcoat composition of the invention, leveling agents, rheology modifiers, ultraviolet absorbers, light stabilizers, curing catalysts can also be employed. Leveling agents are compounds
20 that improve surface properties. Ultraviolet absorbers and light stabilizers include benzotriazole derivatives and hindered amine

light stabilizers (HALS) sold under the trade name Tinuvin® by Ciba Geigy.

Curing catalysts can be strong acids such as sulfonic and phosphonic acids; metal salts of zinc and tin; amino derivatives
5 such as dimethylethanol amine, triethyl amine, and the like. Rheology control agents include inorganic or organic materials. Inorganic rheology control agents include silica derivatives and bentonite clays. Organic rheology control agents are nonaqueous
10 dispersions and diurea based particles such as obtained from the reaction of 2 moles of an amine with 1 mole of an isocyanate.

The clearcoat of the invention is thermosetting and typically applied wet-on-wet over a pigmented basecoat. The coating is preferably carried out by conventional surface coating technology which includes air-spraying, airless spraying and electrostatic
15 spray-coating techniques. The clearcoating thickness is preferably about 20 to 80 microns on a dry basis. Heat-curing is preferably conducted at about 80° to 160°C for about 10 to 40 minutes.

The composition of this invention has excellent adhesion to a variety of substrates (particularly metallic substrates) such as
20 previously painted substrates, cold rolled steel, phosphatized steel, and steel coated with conventional primers by electrodeposition. The present composition can also be used to coat plastic substrates such as polyester reinforced fiberglass, reaction injection-molded urethanes, partially crystalline polyamides, and
25 the like.

Preparations of Acrylic Polyols

Preparation 1

A conventional reaction vessel for acrylic resin production
30 equipped with a stirrer, a thermometer and a reflux condenser was charged with 14 parts of an aromatic hydrocarbon mixture (Solvesso 100). The mixture was heated at reflux with stirring and the following monomer mixture was added over 6 hours: 15 parts
35 of styrene, 21 parts of butyl methacrylate, 9 parts of butyl acrylate, 15 parts of 2-hydroxyethyl acrylate, 3 parts of t-butylperacetate 50% solution in isododecane (Trigonox FC50 (AKZO)) and 18 parts of hydrocarbon solvent (Solvesso 100). After the 6 hour feed, 1 part of hydrocarbon solvent (Solvesso 150) was added and the

reactor mixture was kept at reflux for another 30 min. Finally, 4 parts of Solvesso 150 was added. Test results on the resin solution:

	Solids Content	60.9%
5	Viscosity	L+¼ (Gardner Holdt)
	Acid Value	3.6
	Hydroxyl value	121
	Number Average M_w	2100
	Weight Average M_w	4900
10	T_g (Calculated to the nearest °C by the Flory-Fox equation)	11°C

Preparation 2

15 According to the procedure of Preparation 1, the reactor charge was 20 parts of xylene and a mixture of 24 parts of styrene, 12 parts of 2-ethylhexyl methacrylate, 12 parts of butyl methacrylate, 11.1 parts of 2-hydroxyethyl methacrylate, 0.9 parts of acrylic acid, 2 parts of t-butyl peroxy 3,3,5 trimethylhexanoate
 20 (Trigonox 41S) and 3 parts of Solvesso 100. These ingredients were fed over 4 hours followed by a rinse of 1 part Solvesso 100. The mixture was held 20 min after which another 0.1 part of Trigonox 41S and 3.9 parts of Solvesso 100 was added over 1 hour followed by a rinse with 1 part Solvesso 100. The mixture was held
 25 for another 20 min and finally 9 parts of Solvesso 100 was added.

Test results on the resin solution:

	Solids content	61%
	Viscosity	Z5
	Acid value	12.3
30	Hydroxyl Value	89
	Number Average M_w	5500
	Weight Average M_w	13000
	T_g (calculated as in Preparation 1)	48°C

35 Preparation 3

Preparation 2 was repeated replacing 2-ethylhexyl methacrylate with 2-ethylhexyl acrylate. Test results on the resin solution:

	Solids content	60.8%
	Viscosity	Z2¼
	Acid value	13
	Hydroxyl Value	89
5	Number Average M_w	5800
	weight Average M_w	13000
	T_g (calculated)	19°C

Preparation 4

10 Preparation 1 was repeated with the reactor charged with 10 parts of Solvesso 100 and 22.38 parts of versatic acid monoepoxyester Cardura E10 (Shell). To the refluxing mixture were added 21 parts of styrene, 9 parts of 2-hydroxyethyl methacrylate, 7.62 parts of acrylic acid, 1.5 parts of di-tertiary-
15 butyl peroxide (Trigonox B; AKZO) and 7.5 parts of Solvesso 100 over a period of 6 hours. A rinse of 1 part of Solvesso was added and the reactor content was held at reflux for 1 hour. Finally, 20 parts of butylacetate was added. Test results on the resin solution:

	Solids content	61.9%
20	Viscosity	M
	Acid value	16.9
	Hydroxyl Value	148
	Number Average M_w	2300
	Weight Average M_w	5200
25	T_g (calculated)	20°C

Preparation 5

Preparation 1 was repeated in which the reactor was charged with 9 parts of Solvesso 100 and 7 parts of n-butanol. A mixture
30 of 19.8 parts of styrene, 22.44 parts of 2-ethylhexyl acrylate, 17.16 parts of 2-hydroxyethyl methacrylate, 6.6 parts of gamma-methacryloxypropyl triethoxysilane (Dynasylan MEMO-E HULS) , 8.5 parts of Solvesso 100 and 4.5 parts of 2,2'-azobis
(methylbutyronitrile) (VAZO 67) were added over 5 hours followed
35 by a rinse with 1 part of Solvesso 100. The reactor contents were kept 10 min at reflux after which 0.5 parts of VAZO 67 dissolved in 1.5 parts Solvesso 100 were added over 20 min followed by a rinse with 1 part of Solvesso 100. The mixture was further held for 30

min at reflux and another 1 part of Solvesso 100 was added. Test results on the resin solution:

	Solids content	70.2%
	Viscosity	Y
5	Hydroxyl Value	112
	Number Average M_w	2100
	Weight Average M_w	5500
	T_g (calculated)	-4°C

10 PREPARATIONS OF POLYESTER POLYOLS

Preparation 6

A flask was charged with 20.96 parts of hydrogenated dimer fatty acids (Pripol 1009 Unichema), 19.88 parts of 2,2-ethylbutyl-
 15 1,3-propane diol, 11.1 parts of trimethylolpropane and 21.97 parts of 1,4-cyclohexanedicarboxylic acid (1,4 CHDA). The temperature was raised from 160°C to 220°C over 4 hours while the water of condensation was removed. The mixture was held at 220°C until an acid value of 9-11 was reached. Afterwards, the reactor
 20 contents were diluted with 32 parts of Solvesso 100. Test results on the resin solution:

	Solids content	68.8%
	Viscosity	V
	Acid value	9.8
25	Hydroxyl Value	150
	Number Average M_w	1800
	Weight Average M_w	6100

TABLE 1
Preparations 7 to 11 (Polyester Polyols)*
Comparisons A to C

	Preparation 7	Comparison A	Comparison B	Preparation 8	Preparation 9	Preparation 10	Preparation 11	Comparison C
1,6-hexanediol	15.58		22				7.58	24.56
2,2'-ethylbutyl 1,3-propane-diol		25.05		22.98			10.45	
neopentylglycol					16			
1,4-cyclohexanedimethanol						16.48		
1,4-cyclohexanedicarboxylic acid	24.12	18.4	22.88	26.23	24.73	22.98	22.9	22.03
1,12-dodecanedioic acid		20.48	20.38					
trimethylolpropane	11.79	11.1	10.7	10.58	10.3	12.78	11.33	11.95
Pripol 1009	23			14.60	23.58	21.93	21.85	
adipic acid								18.69
Solvesso 100	32	32	32	32	32	32	32	32
Test Results								
Solids	68.1	68	68.1	68	66.7	67.7	68.2	68
Viscosity	U +	T + ½	R + 1/3	V	U + ¼	Y	U + ¼	U
Acid Value	9.3	9.8	9.8	9	10.8	10.3	10	9.9
Number Av M_w	2100	1700	1800	1700	2000	1900	1800	2400
Weight Av M_w	7000	6200	6200	5400	6200	6400	5900	7500

*The polyester polyols were made by the general method of Preparation 6.

Comparisons D, E and F

	<u>D</u>	<u>E</u>	<u>F</u>
1,6-hexanediol	30.31	12.74	15.71
2,2-ethylbutyl, 1,3-propane diol		12.95	15.97
trimethylolpropane	6.05	12.66	6.68
adipic acid	19	17.82	17.78
1,4-cyclohexane dicarboxylic acid	22.39	21	20.97
Solvesso 100	32	32	32
<u>Test Results</u>			
Solids	68.6	68.8	68.6
Viscosity	N	U + 1/3	P
Acid Value	9.9	10	10.5
Number Av M_w	2200	2200	2100
Weight Av M_w	6000	8300	6100

Preparation 12

Preparation 6 was repeated using 15.5 parts of
5 trimethylolpropane and 52.78 parts of Pripol 1010 (Unichema).
The batch was held until an acid value of less than 1 was reached
before adding 35 parts of Solvesso 100. Test results:

	Solids content	65.9%
	Viscosity	Z3
10	Acid value	0.6
	Hydroxyl Value	145
	Number Average M_w	4600
	Weight Average M_w	51000

15 Preparation 13

To 100 parts of the polyester binder solution as in
Preparation 12 was added 0.1 part of dibutyltindilaurate and the
mixture was heated to 60°C. Then, 3.8 parts of 3-
isocyanatopropyltrimethoxy silane was added followed by a rinse
20 with 1 part of Solvesso 100. The mixture was held at 60°C until
the NCO band in IR had disappeared. Then, 1 part of n-butanol
was added. The polyester polyols of Preparations 12 and 13 can be
combined with any of components (i) and (iii) to prepare coating

compositions of this invention. Test results on this polyester polyol showed the following:

	Solids content	65.8%
	Viscosity	Z4
5	Acid value	0.9
	Hydroxyl Value	130
	Number Average M_w	4300
	Weight Average M_w	75300

10

EXAMPLES 1 TO 6

A typical clearcoat formulation was prepared having the components shown below:

acrylic polyol of Preparation 1	11.48
acrylic polyol of Preparation 1 modified with 5% of an organic rheology control agent ¹	24.522
polyester polyol ²	18.051
melamine formaldehyde Luwipal 013 (BASF) resin	17.155
malamine formaldehyde Luwipal LR8735 (BASF) resin	6.743
Tinuvin 1130 (Ciba)	0.788
Tinuvin 292 (Ciba)	0.394
Irganox 1010 solution (Ciba)	0.944
Reomet TTA solution (Ciba)	0.147
Silicone 017 solution (Bayer)	0.458
Solvesso 150	6.422
dodecylbenzenesulfonic acid blocked with 2-amino methylpropanol	1.238
Solvesso 100	1.559
butylcarbitol	3.669
xylene	6.430

¹Rheology control agent based on a diurea prepared from benzylamine and hexamethylene diisocyanate.

²Examples 1 to 6 are those wherein polyester polyols of Preparations 6 to 11, respectively, were used.

The clearcoat was applied wet-on-wet on a blue basecoat. The panel preparation and coating thickness were as follows:

Substrate:	Act-Tru Cold roll steel B952 P60 DIW: MATT
Primer Surfacer	30-35 microns DFT 30' at 145°C bake
Basecoat	±15 microns DFT
Clearcoat	±40-45 microns DFT Baking Base + clearcoat 30 min at 140-145°C

DFT = Dry Film Thickness.

- After baking, the panels were rated for in-place properties such as gloss, adhesion, humidity, xylene-resistance, acid-resistance (H₂SO₄), chipping, hardness (Persoz, Fisher) and flexibility. The clearcoat formulations all passed typical original equipment manufacturers' specifications.

Comparisons of Appearance And Scratch Performance vs. Coatings Without Component (ii)

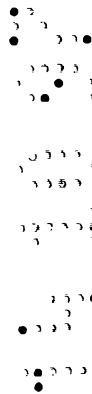
- 10 The test results in Table 2 demonstrate the advantage of using dimer fatty acids in the polyester polyol which improves scratch performance and appearance. The appearance is rated visually in an appearance test which is equivalent for the strike-in resistance of the clearcoat on the basecoat.
- 15 The scratch performance test was run by subjecting the panel to 60 cycles of a rotary synthetic brush (polyethylene) combined with a well-defined abrasive solution. The scratch performance indicates the percent of gloss loss after scratching. Scale of appearance in descending order is excellent, very good, 20 good-very good, good, fair-good, fair, poor. The important consideration is that both appearance and scratch resistance must be in balance. Thus, in Table 2, scratch performances wherein there is 22% of gloss loss can be tolerated when the appearance remains "good-very good". However, even a 5% loss is 25 unacceptable when the appearance is only "fair".

TABLE 2

Example/Comparison	Appearance	Scratch Performance (%)
Example 1	Excellent	-15
Example 2	Very Good	-3
Example 3	Good-Very Good	-22
Example 4	Excellent	-15
Example 5	Very Good	-20
Example 6	Excellent	-10
Comparison (acrylic polyol of Preparation 1; no polyester polyol)	Fair-Good	-30
Comparison A	Fair-Good	-9
Comparison B	Fair	-5
Comparison C	Poor	--
Comparison D	Poor	--
Comparison E	Poor	--
Comparison F	Poor	--

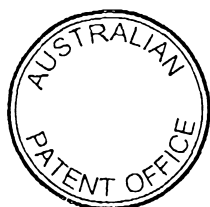
Where the terms "comprise", "comprises", "comprised" or "comprising" are used in this specification, they are to be interpreted as specifying the presence of the stated features, integers, steps or components referred to, but not to preclude the presence or addition of one or more other feature, integer, step, component or group thereof.

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The claims defining the invention are as follows:

1. A coating composition of a crosslinkable binder in an organic solvent, the binder comprising the following components based on total weight of binder:
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- i) 15 to 70 percent of an acrylic polyol having a weight average molecular weight of 2,500 to 40,000; a hydroxyl value of 50 to 180 mg KOH/g; and a glass transition temperature of between -30 to 70° C;
- ii) 5 to 60 percent of an optionally substituted polyester polyol having a weight average molecular weight of 2,000 to 80,000; and a hydroxyl value of 50 to 220 mg KOH/g; the optimal substituent selected from at least one member of the group trialkoxysilyl and urethane;
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- the polyol comprising at least 10 percent by weight of the hydrogenated reaction product of at least one of:
- a) dimer fatty acid and polyol, each having at least 34 carbon atoms,
- b) polyacid and dimer alcohol, each having at least 34 carbon atoms, and
- c) dimer fatty acid and dimer alcohol, each having at least 34 carbon atoms, the reaction product having two groups selected from acid and alcohol functionalities; and
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- iii) 10 to 60 percent of a crosslinking agent selected from at least one of an alkoxyated melamine formaldehyde adduct and a polyisocyanate.
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2. A composition according to Claim 1 in which the acrylic polyol has a molecular weight of 3,000 to 10,000; a hydroxyl value of 80 to 150; and a glass transition temperature of -10 to 50° C.
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3. A composition according to Claim 1 in which the acrylic polyol contains at least one trialkoxysilyl group.
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4. A composition according to Claim 1 in which the polyester polyol has a molecular weight of 2,500 to 15,000; a hydroxyl value of 100 to 170;



and 30 to 60 percent, by weight of polyester polyol, of hydrogenated reaction product selected from a), b) and c).

5. A composition according to Claim 1 in which the polyester polyol contains substituents selected from at least one member of the group trialkoxysilyl and urethane.

6. A composition according to Claim 1 in a two-package system wherein one package comprises the acrylic and polyester polyols and the other comprises an unblocked polyisocyanate.

7. A composition according to Claim 1 which is a topcoat.

8. A composition according to Claim 7 which is a clearcoat.

DATED this 28th day of September 1999

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By their patent attorneys

CALLINAN LAWRIE

