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**D E C I S I O N  
of 30 June 1994**

**Case Number:** T 0351/90 - 3.3.3

**Application Number:** 87107592.5

**Publication Number:** 0247563

**IPC:** C08F 299/06

**Language of the proceedings:** EN

**Title of invention:**

Ultraviolet-curable coating composition and process for preparing the same

**Applicant:**

Nippon Oil and Fats Company, Limited

**Opponent:**

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**Headword:**

-

**Relevant legal norms:**

EPC Art. 56.

**Keyword:**

"Inventive step (affirmed) - closest state of the art re-identified, relevant comparative results supplied"

**Decisions cited:**

-

**Catchword:**

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Boards of Appeal

Chambres de recours

Case Number: T 0351/90 - 3.3.3

**D E C I S I O N**  
of the Technical Board of Appeal 3.3.3  
of 30 June 1994

**Appellant:** Nippon Oil and Fats Company, Limited  
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**Decision under appeal:** Decision of the Examining Division of the  
European Patent Office dated 17 November 1989  
refusing European patent application  
No. 87 107 592.5 pursuant to Article 97(1) EPC.

**Composition of the Board:**

**Chairman:** F. Antony  
**Members:** R. Young  
J. A. Stephens-Ofner

### Summary of Facts and Submissions

I. The Appellant (applicant) lodged an appeal, received on 10 January 1990, against the decision of the Examining Division, dispatched on 17 November 1989, on the refusal of the application No. 87 107 592.5, relating to an ultraviolet-curable coating composition comprising:

- (A) an ultraviolet-curable polyfunctional (meth)acrylate containing at least two (meth)acryloyl groups in the molecule thereof,
- (B) a polyhydric alcohol mono(meth)acrylate polymer having a hydroxyl number of from 10 to 200,
- (C) a non-yellowing polyisocyanate compound,
- (D) a photo stabilizer, and
- (E) a photopolymerization initiator.

The fee for appeal was also paid on 10 January 1990. The statement setting out the grounds of appeal was received on 9 March 1990.

The Examining Division held that the application did not meet the requirements of Articles 52(1) and 56 EPC having regard to the following documents:

- D1: JP-A-59 130 568 as cited in Chem. Abs. 102 (1985) Mar., No. 12, 97052d;
- D2: GB-A-2 109 385, and
- D3: EP-A-0 000 407.

According to that decision, it would have been obvious for the skilled person aiming at an improved light stability of the composition to replace the aromatic diisocyanate used in D1 by a non-yellowing isocyanate as known, e.g. from D2.

II. A new, amended set of claims was filed with the statement setting out the grounds of appeal. This was replaced, following communications issued by the Board on 22 April 1993 and 8 November 1993, by successive further sets of claims, filed with letters dated 24 August 1993 and 25 November 1993 respectively.

With a letter dated 11 February 1994, moreover, comparative tests showing the advantages of the claimed compositions over those of D3 were filed.

III. The Appellant requested in effect that the decision under appeal be set aside and a patent granted on the basis of the following documents:

Claims:

Nos.: 1 to 7 filed with the letter of 25 November 1993, subject to substitution, in Claim 1, of semicolons at the end of the definitions for components (C) and (D), for the full stop and comma, respectively, as agreed over the phone on 29 June 1994;

Description:

Pages 1, 2, 3, 3a, 4, 4a, 4b, 5 filed with the letter of 11 February 1994, subject to substitution, on page 4a, of semicolons at the end of the definitions for components (C) and (D), for the full stop and comma, respectively, as agreed over the phone on 29 June 1994;

Pages 6 to 27 filed with the letter dated 24 August 1993, subject to cancellation of the final paragraph (page 26, line 22, to page 27, line 2), as agreed over the phone on 29 June 1994.

Furthermore, the Appellant requested oral proceedings, as auxiliary request.

IV: The wording of the independent Claims 1 and 7 on file at the time of the present decision reads as follows:

"1. An ultraviolet-curable coating composition for vehicle bodies comprising:

- (A) 30 to 70 % by weight based on the total amount of (A), (B) and (C) of an ultraviolet-curable polyfunctional (meth)acrylate containing at least two (meth)acryloyl groups in the molecule thereof and having a number average molecular weight of from 190 to 2,000;
- (B) a polyhydric alcohol mono(meth)acrylate polymer having a hydroxyl number of from 10 to 200 selected from homopolymers of hydroxyethyl (meth)acrylate, hydroxypropyl (meth)acrylate, polyethylene glycol mono(meth)acrylate, polypropylene glycol mono(meth)acrylate, neopentyl glycol mono(meth)acrylate and glycerin mono(meth)acrylate, or copolymers comprising these monomers and one or more of other monomers copolymerizable therewith, selected from methyl (meth)acrylate, ethyl (meth)acrylate, propyl (meth)acrylate, butyl (meth)acrylate, 2-ethylhexyl (meth)acrylate and styrene;

- (C) a non-yellowing polyisocyanate compound having an isocyanate equivalent of from 0.4 to 1.2 per hydroxyl equivalent of component (B) selected from homopolymers of hexamethylene diisocyanate, homopolymers of isophorone diisocyanate, copolymers of hexamethylene diisocyanate with isophorone diisocyanate, mixtures thereof and blocked isocyanate compounds thereof; the total of (B) and (C) being 70 to 30% by weight based on the total of (A), (B) and (C);
- (D) a photo stabilizer from the group consisting of a hindered amine type antioxidant and a benzotriazole type ultraviolet absorbent; and
- (E) a photopolymerization initiator, said composition providing a cured film having a gloss retention of 90% or more and a color difference  $\Delta E$  of 2 or less when tested with a sunshine weatherometer for an exposure time of 1,000 hours.

7. Process for preparing an ultraviolet-curable coating composition according to claim 1 which comprises uniformly mixing components (A) to (E) of claim 1, wherein component (C) has an isocyanate equivalent of from 0.4 to 1.2 per hydroxyl group equivalent of component (B), in such an amount that in the final product (A) constitutes from 30 to 70% by weight and components (B) and (C) constitute from 70 to 30% by weight of the total amount of (A), (B), and (C)."

V. The Appellant argued essentially as follows:

- (i) The claimed compositions were intended to be applied to vehicle bodies, and provided a cured film having an excellent appearance, high gloss, high colour retention, excellent weather

resistance, good adhesion and high film thickness in one coating, all these features being supported by the examples. On the other hand, the effects afforded by D1 were only high hardness and good adhesion. There was no reference to vehicle bodies (see grounds of appeal, paragraphs 3, 4).

(ii) D2 did not relate to a UV-curable composition at all and in particular did not disclose a component corresponding to (A) of the application in suit (grounds of appeal, paragraph 6).

(iii) As regards the composition of D3, this differed with respect to both component (B) and component (D). Consequently, it was impossible for the compositions of D3 to attain high levels of flexibility, weather resistance and appearance as compared with the compositions of the application in suit. A comparative test in which Examples I and IV of D3 were repeated was provided in support of this contention (see submission of 11 February 1994, parts I and II).

#### **Reasons for the Decision**

1. The appeal is admissible.
2. *Amendments*

Claim 1 finds support in the application as filed, as follows:

- component (A), by Claims 1 and 2;

- component (B), by Claim 1 and page 7, lines 8 to 20;
- component (C), by Claims 1 and 8, and page 8, lines 10 to 19;
- component (D), by Claims 1 and 9;
- component (E), by Claim 1.

Claims 2 and 3 are supported by Claims 3 and 4 respectively, and Claims 4, 5 and 6 by Claims 10, 11 and 12 respectively, of the application as filed. Claim 7 is supported by original Claims 2 and 13.

Apart from an acknowledgment of prior art and minor editorial matters, the description differs from that as filed only in that it has been adapted to the current claims.

Consequently, no objections arise under Article 123(2) EPC.

3. *The closest state of the art; the technical problem*

The application in suit relates to an ultraviolet-curable coating composition which can be coated in large film thickness in one operation and be cured even with insufficient ultraviolet irradiation to form a film excellent in appearance (distinctness of image gloss), adhesion and weathering resistance (page 1, opening paragraph). It may, for instance, be applied to vehicle bodies (page 14, lines 12, 13).

- 3.1 The disclosure of D1 - an Abstract - relied upon as a starting point in the decision under appeal, on the other hand, relates to a composition which, whilst admittedly being photocurable, is stated to be coated on self-supporting sheets, bonded to objects, cured by light, and the sheet peeled off to give a protective coating, e.g. with good adhesion and hardness.

Thus there is no indication of suitability for applications where a glossy appearance is necessary. In particular, there is no mention of coating vehicle bodies. On the contrary, the mode of application, by stripping from a backing sheet after curing of the composition, is more akin to a lamination process and, in the opinion of the Board, most unlikely to result in a mirror-like surface such as is the goal of the claimed compositions.

Consequently, this disclosure is not considered to be a suitable starting point for assessing the subject matter claimed in the application in suit.

- 3.2 The closest state of the art is considered to be represented by D3. According to D3, a substrate was treated with a radiation curable coating composition based on a polyester resin esterified with acrylic acid and/or methacrylic acid; a vinyl compound, and a photoinitiator, the coating composition being dried under the influence of ultraviolet light having a wavelength of 200 to 600 nm. The polyester resin component had a hydroxyl number of 50 to 250, and the composition also contained a polyisocyanate in an amount of 0.7 to 1.3 equivalents, preferably 0.9 to 1.1 equivalents, of isocyanate per equivalent of hydroxyl contained in the composition (cf. Claims 1, 4). Application of the coating composition could be, for instance, by rolling, spraying, flow coating or offset printing (cf. page 6, lines 19 to 24). The coating could be applied to a metal, e.g. as an automobile paint, or as lacquer to wood-like materials (cf. page 6, lines 25 to 30).

According to Example IV, read in conjunction with Table 1, which in the Board's view represents the closest approach to the compositions claimed in the

application in suit, a coating composition was prepared by admixing:

- (A') a polyethylene glycol diacrylate, the glycol having a number average molecular weight of 200;
- (B') a modified polyester prepared by polycondensation of trimethylol propane (0.55 moles), phthalic anhydride (0.46 moles) and palmitic acid (0.08 moles), and esterification of the resulting product with acrylic acid (0.54 moles), to yield a product having a hydroxyl number of 59 and a number average molecular weight of 1068;
- (C') a polyisocyanate which was the adduct of 3 molecules of hexamethylene diisocyanate and 1 molecule of water, and
- (E') a benzildimethylketal as photoinitiator.

The composition was applied in a layer thickness of 60 $\mu$ m on a substrate of tinplate and exposed to the radiation of a UV lamp for 4 sec. After irradiation, the coated substrates were left at a temperature of 20°C for three weeks, or heated for 10 minutes at 160°C.

- 3.3 Compared with this state of the art, the technical problem underlying the application in suit could be seen in the search for an ultraviolet-curable coating composition for vehicle bodies which could be applied in equally large film thickness in one operation to give a cured film of improved appearance in terms of distinctness of image gloss, of improved weather resistance with higher gloss retention and lower colour difference ( $\Delta E$ ), and of improved adhesion.

The solution proposed according to Claim 1 of the application in suit was:

- (i) to replace the hydroxyl-containing modified polyester component (B') of the composition according to D3 by a polyhydric alcohol mono(meth)acrylate polymer as defined under (B) of Claim 1 of the application in suit, and
- (ii) to add a photostabilizer from the group consisting of a hindered amine type antioxidant and a benzotriazole type ultraviolet absorber.

3.4 The results of Examples 1 to 5 in Table 2 of the application in suit were compared with those of the subsequently filed Comparative Example 6 (see submission dated 11 February 1994, pages 5 and 6), in which a coated specimen was prepared and evaluated according to the standards of the Examples of the application in suit, but using as a coating composition one prepared according to Example IV of D3. From these comparisons, it is evident that the distinctness of image gloss, gloss retention, colour difference  $\Delta E$ , weathering resistance (after 1000 hours exposure in a weatherometer) and adhesion to a substrate of the cured film prepared from the composition according to the application in suit was in each case superior to that of D3.

Furthermore, it is evident from a comparison of the results of Examples 1 to 5 with those of Comparative Examples 1, 2 and 3 in the application itself (the first two of the latter of which differed from the claimed subject matter only in the weight ratio of the components  $(A)/(B)+(C)$ , and the third only by the omission of the photostabilizer component (D)), that

these variants each yielded a cured coating which was inferior, in at least one of the above respects, to the compositions conforming to the claimed subject matter.

Thus, evidence of the superiority of the claimed compositions has been provided not only by a comparison with the closest state of the art, but also with variants lying closer in terms of common features to the claimed subject matter than the closest state of the art.

Consequently, the Board accepts that the claimed measures provide an effective solution to the stated problem.

4. *Novelty*

Lack of novelty was not given as a ground of refusal in the decision under appeal.

Indeed, none of the documents cited in the decision under appeal discloses a composition having all the components (A) to (E) defined in Claim 1 of the application in suit.

Consequently, the subject matter of Claim 1 is novel. The subject matter of Claims 2 to 6, which are directly or indirectly dependent on Claim 1 is therefore also novel. Claim 7, furthermore, which is directed to a process of preparing a composition according to Claim 1, is limited to components (A) to (E) of the latter and is therefore also directed to novel subject matter.

In summary, thus, the subject matter claimed in the application in suit is novel.

5. *Inventive step*

In order to determine the issue of inventive step, it is necessary to establish whether the skilled person, starting from a composition according to D3, and in particular a composition according to the relevant Example IV of that document, would have expected that a cured coating having improved distinctness of image gloss, improved weathering resistance with high gloss retention and reduced colour difference and improved adhesion to a substrate would be achieved by making the modifications (i) and (ii) referred to in section 3.3, second paragraph, above.

5.1 There was no suggestion in D3 itself to make the above modifications for any reason, let alone for the purpose of simultaneously improving the various coating qualities mentioned. In particular, there was no hint to add a photostabilizer of the type of component (D). On the contrary, the skilled person would at least be somewhat reluctant to include a photostabilizer in a composition to be cured by UV radiation.

5.2 As for D1, there was no reason for supposing its teaching to be relevant to a solution of the technical problem in the first place (cf. section 3.1, above).

5.3 Notwithstanding the above, the composition disclosed in D1, which was a mixture of 2-ethylhexylacrylate-2-hydroxyethyl methacrylate-methyl methacrylate copolymer (molecular weight 6000), TDI [toluylene diisocyanate], trimethylolpropane urethane, tetraethylene glycol dimethacrylate, benzophenone, and hydroquinone, also did not comprise a photostabilizer of the type of component (D) above.

Consequently, if the skilled person had, in spite of the apparent lack of relevance of D1 to the stated problem, nevertheless attempted a combination of its disclosure with that of D3, the result would not have been something falling within the terms of Claim 1 of the application in suit.

- 5.4 Although D2 referred to "gloss" (cf. page 5, Table 2), it was concerned with coating compositions in which a metallic, e.g. aluminium pigment was incorporated to impart a metallic lustre to the coat. If the fluidity of the coating material was too high, there would be a migration of aluminium particles causing an "uneven colour or gloss" (cf. page 1, lines 21 to 27). Thus the "gloss" was due at least in part to the presence of lustrous pigment particles.

Furthermore, the compositions were for use in a "two-coat, one bake" coating method, i.e. they were not ultraviolet-curable compositions and contained no photocurable component. On the contrary, the compositions preferably contained both an ultraviolet absorber and an antioxidant (cf. Claim 3).

Thus the compositions of D2 differed from those of D3 not only in their essential manner of curing and in at least one of their essential components, but also in a preference for additives which would tend to absorb the ultraviolet radiation necessary for curing in the latter. To this extent, the teachings of D2 and D3 were not only mutually unrelated but indeed also mutually incompatible.

Consequently, there would have been no incentive to apply the teaching of D2 in a composition of D3.

5.5 In a similar manner, there would have been no incentive to apply the teaching of D2 in a composition according to D1, since the differences between the compositions of D2 and D1 respectively were analogous to those between D2 and D3.

Consequently, the approach based on a combination of D2 and D1 adopted in the decision under appeal would not have led the Board to a different result.

In summary, the solution of the technical problem did not arise in an obvious way from the state of the art. Hence, the subject matter of Claim 1 and its dependent Claims 2 to 6 is based on an inventive step. For the same reasons, mutatis mutandis, the subject matter of independent Claim 7 also involves an inventive step (cf. section 4, above).

**Order**

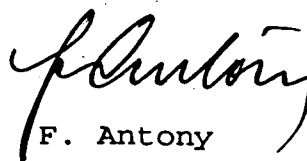
**For these reasons, it is decided that:**

1. The decision of the Examining Division is set aside.
2. The case is remitted to the Examining Division with the order to grant a patent on the basis of the documents set out in section III. above.

The Registrar:

The Chairman:

  
E. Gorgmaier

  
F. Antony