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(54) Title: COATING COMPOSITION CAPABLE OF ABSORBING UV RADIATION

(57) Abstract: The invention is concerned with a composition for coating a substrate such as glass to provide a UV protective coating. The composition includes a major portion of a base carrier material and a minor portion of an inorganic oxide material selected from the group consisting of zinc oxide, cerium oxide and titanium dioxide. The minor portion of inorganic oxide material is dispersed in the major portion of the base carrier material as a particulate dispersion to thereby create a coating capable of absorbing UV light and transmitting visible light. In particular the invention takes advantage of the fact that some UV adsorbing inorganic oxides can be milled to a sub micron particle size at which point they become transparent/translucent in dispersion. A transparent UV coating can therefore be made.

COATING COMPOSITION CAPABLE OF ABSORBING UV RADIATION

FIELD OF THE INVENTION

The present invention relates to a surface coating producing enhanced ultra violet light protective capacities. The coating of the invention finds use, inter alia, in the food and beverage industries in coating containers whose contents are sensitive to degradation
5 resulting from exposure to ultra violet (UV) light.

BACKGROUND OF THE INVENTION

Ultra violet light is well known for its capacity to cause degradation to a number of materials both natural and man-made. The present invention is concerned with the effect of
10 ultra violet light of certain frequencies on foodstuffs. Beer, in particular is known to be sensitive to the effects of UV light.

Exposure of beer to UV light results in off odours known variously as light strike or skunky flavours; this last term referring to the resemblance of the off odours/flavour to the odour of the North American skunk.

15 The compounds present in the beer responsible for the off odours and flavours have been identified as mercaptans notably, 3-methyl-2-butene-1-thiol, (MBT). These compounds are detectable at extremely low concentrations, and will adversely affect the quality of a beer product at levels in the part per billion ranges. MBT is produced as a result of the effect of
20 light on various iso-alpha acids present in the beer. In turn the iso-alpha acids owe their presence to the hops from which the beer is brewed. Iso-alpha acids are obtained during the boiling and fermenting of hops. A specific reaction mechanism for the production of MBT from iso-alpha acids has been proposed which involves the production of dehydrohumulinic acid from trans-isohumulone together with a precursor of MBT.

The wavelengths of light responsible for the development of light struck flavour lie
25 generally in the region 350-500nm. To prevent the formation of the undesirable MBT compounds it is common practice to deliver beer in containers impervious to UV light. Such containers include metal cans and dark brown glass bottles. This need to use opaque containers has limited the opportunities available to those concerned with the marketing of beer products.

It has been found possible to replace the whole of the hop in beer production with hop products to circumvent the production of iso-alpha acids during boiling. These treatments however are not entirely satisfactory as the iso-alpha acids are responsible for much of the characteristic bitter flavour of the beer. Accordingly, although beer produced in this way is easier to store the product is less desirable to drinkers. The process results in a beer product having a very narrow flavour range, which is considered a less attractive product by many drinkers.

Similarly, some wines are sensitive to the effects of UV degradation. White wines in particular are known to be sensitive to be adversely affected by UV. In this case the degradation is identified by a change in the aroma and palate of the wine. Thus, longer-term storage of many white wines is precluded because of the sensitivity of the complex compounds in the wine to UV.

One of the methods used to reduce UV radiation exposure in foodstuffs stored in glass is the use of green glass incorporating metal oxides; specifically, chromium and nickel compounds are used. As will be readily appreciated the use of either chromium or nickel compounds in foodstuff storage containers is undesirable both from a cost and an environmental point of view.

International Patent Application No WO 96/15074 to Heineken Technical Services B.V. (granted in the US as patent No 5912199) has developed further the technique of modification of the glass by using a formula incorporating significant quantities of iron into soda-lime glass to create a green coloured soda lime glass to produce a green glass product that absorbs UV radiation whilst transmitting visible radiation. The glass contains no less than 2.5wt % iron calculated as Fe_2O_3 , no less than 12wt. % sodium calculated as Na_2O and no more than 4wt.% aluminium, calculated as Al_2O_3 . The glass product has significant UV absorbing abilities in the range 380-400nm.

However, tests conducted by the applicants on commercially available green glass beer products indicate that the formulation described in the patent does not appear to be in commercial use. Figure 1 illustrates the absorbance and transmission spectra measured over the relevant range for a number of current glass beer containers as sold in Australia. Significantly, with the exception of the well-known amber glass product all of the products have transmission of >60% in the critical wavelength regions 380-400nm.

The present invention proposes a coating to be applied to a surface that enhances the UV absorbance of the coated surface without a concomitant requirement for the surface to be darkly coloured.

SUMMARY OF THE INVENTION

5 Therefore, according to a first aspect of the present invention, although this need not be the broadest nor indeed the only aspect of the invention there is provided a composition for coating a substrate said composition including:

-a major portion of a base carrier material; and

10 -a minor portion of an inorganic oxide material selected from the group consisting of zinc oxide, cerium oxide and titanium dioxide; and

wherein the minor portion of inorganic oxide material is dispersed in the major portion of the base carrier material as a particulate dispersion to thereby create a coating capable of absorbing UV light and transmitting visible light.

15 Preferably, the minor portion of the inorganic oxide material is dispersed as a dispersion of ultra fine particles in the polymer base. For example, a dispersion of ultra fine zinc oxide particles produces a coating having a wide band absorbance band in the UV range.

In the context of the present application a dispersion of ultra fine particles are particles of a sub micron size. At an appropriate particle size the inorganic oxide particles become substantially translucent. Typically, milling can produce particles of this size. The
20 technology requires the production of ultra fine particles as described in international patent application no WO 97/17406. Essentially, a process that includes comminuting the oxide in the presence of a liquid, the liquid being constituted by or including a component having available hydrogen and/or oxygen ions, produces ultra-fine particles of the oxide. The liquid may be an alcohol ester, a hydrogenated ester or a polymer containing hydroxyl
25 or hydrogen group(s).

The process results in a stable dispersion that does not aggregate or agglomerate. More usefully for the present invention the milling process results in a particulate material, which has a clear transparent appearance. This clear characteristic is carried through to the coating used in the present invention. Thus the coating of the invention has UV

absorbance properties whilst being of a clear colourless appearance- an attractive commercial proposition.

Preferably, the inorganic oxide is milled in any one of capric caprylic triglyceride, methyl ethyl ketone (MEK), ethyl ethoxy propionate (EEP), or propylene glycol methyl ether acetate (PGMA).

Preferably the major portion of the base carrier material is in the range 90-99 wt.% of the composition and the minor portion of an inorganic oxide material is present in the range 1-10 wt.%.

The composition of the invention may, in addition to the components outlined above include a number of further additives. For example, the addition of iron oxide (Fe_2O_3) increases the absorbance of the coating around the 390nm mark into the red end of the visible spectrum. In some cases this type of coating may be preferred by end users for aesthetic or other reasons. The composition may include up to 2 wt.% of iron oxide.

Optical brighteners have the advantage of absorbing light from the UV region and re-emitting the light in the visible region. The addition of such materials to the composition has the effect of enhancing the UV protective features of the composition.

A suitable optical brightener might be diethylamino-4-methyl coumarin (DEMAC). More preferably still the optical brightener would be commercially available UV brighteners such as those sold under the name Uvitex OB as supplied by *Ciba Geigy*. The composition may include up to 2 wt.% of optical brighteners in the formulation. Uvitex OB is a particularly preferred optical brightener.

The composition of the invention may additionally include dispersants to encourage an even distribution of the inorganic material within the polymer base.

Preferably, the base carrier material is a polyurethane polymer material. Such materials can be used to provide a thin film coating on glass. A coating suitable to achieve the aims of the invention would be laid down as a wet film of up to approximately $60\mu\text{m}$ thickness that corresponds to a dry thickness of up to approximately $30\mu\text{m}$ thickness. Alternative carrier materials include polyethylene and long chain fatty acids such as oleic or stearic acids.

It will be appreciated that using an increasing loading of inorganic oxide material and optical brightener can reduce the coating thickness. Similarly, in a thicker coating the loading of inorganic oxide material and optical brightener may be reduced.

5 In one form of the invention the coating is applied as a cold end coating in the manufacture of glass bottles, with a coating thickness of perhaps as little as 0.1 μ m. The application of the coating of the present invention can therefore be incorporated into the glass manufacturing process. In such a way a glass manufacturer is able to incorporate the composition of the invention into the product with minimal interruption of the glass manufacturing process. Thus, the cost of creating the coating on the product can be
10 minimised.

In one preferred embodiment the invention is constituted by a vitreous surface coating of 15-25 μ m thickness containing 5% ZnO and approximately 0.1% Uvitex which has been found to block 85% of the light at 400nm, and in a second preferred embodiment a vitreous surface coating of 15-25 μ m thickness containing 5% ZnO and approximately 0.5% Uvitex
15 which has been found to block 94% of the light at 400nm

In a further aspect the present invention provides a process for creating a coating capable of absorbing UV light and transmitting visible light on a surface said process including the steps of milling an inorganic oxide material selected from the group consisting of zinc oxide, cerium oxide and titanium dioxide and adding this to a base carrier material to form
20 a dispersion containing a minor portion of the inorganic oxide a major portion of the base material together with a minor portion of an optical brightener.

In a particularly preferred form of the invention the inorganic oxide base is milled as a paste in a liquid, the liquid being constituted by or including a component having available hydrogen and/or oxygen ions. The liquid may be an alcohol ester, a hydrogenated ester or
25 a polymer containing hydroxyl or hydrogen group(s). The process results in a stable dispersion of the inorganic oxide that does not aggregate or agglomerate.

Preferably, the inorganic oxide is milled in any one of capric caprylic triglyceride, methyl ethyl ketone (MEK), ethyl ethoxy proprionate (EEP), or propylene glycol methyl ether acetate (PGMA).

30 The composition of the invention therefore represents a UV absorbing coating that is adapted for use on a number of substrates and in a wide range of situations. The

composition is thought to be particularly useful as a coating to be applied to food and beverage containers.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described with reference to a number of preferred
5 embodiments thereof and with reference to the accompanying figures in which:

Figure 1 indicates the UV absorbance of commercially used glass beer bottles,

Figure 2 illustrates the UV absorbance of a composition containing BM5050 and various loadings of ZnO milled in PGMA,

10 Figures 3a, 3b and 3c represent the UV absorbance of a composition containing BM5050 and various loadings of ZnO milled in PGMA together with various loadings of optical brightener.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The UV absorbance of a number of compositions was tested. Attention as paid to the UV absorbance of the thin coating films of various compositions in the critical UV-A (290-
15 320nm) and UV-B (320-400nm) wavelengths. For purposes of comparison the absorbance of the compositions can be tested against those for commercially available glass products used for beer shown in Figure 1.

1. Zinc Oxide Formulations

20 Zinc Oxide was milled to an ultra fine state in a paste of propylene glycol methyl ether acetate (PGMA) together with a dispersant (Solsperse 20000). The milled product was dispersed into a moisture curing polyurethane resin BM5050 at loadings of 2, 4 and 5 % and laid down as 40µm wet films on microscope slides. Glass microscope slides were used instead of more typical quartz slides as the glass more accurately represents the glass typically used in beer production and has a similar UV absorbance profile.

25 UV absorbance was tested across the range 190nm –800nm covering the UV and visible spectra. Absorbance spectra for the resulting coating are shown in Figure 2.

Good absorbance was observed for all films in the UV region, with even the lowest loading of zinc oxide UV, i.e. 2 wt. % giving an absorbance of 1, corresponding to 90 % light absorbance.

5 An optical brightener (Uvitex manufactured by *Ciba Geigy*) was also milled in PGMA, Solsperse 20000 and a dispersant Desmophen 1652 (source: *Bayer*), and added to ZnO/BM5050 mixtures at loadings of 0.5, 1 and 2%. Results of these tests are shown in Figure 3. All samples display good absorbance in the visible range above 400nm and particularly in the region 420nm –430nm.

10 The tests described above include the combining of two separately milled dispersions into the BM5050 polyurethane resin. It is also possible for the optical brightener and the inorganic oxide to be co-milled in the same dispersion with the PGMA and a dispersant.

Mixtures of BM5050 and the co-dispersion were prepared according to the following formulations:

4wt % ZnO + 0.08wt% Uvitex

15 5wt % ZnO + 0.09wt% Uvitex

Plaques prepared with the co-dispersed additives were significantly whiter than blank BM5050, and also whiter than those produced with separate dispersions of additives. This effect is illustrated in haze measurements shown below in table 1. The increased whiteness is also responsible for the apparent increase in absorbance noted in these 20 formulations. This increase is, however, due to a larger degree of light scattering i.e. the whiteness.

Sample	% Haze	% Haze increase
BM5050	10.6	-
BM5050 + 4% ZnO & 0.08 Uvitex, separate dispersions	10.2	-
BM5050 + 4% ZnO & 0.08 Uvitex; co-dispersion	20.8	10.2
BM5050 + 5% ZnO & 0.09 Uvitex; separate dispersions	10.0	-
BM5050 + 5% ZnO & 0.09 Uvitex; co-dispersion	20.4	9.8

Table 1 Haze measurements comparing films of BM5050 prepared using co-dispersed and separate dispersions of ZnO and Uvitex.

2. Taste/Sensory Tests

A sensory assessment of white wine samples contained in coated and uncoated bottles after being subjected to ultraviolet radiation. The coating formulation used included 5% ZnO sub micron particles prepared as indicated previously. Dispersed in a polyurethane resin.

Background

Twenty-four bottles of white wine were submitted for testing to the Australian Wine Research Institute. A description of the samples submitted, and the reference code assigned to each sample on receipt at the Institute, are presented in Appendix 1.

All bottles were indicated by "standard ACI 15590 Flint Punted Claret" bottles, however, twelve of the bottles had been coated with UV Protective Coating, which absorbs a minimum of 90% of ultraviolet (UV) radiation with wavelengths up to 400nm. The bottles were rinsed with a 4% sodium metabisulfite solution and filled on Monday the 14th of May 2001 with Yalumba Unwooded Chardonnay wine. The bottles were then immediately packaged into cartons. The bottles were accepted for testing by the Institute in good faith, as no Institute staff were present when the wine was bottled.

Sensory assessments were conducted on the wine after the bottles had been subjected to UV radiation, in order to determine if there might be differences between the wine contained in the bottles coated with UV Protective Coating and the wine contained in the bottles without the coating, after exposure to the radiation.

Experimental

The 24 bottles of wine were layed down in a single layer in a 'staggered' fashion (a 'coated' bottle followed by an 'uncoated' bottle etc.) in a cupboard, approximately 50 cm from a UVA light source (emitting radiation of wavelength approximately 360nm) continually for 21 days.

The sensory assessments were performed using triangular difference tests to establish whether significant differences existed between the wine contained in the bottles coated with the UV Protective Coating ('coated') and the wine contained in the bottles without the coating ('uncoated'). The tables given by Jellinek were used to establish the level of significance from the number of correct judgements. Jellinek, G. Sensory evaluation of

food: etc see top of next page. A panel comprising twenty Institute Staff members with experience in the sensory assessment of wines using triangular difference testing was used for the assessment. Panellists were asked to describe the any differences observed. Four comparisons were made, using a 'coated' and 'uncoated' bottle for each, to give a
5 total of twenty sets of data for each comparison.

Results

The results of the sensory trials are summarised in Table 1. A minimum of seventeen
10 correct responses from the twenty assessments performed on each of the four different comparisons was obtained, where tasters were correctly able to distinguish between the bottles being compared. This indicates that the difference between any of the two bottles, which were compared with one another, was statistically significant.

15 The bottles used in each comparison were statistically significantly different, to within a level of error of 0.1% in other words, the probability of obtaining such an outcome by chance alone is less than 1 in 1000.

Inspection of the comments section of the tasting sheets revealed that the tasters used
20 terms including, "reduced sulphur", "smoky", "burnt rubber", "sulphide-like", "bacon", "burnt match", "gunsmoke", and "plastic-like" to describe the character(s) present in the wine from the 'uncoated' bottles. These terms are consistent with the terms commonly used by tasters to describe reduced sulphur compounds in wine. In contrast, tasters described the wine from the 'coated' bottles as having "more fruit", "more fruit intensity", "more floral fruit"
25 and as being "more fresh" and "more estery".

Conclusion

The results indicated that after 21 days of being subjected to UVB radiation, there were
30 statistically significant differences between the wine stored in the bottles coated with the UV Protective Coating, and the wine stored in the bottles without the coating.

The tasters generally considered the wine from the bottles coated with the UV Protective Coating to be more fresh and to exhibit more fruit intensity than the wine from the uncoated
35 bottles. The terms used by the tasters to describe the wine from the bottles without the UV Protective Coating were consistent with the terms commonly used by tasters to describe reduced sulphur compounds in wine.

Table 2. Results of sensory assessment - Results obtained for following comparison³:

Taster	PEB24D VS PEB24T	PEB24D VS PEB24N	PEB24J VS PEB24P	PEB24M VS PEB24S
1	Y	Y	Y	Y
2	Y	Y	Y	N
3	Y	Y	Y	Y
4	Y	Y	N	Y
5	N	Y	Y	Y
6	Y	N	Y	Y
7	Y	Y	Y	Y
8	Y	Y	Y	Y
9	Y	N	Y	Y
10	Y	Y	Y	Y
11	Y	Y	Y	Y
12	Y	Y	Y	Y
13	Y	Y	Y	Y
14	Y	Y	Y	N
15	Y	Y	N	Y
16	Y	Y	Y	Y
17	Y	N	Y	Y
18	Y	Y	Y	Y
19	Y	Y	Y	Y
20	Y	Y	Y	Y
Total no. of corrected responses (from 20 assessments)	19	17	18	18
Significance³	***	***	***	***

Notes:

- 5 1. The tasters were presented with 10 of wines consisting of 2 'uncoated' samples and 1 'coated' sample for each comparison, and 10 of wines consisting of 2 'coated' samples and 1 'uncoated' sample for each comparison.
2. Y and N indicates whether the taster was able to distinguish between the samples. Y = Yes and N = No
- 10 3. *** = significant at $P < 0.001$, according to the tables given by Jellinek (1985).

Appendix 1. Description of the samples and Institute reference number assigned to each

Sample description	Reference
1x750ml Chardonnay bottle no. 1 (standard ACI 15590 Flint Claret bottle)	PEB24B
1x750ml Chardonnay bottle no. 2 (standard ACI 15590 Flint Claret bottle)	PEB24C
1x750ml Chardonnay bottle no. 3 (standard ACI 15590 Flint Claret bottle)	PEB24D
1x750ml Chardonnay bottle no. 4 (standard ACI 15590 Flint Claret bottle)	PEB24E

Sample description	Reference
1x750ml Chardonnay bottle no. 5 (standard ACI 15590 Flint Claret bottle)	PEB24F
1x750ml Chardonnay bottle no. 6 (standard ACI 15590 Flint Claret bottle)	PEB24G
1x750ml Chardonnay bottle no. 7 (standard ACI 15590 Flint Claret bottle)	PEB24H
1x750ml Chardonnay bottle no. 8 (standard ACI 15590 Flint Claret bottle)	PEB24I
1x750ml Chardonnay bottle no. 9 (standard ACI 15590 Flint Claret bottle)	PEB24J
1x750ml Chardonnay bottle no. 10 (standard ACI 15590 Flint Claret bottle)	PEB24K
1x750ml Chardonnay bottle no. 11 (standard ACI 15590 Flint Claret bottle)	PEB24L
1x750ml Chardonnay bottle no. 12 (standard ACI 15590 Flint Claret bottle)	PEB24M
1x750ml Chardonnay bottle no. 13 (Coated with Bottle Magic UV Protective Coating)	PEB24N
1x750ml Chardonnay bottle no. 14 (Coated with Bottle Magic UV Protective Coating)	PEB24O
1x750ml Chardonnay bottle no. 15 (Coated with Bottle Magic UV Protective Coating)	PEB24P
1x750ml Chardonnay bottle no. 16 (Coated with Bottle Magic UV Protective Coating)	PEB24Q
1x750ml Chardonnay bottle no. 17 (Coated with Bottle Magic UV Protective Coating)	PEB24R
1x750ml Chardonnay bottle no. 18 (Coated with Bottle Magic UV Protective Coating)	PEB24S
1x750ml Chardonnay bottle no. 19 (Coated with Bottle Magic UV Protective Coating)	PEB24T
1x750ml Chardonnay bottle no. 20 (Coated with Bottle Magic UV Protective Coating)	PEB24U
1x750ml Chardonnay bottle no. 21 (Coated with Bottle Magic UV Protective Coating)	PEB24V
1x750ml Chardonnay bottle no. 22 (Coated with Bottle Magic UV Protective Coating)	PEB24W
1x750ml Chardonnay bottle no. 23 (Coated with Bottle Magic UV Protective Coating)	PEB24X
1x750ml Chardonnay bottle no. 24 (Coated with Bottle Magic UV Protective Coating)	PEB24Y

The invention has been described by way of example only and that the examples given represent the optimal compositions of the invention known to the applicant at this time. It is to be realised that there are many formulations would in fact fall within the scope of the invention and the applicant claims rights in these formulations also. It should also be noted
5 that the selection of any particular composition is dependant on the substrate material and also on the intended end use of the product.

Modifications and variations of the present invention such as would be apparent to a skilled addressee are deemed to be within the scope of the invention.

CLAIMS

1. A composition for coating a substrate, characterized in that said composition includes:
 - a major portion of a base carrier material; and
 - 5 -a minor portion of an inorganic oxide material selected from the group consisting of zinc oxide, cerium oxide and titanium dioxide; andwherein the minor portion of inorganic oxide material is dispersed in the major portion of the base carrier material as a particulate dispersion to thereby create a coating capable of absorbing UV light and transmitting visible light.
- 10 2. A composition according to claim 1, wherein one minor portion of an inorganic oxide material is present in the range 1-50 wt.%.
3. A composition according to claim 1, characterized in that the minor portion of the inorganic oxide material consists of a dispersion of ultra fine particles in the polymer base.
- 15 4. A composition according to claim 1, characterized in that the minor portion of the inorganic oxide material, consists of a dispersion of ultra fine zinc oxide particles that thereby produces a coating having a wide band absorbance band in the UV range.
- 20 5. A composition according to claim 1, characterized in that the minor portion of the inorganic oxide material, consists of a dispersion of ultra fine particles of a sub micron size.
6. A composition according to claim 1, characterized in that the minor portion of the inorganic oxide an appropriate particle size the inorganic oxide particles are substantially translucent.
- 25 7. A composition according to claim 1, characterized in that the minor portion of the inorganic oxide material, consists of a dispersion of ultra fine particles of a sub micron size produced by a process that includes comminuting the oxide in the presence of a liquid, the liquid being constituted by or including a component having available hydrogen and/or oxygen ions.

8. A composition according to claim 7, characterized in that the liquid is an alcohol ester, a hydrogenated ester or a polymer containing hydroxyl or hydrogen group(s).
- 5 9. A composition according to 7 or 8, characterized in that, the minor portion of the inorganic oxide is milled in any one of capric caprylic triglyceride, methyl ethyl ketone (MEK), ethyl ethoxy proprionate (EEP), or propylene glycol methyl ether acetate (PGMA).
- 10 10. A composition according to claim 1, characterized in that the composition includes further additives.
- 10 11. A composition according to claim 10, characterized in that the composition additionally includes up to 2 wt.% of iron oxide.
- 15 12. A composition according to claim 10, characterized in that the composition further includes optical brighteners that absorb light from the UV region and re-emit the light in the visible region thereby enhancing the UV protective features of the composition.
13. A composition according to claim 12 characterized in that the optical brightener is diethylamino-4-methyl coumarin (DEMAC).
14. A composition according to claim 12 or 13 characterized in that the composition includes up to 2 wt.% of optical brighteners in the formulation.
- 20 15. A composition according to claim 1, characterized in that the composition additionally includes dispersants to encourage an even distribution of the inorganic oxide within the polymer base.
- 25 16. A composition according to claim 1, characterized in that the base carrier material is selected from a polyurethane polymer material, polyethylene and long chain fatty acids.
17. A composition according to claim 1, characterized in that it contains 50-60 wt% polyethylene as base carrier material and 50-40 wt% zinc oxide as inorganic oxide.

18. A composition according to claim 1, characterized in that the composition includes 90-99 wt% polyurethane resin as base carrier and 1-10 wt% zinc oxide as inorganic acid.
- 5 19. A composition according to claim 16, characterized in that the composition is laid down as a wet film of up to 60 μ m thickness corresponding to a dry thickness of up to 30 μ m thickness.
20. A composition according to claim 1, characterized in that the composition is applied as a cold end coating in the manufacture of glass bottles, with a coating thickness of perhaps as little as 0.1 μ m
- 10 21. A process for creating a coating capable of absorbing UV light and transmitting visible light on a surface said process including the steps of milling an inorganic oxide material selected from the group consisting of zinc oxide, cerium oxide and titanium dioxide and adding this to a base carrier material to form a dispersion containing a minor portion of the inorganic oxide a major portion of the base material together with a minor portion of an optical brightener.
- 15 22. A process according to claim 21, characterized in that the inorganic oxide is milled as a paste in a liquid, the liquid being constituted by or including a component having available hydrogen and/or oxygen ions.
- 20 23. A process according to claim 22, characterized in that the liquid is be an alcohol ester, a hydrogenated ester or a polymer containing hydroxyl or hydrogen group(s).
24. A process according to claim 23, characterized in that, the inorganic oxide is milled in any one of capric caprylic triglyceride, methyl ethyl ketone (MEK), ethyl ethoxy propionate (EEP), or propylene glycol methyl ether acetate (PGMA).

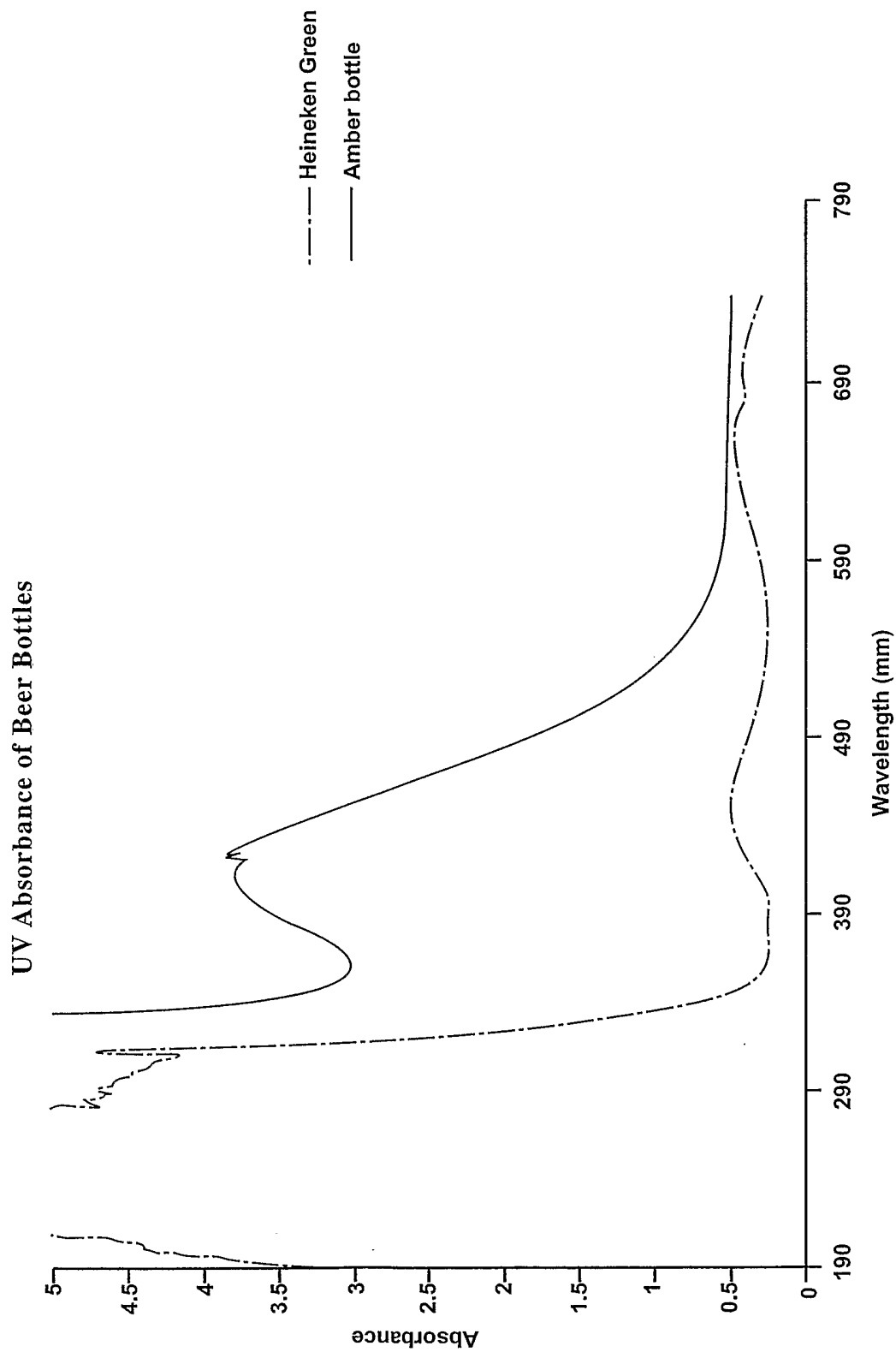


FIG 1a

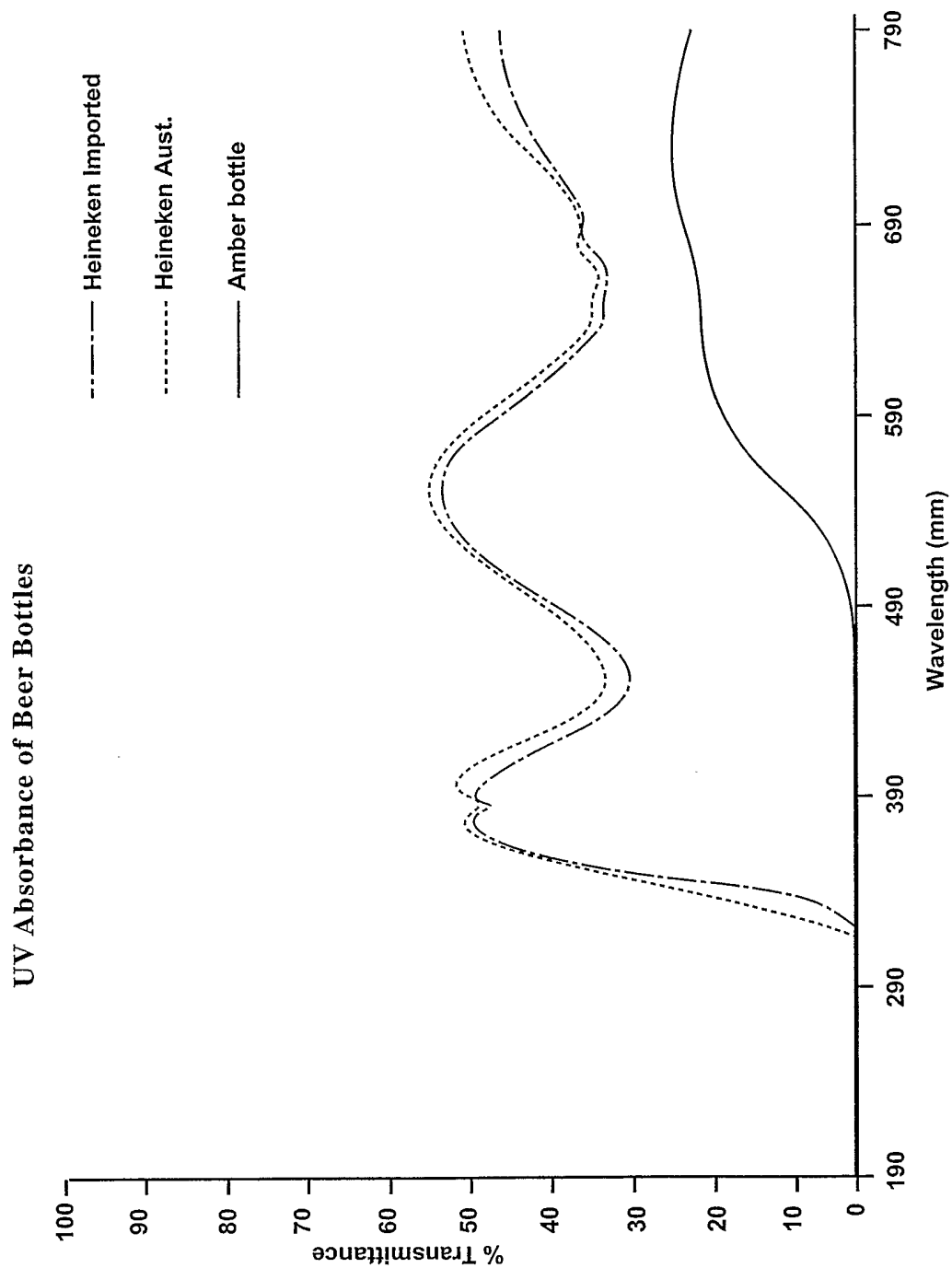
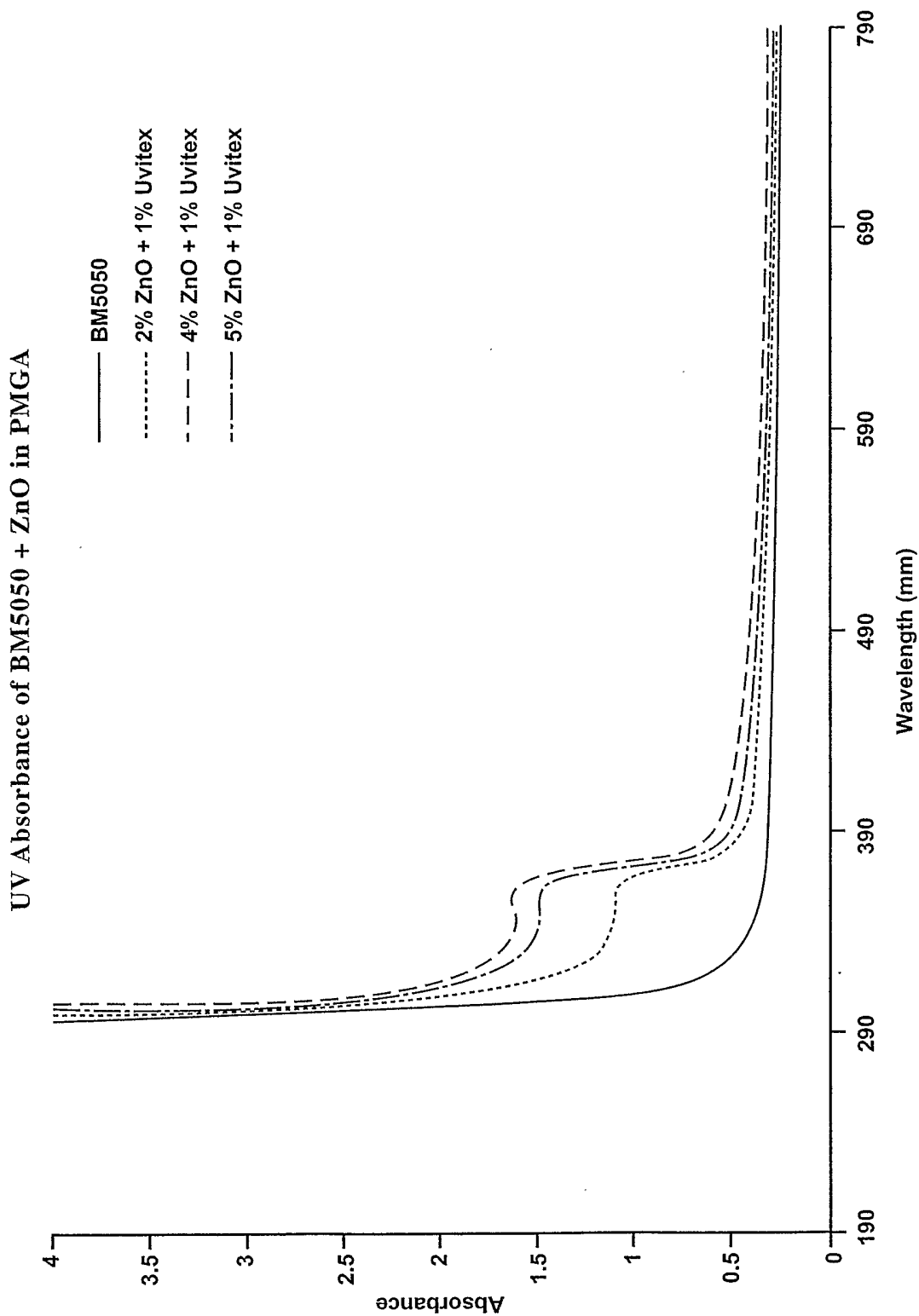


FIG 1b



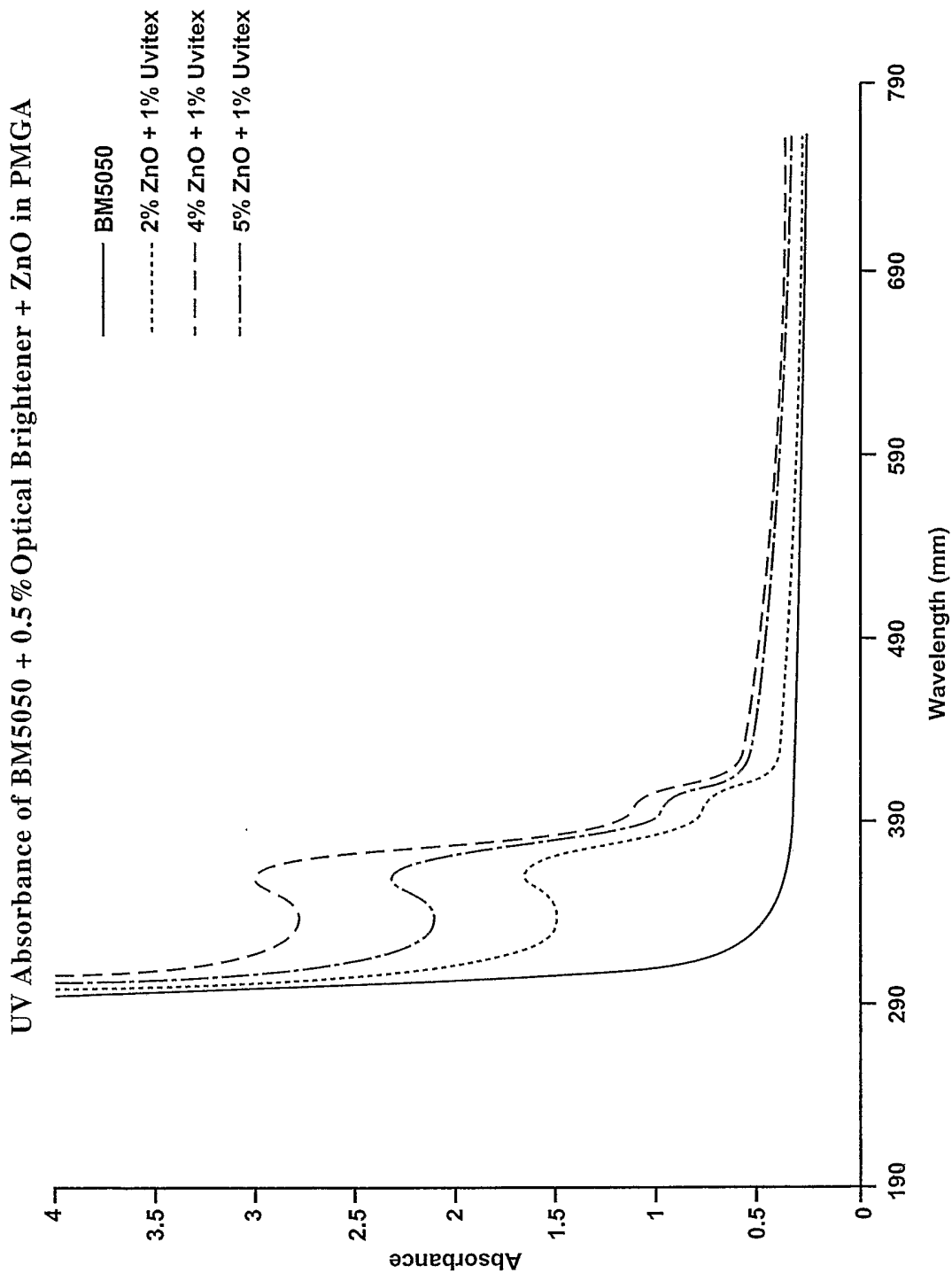


FIG 3a

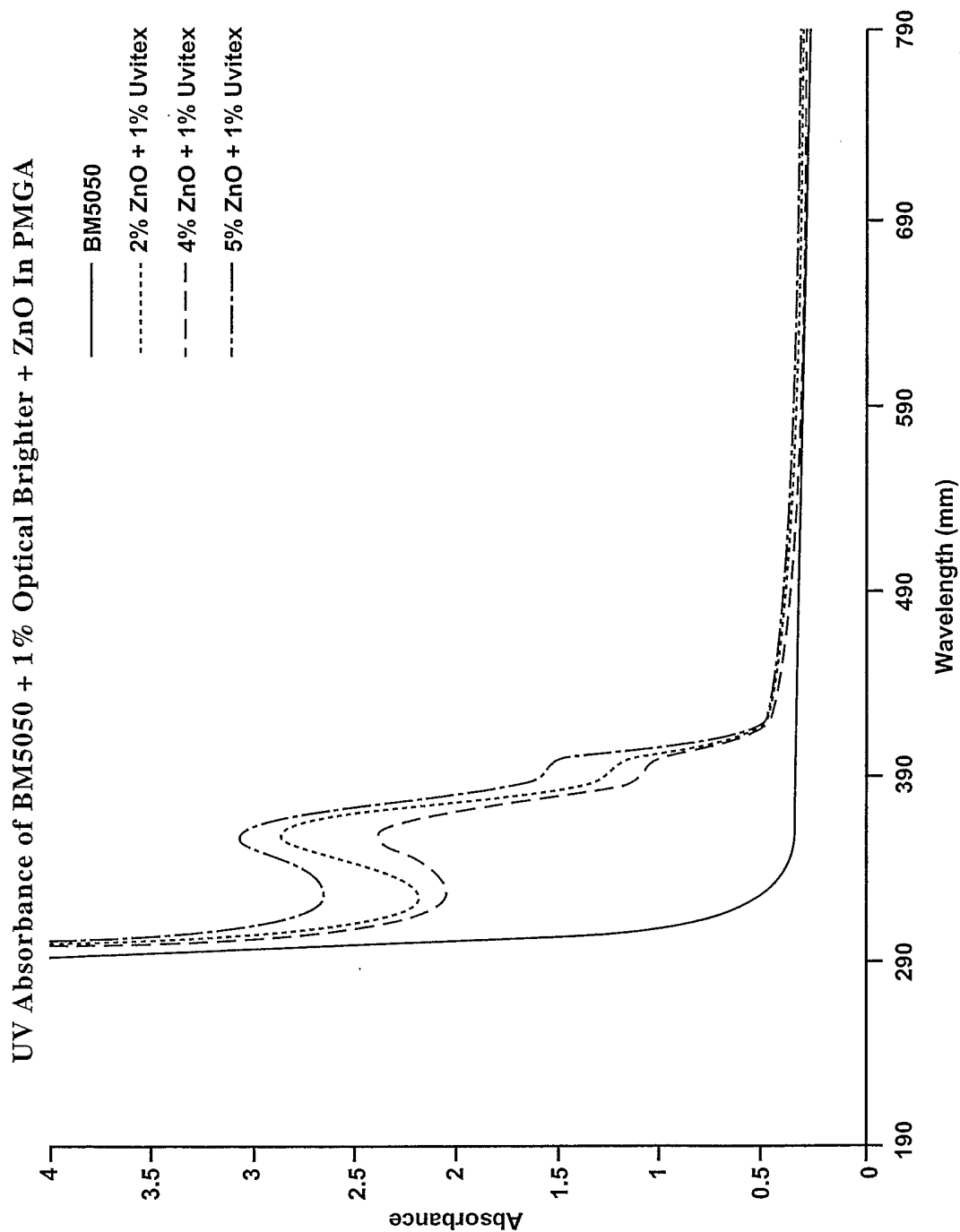


FIG 3b

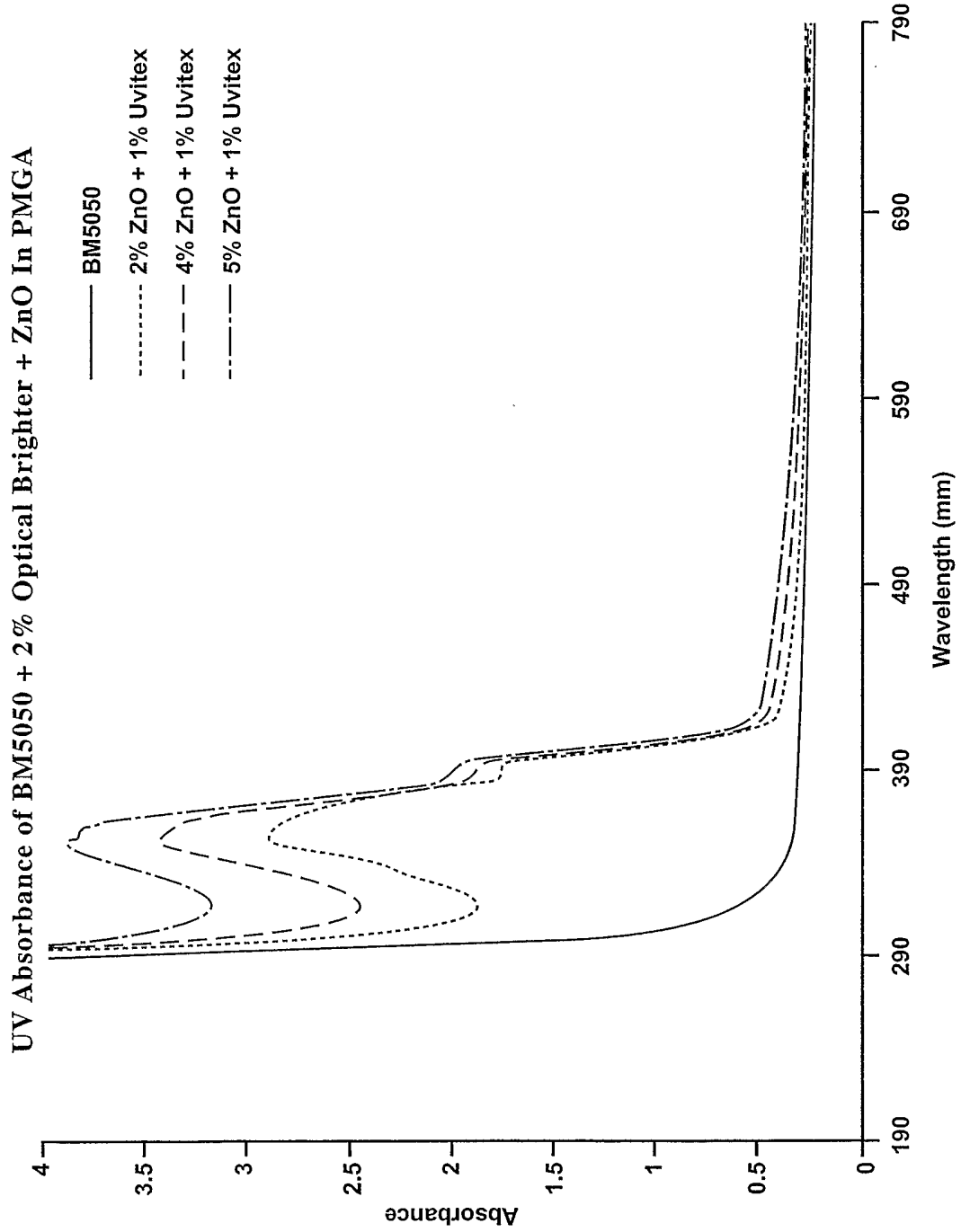


FIG 3c

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU01/01050**A. CLASSIFICATION OF SUBJECT MATTER**Int. Cl. ⁷: C09D 5/32, 175/04, C03C 17/23, 17/32

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: AS ABOVE

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPAT & JAPIO (Search terms: polyurethane, ZnO, CeO, TiO₂)**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	US 6214416 A (SAKAGAMI et al.) 10 April 2001 See column 6 lines 3-33 and Examples 4-6	1-24
P,X	US 6200680 A (TAKEDA et al.) 13 March 2001 See column 68 line 22 to col 70 line 31 and Examples 8,9, 19-21	1-24
P,X	US 6187438 A (CHOPIN et al.) 13 February 2001 See Example 5 and claim 18	1-24

 Further documents are listed in the continuation of Box C See patent family annex

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

19 September 2001

Date of mailing of the international search report

24 SEPTEMBER 2001

Name and mailing address of the ISA/AU

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INTERNATIONAL SEARCH REPORT

International application No.

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Derwent Abstract Accession No. 92-320225/39, Class A82, G02, L01, JP 04224865 A, 14 August 1992 See abstract	1-24
A	US 5401573 A (BABEL et al.) 28 March 1995 See whole document	1

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU01/01050

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	6214416	EP	931820	JP	11209695		
US	6200680	WO	9533688	EP	768277	EP	893409
		JP	8060022	JP	7328421		
US	6187438	WO	9801392	AU	35474/97	BR	9710247
		EP	910549	CA	2259281	FR	2753980
JP	4224865	NONE					
US	5401573	NONE					
END OF ANNEX							