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File Number: T 525/90 - 3.3.2
Application No.: 82 305 580.1
Publication No.: 0 078 632
Title of invention: Titanium dioxide pigments and their preparation

Classification: C09C 1/36

D E C I S I O N
of 17 June 1992

Applicant: TIOXIDE GROUP PLC
Opponent: 01) KRONOS TITAN-GmbH, Leverkusen
Wissenschaftliche Abteilung -Patentgruppe-
02) BAYER AG; Leverkusen

Headword: Pigments/TIOXIDE

EPC Articles 54 and 56

Keyword: "Prior art process not inevitably leading to the claimed product
- absence of convincing evidence - no reversal of the burden of
proof"
"Inventive step (no) - obvious to try in view of the disclosed
improvement"



Case Number : T 525/90 - 3.3.2

D E C I S I O N
of the Technical Board of Appeal 3.3.2
of 17 June 1992

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Decision under appeal :

Decision of Opposition Division of the European
Patent Office dated 4 December 1989, posted on
10 May 1990 rejecting the opposition filed
against European patent No. 0 078 632 pursuant to
Article 102(2) EPC.

Composition of the Board :

Chairman : A.J. Nuss
Members : M.M. Eberhard
E.M.C. Holtz

Summary of Facts and Submissions

- I. European patent No. 0 078 632 based on application No. 82 305 580.1 was granted on the basis of eight claims.

Claim 1 reads as follows:

"A chemically treated titanium dioxide pigment comprising a core of particulate pigmentary rutile titanium dioxide having thereon:

an inner coating of an oxide or hydrous oxide of zirconium in an amount of up to 5% by weight expressed as ZrO_2 on weight of TiO_2 ;

an intermediate coating of dense amorphous silica in an amount of up to 12% by weight expressed as SiO_2 on weight of TiO_2 carried on the inner coating; and

an outer coating of a hydrous oxide of aluminium in an amount of up to 6% by weight expressed as Al_2O_3 on the weight of TiO_2 carried on the intermediate coating."

Independent Claim 5 relates to a process for the manufacture of a TiO_2 -pigment as defined in Claim 1.

- II. Two notices of opposition were filed against the granted patent. The Appellant (Opponent II) requested revocation of the patent on the grounds of lack of novelty and lack of inventive step. During the opposition proceeding the Opponents relied, inter alia, upon the following documents in support of these grounds:

- (3) DE-A-15 92 951
- (4) DE-A-27 40 561
- (5) US-A-2 885 366
- (6) DE-A-22 23 524
- (11a) EP-A-0 008 101
- (13) DE-A-26 22 902.

III. The Opposition Division rejected the oppositions. In the decision novelty of the claimed coated pigment was acknowledged with respect to the product of (11a), i.e. EP-A-0 008 101, which was regarded as the closest prior art. The problem to be solved was seen in providing TiO₂-pigments with improved durability or resistance to weathering when used in a paint. The Opposition Division considered that there was no reason for the skilled man to combine the teaching of any of the documents concerned with the precipitation of usual amorphous silica, for example (11a) and (6), with the teaching of documents relating to the precipitation of dense amorphous silica on TiO₂-pigments (a.o. (3), (4), (5) and (13)) since the latter documents unambiguously taught that the dense silica had to be precipitated directly onto the TiO₂-pigment particles. As the replacement of the intermediate layer of silica by a layer of dense amorphous silica in the pigments of (11a) would have been in contradiction with the teaching of (3), (4), (5) or (13) no improvement of durability could be expected.

IV. The Appellant lodged an appeal against this decision. Oral proceedings were held on 17 June 1992.

Throughout the appeal proceedings the Appellant has contended that Claim 1 of the main request lacked clarity because the term "dense silica" was unclear and did not make it possible to distinguish the claimed pigment from the known ones. In view of this unclear term the requirement of industrial application set out in Article 52 was not met. This also resulted from decision T 172/87. The Appellant has further alleged that the presence of the coating layers was optional since the wording of Claim 1 did not exclude the value zero for the amounts of oxides.

Novelty of the claimed coated TiO₂-pigments over the pigments of (11a) was also disputed as well as novelty of the claimed process. The Appellant has pointed out that there existed various definitions of the "dense silica" in the prior art, for example in (5) and (13). Assuming that a dense silica was one which had been precipitated from an alkaline medium, then a coating of dense silica was also deposited onto the zirconia layer in Example 1 of (11a). This was confirmed by the reference to "dense deposits" or "dense coating layers" in the paragraph bridging pages 5 and 6. In the Appellant's view it was derivable from the comparison of the electronmicrographs submitted with the Statement of Grounds of Appeal that the intermediate layer consisted of dense silica in Example 1 of (11a). Although the amount of silica in the compared products was not the same, products with identical amounts of silica would have had the same appearance. Furthermore the data based on analysis carried out at various stages of the process described in Example 1 of (11a) clearly showed the succession of separate layers as claimed in the patent in suit.

As regards inventive step, the Appellant has stressed that starting from (4) as closest prior art it was obvious to the skilled person to combine the teaching of documents (4) and (6) in order to obtain a pigment exhibiting improved durability since according to (6) the chalking resistance and the gloss retention could be substantially improved by depositing a ZrO₂-layer directly onto the pigment core before deposition of the other substances. The Respondent's arguments that there existed two lines of work in the prior art, which had never crossed were contested. They did cross in (11a) and thus (6) and (4) were not incompatible. The statement in column 14 of (5) also did not lead away from such a combination.

V. With a letter dated 27 April 1992 the Respondent submitted an amended set of claims as first auxiliary request. The independent Claims 1 and 5 thereof differ from the granted one by the mention of the lower limits 0.5%, 2% and 1 wt% for the amounts of zirconia, silica and hydrous oxide of alumina respectively. A second auxiliary request was based on the claims of the first auxiliary request but with the ranges 1% to 4% of zirconia, 4% to 8% of silica, 1% to 3% of hydrous alumina, incorporated into the independent claims, the dependent Claims 2, 3 and 4 being deleted and the remaining claims renumbered accordingly.

The Respondent's arguments may be summarised as follows: Lack of clarity is not a ground of opposition. Furthermore "dense amorphous silica" was a well known substance before the priority date as well as the conditions for producing it: cf. "Ullmans Encyklopädie", 1979, Vol. 18, p. 579 (document (17)), document (5) or (4) for example. Thus, a skilled person would have had no difficulty in understanding this term and in putting the invention into effect over the whole area of Claim 1. It is also clear from the wording of Claim 1 that the three layers are compulsory.

The pigment of Claim 1 is novel over (11a) since the conditions indicated in (5) for the obtention of a dense amorphous silica layer are not used in (11a) and thus the intermediate layer cannot comprise a dense amorphous silica layer. The electromicrographs supplied by the Appellant show that the silica layers of Figure 4 and Figure 5 are different, the silica of Figure 4 being more gelatinous than that of Figure 5. Furthermore the amount of silica in Figure 5 is six-fold that used in the pigment of Figure 4. The Appellant's assertion that Figure 4 would look exactly the same if the pigment contained 4.4 wt% of SiO₂ instead of 0.77 wt% is not credible.

There are a number of clearly discernible lines of work within the method of chemical coating of TiO_2 -pigments. One line of work is represented by (5) and by its further developments in documents (3), (13) and (4). The clear teaching of these documents is that dense amorphous silica is a useful coating for improving TiO_2 -pigments, but this coating should in all cases be deposited directly onto the core TiO_2 -pigment. Providing a layer therebetween would go against this teaching. A second line of work relates to the use of mixed or sequential layers of conventional coatings such as in (6) or in (11a). According to (6) it is essential to have the zirconia layer in direct contact with the core particle. Therefore the disclosures of (6) and (4) are inherently incompatible in this respect. Furthermore the reader is not told what particular element of the coatings leads to the improved results. Thus, the combination of (6) and (4) may appear to be obvious only on the benefice of hindsight. Document (4), which is a development of the process according to (5), explicitly refers thereto. As it can be inferred from (5) that it does not matter what is underneath the coating of dense amorphous silica (cf. column 14, lines 32 to 40), there was no point in trying to put another layer under the dense silica layer. No improvement of the durability could be expected from having a zirconia layer underneath a dense silica coating which already leads to optimum durability. Moreover according to (6) a pigment with outstanding properties is obtained by depositing the zirconia layer onto the core pigment and then putting one alumina-containing layer on the top of the zirconia layer. It would be contrary to the teaching of (6) to have a dense silica layer between the zirconia layer and the layer of mixed Al-, Si-oxides. This would also be inconsistent with the aim of (6) which is to simplify the prior art process, in particular to avoid multiple post-treatments.

As regards Claim 1 of the second auxiliary request, the amounts of alumina and silica recited therein fall within the ranges mentioned in (4), however the amount of ZrO_2 starts from 1 wt%, i.e. from the highest possible amount disclosed in (6). The use of the claimed amount might have an unexpected effect.

- VI. The Appellant requested that the appealed decision be set aside and that the patent be revoked.

The Respondent requested that the appeal be dismissed and that the patent be maintained unamended (main request), alternatively on the basis of Claims 1 to 8 (first auxiliary request) or Claims 1 to 5 (second auxiliary request), both as submitted on 27 April 1992.

Reasons for the Decision

1. The appeal is admissible.

Main request

2. At the appeal stage the Appellant has raised an objection of lack of clarity against the granted Claim 1. In his view the requirement of industrial application set out in Article 52(1) was not fulfilled because of the unclear teaching of Claim 1 (cf. point V above).

- 2.1 Objections to clarity of claims under Article 84 EPC must be taken into account in opposition proceedings whenever the granted claims have been amended. Otherwise, the claims should be understood as they stand, if necessary using the description and the drawings in accordance with Article 69(1) (cf. T 23/86, OJ EPO, 1987, 316, point 2). However, such objections are relevant to opposition proceedings insofar as they can influence the decisions on issues under Article 100 EPC (cf. T 127/85, OJ EPO, 1989,

273). In the present case, novelty of the products according to Claim 1 depends upon the meaning of the term "dense amorphous silica". As novelty cannot be assessed without having previously clearly set out what the skilled person would understand under this term and whether the presence of the coating layers is optional or compulsory, these questions have to be settled first, if necessary by using the description.

2.2 It is indicated in the patent (column 1, lines 58 to 60) that dense amorphous silica, and the process for producing it by chemical methods, is well known to those skilled in the art. In this respect the Board notes that document (17), which undoubtedly represents common general knowledge before the priority date, explicitly refers to document (5) in connection with the deposition of a dense silica layer onto TiO_2 -pigments. According to (5) a dense amorphous silica is a non-porous amorphous silica. The non-porous character of the silica coating can be readily shown for example by measuring the specific surface area of the coated product by nitrogen adsorption and comparing it with the specific surface area of the substrate or core material. With a dense silica coating, and in contrast to a porous silica coating, the change in surface area is not greater than zero after correction taking into account a possible difference in density (cf. column 4, lines 35 to 68; column 8, line 75 to column 9, line 42; column 13, line 73 to column 14, line 19). This document also discloses processes for depositing the dense amorphous silica onto a core material, for example onto a TiO_2 -pigment. These processes are carried out by suspending the core material in water and then adding "active silica" thereto, the pH of the suspension being maintained between 8 and 11 (cf. column 6, lines 45 to 53). It results from the preceding that the term "dense amorphous silica" had a well-recognised meaning in the field of coated TiO_2 -pigments before the priority date. Therefore, the skilled

person in the art would have understood this term correspondingly when reading Claim 1, all the more as the definition given in the contested patent for the coating of dense silica and its preparation is in agreement with the teaching of (5) (cf. patent in suit, column 4, lines 22 to 51).

The Board cannot share the Appellant's opinion that the term "dense silica" is unclear because of the different ways of defining it in (13) and (5). Thus, it clearly derives from (13) that a dense silica coating is a non-porous silica coating (cf. page 2, lines 9 to 10). Furthermore the process for the preparation of the dense silica described on page 6 of (13) corresponds essentially to that used in (5).

2.3 As regards the optionality of the coating layers, the Board observes that according to Claim 1 the treated TiO_2 -pigment comprises a core of rutile TiO_2 having thereon an inner coating of zirconia, an intermediate coating of a dense amorphous silica carried out on the inner coating and an outer coating of hydrous alumina carried out on the intermediate coating. It is mentioned neither in Claim 1 nor in the description that the lower limits for the respective amounts of zirconia, silica and alumina may be "zero". Furthermore it does not derive from the patent as a whole that one of these layers might be omitted. Under these circumstances the skilled person reading Claim 1 and the description would have no reason to consider the coating layers to be optional. Therefore it is considered that the claimed product comprises at least the three layers mentioned in Claim 1.

2.4 In the Board's opinion, the objection under Article 52(1) in conjunction with Article 57 is not founded since it is self-evident that the claimed coated pigment can be manufactured or used in some industrial area, for example

in the paint industry. In the decision T 172/87 referred to by the Appellant in support of his argument, the patent was not revoked on the ground of lack of industrial application, i.e. under Article 100(a), but under Article 100(b) because of insufficiency of disclosure. The circumstances of the present case are completely different since the Appellant has himself pointed out during oral proceedings that the requirement of sufficiency of disclosure was fulfilled and the Board sees no reason to doubt that this requirement is met.

3. The novelty of the claimed TiO_2 -pigment was disputed with respect to the disclosure of document (11a).

3.1 According to the process of (11a) the alkaline zirconium complex is added to the alkaline pigment suspension and the hydrous zirconia is slowly precipitated by addition of compounds of Ti and/or Al and/or Si (cf. Claim 1). In particular, the zirconium carbonate complex is added to the alkaline pigment suspension, then an alkaline water-glass solution and finally a solution of an alkali metal aluminate or of aluminium sulphate (cf. page 5, lines 1 to 9). It is not mentioned that three separate layers of zirconia, silica and alumina are deposited on the pigment. This is also not directly and unambiguously derivable from the whole content of (11a) since it is emphasised on page 4 and in the main claim that the hydrous zirconia is slowly precipitated by addition of the Si and/or Al compounds. According to the paragraph bridging pages 5 and 6 the process enables the deposition of dense coating layers, however it cannot be unambiguously deduced from this paragraph, even when read in the light of the prior art discussed on pages 2 and 3, that the final product necessarily comprises a layer of dense amorphous silica. In this context, the Board notes that during the opposition proceedings, even the Appellant, who is the Applicant of (11a), did himself not find the teaching of

(11a) clear enough to derive therefrom that a layer of dense amorphous silica was present in the final product since he manifestly believed at that time that a porous silica layer was formed and therefore recognised novelty on this basis. If the teaching of (11a) were not ambiguous as regards the kind of the silica coating, then the Appellant would not have come to such a conclusion.

3.2 When putting the teaching of (11a) into practice by repetition of its Example 1 as this has been done by both parties, then it becomes clear, provided that intermediate products are analysed at particular steps of the process, that three separate layers of respectively zirconia, silica and alumina are successively deposited on the pigment with a layer of mixed oxides between the silica and the alumina layers as in the claimed products: see the Appellant's results of analysis submitted on 19 November 1992. These results also show that zirconia is fully precipitated before addition of the sodium silicate in contrast to the teaching of (11a) (see page 4, first paragraph and Claim 1). The Respondent has confirmed these results during oral proceedings. From the comparison of the electronmicrographs submitted by the Appellant, in particular Figures 4, 5 and 6, it appears that the coating of Figure 4 contains far less fluffy material than the porous coating of Figure 6. However the amount of fluffy material in Figure 4 appears to be higher than in Figure 5 although the amount of silica in the case of Figure 4 is between five and six times lower than in the product according to the disputed patent (Figure 5). Under these circumstances, it cannot be concluded from this comparison that the coating of Example 1 of (11a) is a dense silica coating. The Appellant's assertion that the intermediate product of Figure 4 would look exactly the same if it contained a five times greater amount of SiO_2 was strongly contested by the Respondent. It is also the Board's opinion that this assertion is not credible in the absence

of evidence to support it. In such a situation the Board has to decide in favour of the party not having the burden of proof, i.e. the Respondent (cf. T 219/83, OJ EPO, 1986, 211) and concludes that it has not been convincingly shown that the coated pigment of Example 1 of (11a) comprises a layer of dense amorphous silica as claimed.

The Appellant's argument that the process used in Example 1 of (11a) for precipitating the silica is identical to the process of the patent and therefore a layer of dense amorphous silica is obtained in both cases cannot be followed by the Board. Thus, according to the patent in suit the coating of dense silica is deposited from a solution of a soluble silicate at a pH greater than 8, most preferably at a pH of from 9 to 11. The deposition of dense silica results from the addition to an alkaline solution of the soluble silicate of a mineral acid such as sulphuric acid which hydrolyses the silicate in solution to amorphous silica (cf. column 4, lines 23 to 42). In all the examples of the patent in suit the solution of sodium silicate is added to the stirred dispersion simultaneously with diluted sulphuric acid. This addition of a mineral acid also corresponds to the teaching of (5) referred to in (17). However in Example 1 of (11a) no acid is added to the alkaline suspension either simultaneously with the sodium silicate or thereafter and the pH is of 12 after stirring, i.e. a value higher than that recommended in (5) and in the patent in suit. Therefore the two ways of depositing the silica cannot be considered as identical.

- 3.3 It results from the preceding that the claimed pigment is novel over the disclosure of (11a). After having examined the other cited documents the Board has come to the conclusion that none of them discloses the claimed pigment either. Since this is not in dispute, there is no need to give further details.

4. In connection with the issue of novelty the Appellant has questioned whether, in two distinct situations, the burden of proof should rest with the Opponent, i.e. firstly where the most pertinent document was not retrieved by the Office during examination and secondly where comparative examples or other evidence were submitted by the Opponent.

As regards the first situation, the Board must observe that under Rule 55(c) EPC, it is for the Opponent who invokes the invalidity of a patent to indicate the facts, evidence and arguments presented in support of the grounds of opposition. Therefore, the Opponent alleging lack of novelty in respect of document (11a) must prove that the claimed pigment is not novel over the disclosure of this document irrespective of the quality of the examination before grant. Hence the latter can never have such a fundamental consequence as the reversal of the burden of proof.

In the second situation the question whether or not the burden of proof is reversed depends upon the weight of the evidence submitted by the Opponent. If the evidence in respect of the point to be made is such that the Board can conclude "we think it more probable than not", the burden is discharged (cf. T 109/91 of 15 January 1992). As in the present case the evidence presented by the Appellant was not sufficient to establish his allegation with regard to the nature of the silica layer in the intermediate products of (11a) (cf. point 3.2 above), there was no discharge of the original burden of proof, hence no shift of this burden has taken place.

5. It remains to examine whether the claimed coated pigment satisfies the requirement of inventive step.

- 5.1 In view of the fact that, on the one hand, the written teaching of (11a) is not in agreement with at least Example 1 when the latter is put into practice (see point 3.2 above) and, on the other hand, this document does not disclose a coated pigment comprising a layer of dense amorphous silica, the Board does not consider (11a) as the closest prior art. Instead (4), upon which the Appellant relied during oral proceedings, is regarded as a more suitable starting point. This document discloses a chemically treated TiO_2 -pigment comprising a TiO_2 -core pigment having thereon a continuous coating of dense amorphous silica in an amount of preferably 1.5 to 6 wt% and an outer coating of hydrous alumina in an amount of preferably 2 to 3 wt%, deposited on the silica coating. The core pigment is preferably formed by the "chloride" process. This coated TiO_2 -pigment exhibits a very good durability, in particular outstanding chalking resistance and tint retention, as well as a good dispersibility and a good retention of gloss when used in paint compositions (cf. page 4, lines 8 to 24; page 7, lines 3 to 21, Example 1).
- 5.2 In the light of this closest prior art, the technical problem underlying the patent is to provide a pigment having improved durability, i.e. an improved resistance to degradation by the action of light, and thus increased effective life.
- 5.3 The patent proposes to solve this problem by coating the core pigment with, in sequence, an inner coating of an oxide or hydrous oxide of zirconium, an intermediate coating of a dense amorphous silica and an outer coating of a hydrous alumina, each coating being present in the amounts recited in Claim 1. In view of examples 1 and 2 and of comparative example 3 of the patent in suit, which show that the pigment comprising the three claimed coatings has an improved durability over a pigment with

two coatings, namely a coating of dense amorphous silica on the core pigment and an outer coating of hydrous alumina, the Board is satisfied that the above technical problem has been solved.

5.4 As regards obviousness of the claimed solution, the first question to consider is whether or not the cited prior art contains information which could give the skilled person an incentive to provide the pigment disclosed in (4) with an inner coating of zirconia, the latter being deposited directly on the core pigment, i.e. underneath the coating of dense amorphous silica. Document (4) itself teaches that the continuous coating of dense silica is primarily responsible for the durability of the finished product but decreases gloss, dispersibility and hiding power if used without additional alumina coating. Therefore, a coating of alumina is deposited onto the dense silica where not only good durability but also a good dispersibility and good optical properties are desired (cf. page 7, penultimate paragraph; page 2, last paragraph; page 3, first and second paragraphs). This document does not give any information as to how the photodurability of such coated TiO_2 -pigments might be improved.

5.5 Document (6) relates to the production of TiO_2 -pigments which exhibit an increased resistance to weathering, in particular an improved chalking resistance and retention of gloss, and thus an improved durability. According to (6), if a TiO_2 -pigment is treated with a zirconium salt after precipitation of compounds of Ti, Al and optionally Si, this treatment does not lead to any substantial improvement in chalking resistance and retention of gloss. On the contrary a significant improvement of these properties is achieved when the core TiO_2 -pigment is first treated with the zirconium salt so that a hydrous zirconia is at least partially precipitated directly onto the core pigment before addition of the other salts and subsequent

precipitation of the hydrous oxides (cf. page 2, typed number, second paragraph; page 3, lines 6 to 11; page 4, lines 19 to 22; page 10, table; Claims 1 and 4). Document (6) further teaches that this process makes it possible to obtain rutile pigments having a resistance to chalking and a gloss retention which are as good as those obtainable with a double post-treatment although it merely involves a single treatment. Very good results are already achieved when only an aluminium salt is used in addition to the zirconium salt (cf. page 3, second and third paragraphs).

In view of (6), which discloses that the improvement in durability results from the inner coating of hydrous zirconia being deposited directly onto the core pigment, the skilled person faced with the problem of improving the photochemical durability of the coated pigment of (4) would at once contemplate applying a similar measure to this pigment, i.e. depositing an additional coating of zirconia directly onto the core pigment. As document (6) further teaches that the zirconium salt may be employed in an amount of 0.2 to 1 wt%, preferably about 0.5 wt%, expressed as ZrO_2 with respect to the weight of TiO_2 (cf. page 5, second paragraph and Claim 5), the skilled person would at first try these amounts of zirconia to verify whether a similar improvement is obtained when the adjacent layer is a dense silica layer. By doing so he would inevitably arrive at the claimed solution. The Board cannot agree with the Respondent's submission that the incorporation of an inner coating of zirconia into the pigments of (4) is in contradiction with the disclosure of (6) where the adjacent layer is an alumina containing layer. On the contrary, this incorporation is clearly based upon the essential teaching of (6), namely that the deposition of the zirconia layer must be effected directly on the core pigment before deposition of further hydrous oxides, in order to obtain the desired improvement in photochemical durability. According to (6) this

improvement is achieved whatever the sequence of addition of the other salts. In other words the alkali silicate may be added before the aluminium salt (cf. paragraph bridging pages 5 and 6).

Contrary to the Respondent's opinion, the addition of an inner coating of zirconia in the products of (4) is also not inconsistent with the aim of (6). Thus, according to (6) the prior art process as described in DE-C-1 198 950 requires two successive post-treatments, each post-treatment comprising the precipitation of various oxides on the core pigment, filtration of the treated pigment, washing and drying. The aim of (6) is to achieve a substantial improvement of the resistance to chalking and retention of gloss without subjecting the pigment to these two successive post-treatments, not to avoid the deposition of multiple layers (see whole page 1 and page 2, first and second paragraphs). This is confirmed by the solution proposed in (6) which comprises the deposition of at least two layers, i.e. the zirconia layer and the additional layer(s), in a single post-treatment (cf. page 3).

5.6 The Respondent has further argued that the skilled person would not combine the disclosures of (6) and (4) since, on the one hand, they belong to two divergent lines of work and, on the other hand, they are "inherently incompatible" in view of the requirement that both the zirconia layer and the dense silica layer are deposited directly onto the core pigment (see point V above). The Board cannot share this opinion for the following reasons.

5.6.1 It is true that a first group of documents, i.e. (4), (3), (5) and (13), relates to coated TiO₂-pigments comprising a coating of dense amorphous silica which is deposited onto the core pigment under alkaline conditions, whereas other documents are directed to the use of mixed or sequential

layers of conventional coatings instead of a dense silica layer, for example document (6). However, even if two lines of work actually existed before the publication of (11a), they form part of the same technical field or would at most represent two very closely related technical fields. Therefore the skilled person would not hesitate to look for suggestions in the second line of work all the more as both lines of work are discussed in (11a). Moreover the cited documents do not contain any information which would deter the skilled person from combining a dense amorphous silica coating with additional layers of conventional coatings. In particular the analysis of document (5) on page 2 of (11a) does not lead away from using a dense silica since the unfavourable effect on the optical properties is not attributed to the dense silica itself but to the great amount thereof.

5.6.2 As regards the alleged incompatibility between (6) and (4), it is true that according to (6) the hydrous zirconia must be deposited directly onto the core pigment in order to achieve the desired improvement in durability. However, there is no similar requirement in connection with the dense silica coating in the documents of the first group. Although the dense silica coating is deposited directly on the core pigment in the examples of (4), this is not considered as a prerequisite for the obtention of the desired durability. According to document (5), which is referred to in (4), the skin of dense silica may be deposited onto a core which has been covered with a layer of metal oxides or hydrated oxides such as those recited in column 3, lines 1 to 47 or column 2, lines 32 to 47). It does not derive from (5) that in the case of a TiO_2 -core the dense silica coating is necessarily applied directly onto the core. Therefore the disclosure of (4) is not "inherently incompatible" with that of (6).

5.7 In the Respondent's view no improvement in photodurability could be expected from the presence of a zirconia layer underneath a dense silica coating in view of the statement in (5), column 14, lines 33 to 40. In this paragraph it is pointed out that the coated pigment has the high opacity of TiO_2 and the chemical characteristics of the silica skin, in particular its insolubilising effects in water dispersions of organic polymers. However, the photodurability of the paint films containing this pigment is not at all discussed, nor the extent of this insolubilising action and the influence of the time thereupon. Furthermore, it can be inferred from the analysis of (5) in document (11a) that the photodurability of the coated pigment increases with increased amounts of dense silica but that great amounts thereof unfavourably affect the optical properties (cf. page 2, lines 7 to 22). It results therefrom that the improvement in photodurability of TiO_2 -pigments by a dense silica coating is possible only in limited extent. Under these circumstances the Respondent's allegation that the photodurability of paint films containing pigments with a dense silica coating is already optimal and thus no improvement can be expected, is not convincing. By the way, this allegation does not take into account that the problem to be solved is precisely to improve the photodurability of the pigments of (4) when used in paints.

5.8 It results from the preceding that the subject-matter of Claim 1 of the main request does not involve an inventive step and therefore does not meet the requirement set out in Article 56.

Auxiliary requests

6. There are no objections under Article 123(2) and (3) to the amended claims of the first and second auxiliary

requests. The lower limits of 0.5 wt% ZrO₂, 2 wt% SiO₂ and 1 wt% Al₂O₃ recited in Claim 1 of the first auxiliary request as well as the preferred ranges 1 to 4 wt% ZrO₂, 4 to 8 wt% SiO₂ and 1 to 3 wt% Al₂O₃ stated in Claim 1 of the second auxiliary request are supported by the application as originally filed (see page 6, the last three paragraphs). The amended claims manifestly do not broaden the scope of the granted claims.

7. With regard to the first auxiliary request, the Board notes that the amounts of dense silica and alumina deposited on the TiO₂-pigment of (4) are 1.5 to 15%, preferably 1.5 to 6 or 8 % SiO₂ with respect to TiO₂ and 1.5 to 5%, preferably and 2 to 3 % Al₂O₃ (cf. page 7 and Claim 4). Furthermore according to (6) the preferred amount of zirconium salt is 0.5 to 1 wt% calculated as ZrO₂ (cf. page 5, second paragraph). In the case of alumina and zirconia these amounts fall within the claimed ranges. Moreover the preferred range disclosed in (4) for the amount of dense silica overlaps to a considerable degree with the claimed range of 2 to 12%. Consequently, the preceding reasoning in connection with the main request applies analogously to Claim 1 of the first auxiliary request.

8. In connection with the narrower ranges of the second auxiliary request, it is observed that the preferred amount of Al₂O₃ disclosed in (4) lies within the claimed range of 1 to 3 wt%. The claimed range for dense silica is narrower than that indicated in (4) whereas the claimed range for the amount of ZrO₂ is directly adjacent to the preferred range recommended in (6). However the skilled person can infer from (6) that there exists no precise upper limit to the amount of ZrO₂, the upper value of 1 wt% mentioned in (6) resulting from cost considerations (cf. page 5, second paragraph). The Board cannot conclude that in the light of the teachings of (6) and (4) an

inventive skill is necessary to determine the most appropriate amounts of dense silica and zirconia which, in combination, lead to an improvement in photodurability since this determination involves only routine experimentation which belongs to the usual task of the skilled person in this technical field.

9. For the reasons given above, the pigments as defined in the main claims of the two auxiliary requests also do not meet the requirement of inventive step set out in Article 52(1) and 56.

10. In view of the non-patentability of all three product claims, none of the Respondent's requests can be allowed. The dependent claims and the process claims thus fall with Claim 1 of each request.

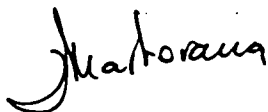
Order

For these reasons, it is decided that:

1. The decision under appeal is set aside.

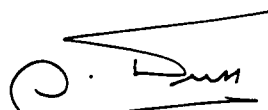
2. European patent No. 0 078 632 is revoked.

The Registrar:



P. Martorana

The Chairman:



A.J. Nuss

H. Eb
Gr