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**Datasheet for the decision
of 26 June 2009**

Case Number: T 1248/06 - 3.3.03

Application Number: 99302577.4

Publication Number: 0950669

IPC: C08F 8/06

Language of the proceedings: EN

Title of invention:

Method of catalytic crosslinking of polymers and two-pack composition used therein

Patentee:

ROHM AND HAAS COMPANY

Opponent:

Akzo Nobel N.V.

Headword:

-

Relevant legal provisions:

EPC Art. 100(a), 54, 56

Keyword:

"Novelty (yes)"
"Inventive step (yes)"
"Inventive step - closest state of the art"
"Inventive step - ex post facto analysis"

Decisions cited:

-

Catchword:

-



Case Number: T 1248/06 - 3.3.03

D E C I S I O N
of the Technical Board of Appeal 3.3.03
of 26 June 2009

Appellant:
(Opponent)

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Decision under appeal:

Decision of the Opposition Division of the
European Patent Office of 31 May 2006 posted
13 June 2006 rejecting the opposition filed
against European patent No. 0950669 pursuant to
Article 102(2) EPC 1973.

Composition of the Board:

Chairman: R. Young
Members: A. Däweritz
C. Vallet

Summary of Facts and Submissions

I. The grant of European patent No. 0 950 669 in respect of European patent application No. 99 302 577.4, filed on 1 April 1999 and claiming the priority of 13 April 1998 of an earlier application filed in the USA (81491 P), was announced on 8 September 2004 (Bulletin 2004/37). The patent was granted with ten claims, including the following independent claims:

1. A method of crosslinking an oxidative polymer having oxidatively crosslinkable functional groups, wherein said oxidative polymer is polymerized from at least one ethylenically unsaturated monomer, said method comprising:

contacting said oxidative polymer with a catalytic amount of an oxidizing enzyme; and crosslinking said oxidatively crosslinkable functional groups on said oxidative polymer.

9. A method of applying a coating on a substrate comprising:

contacting a polymeric component of a coating composition with a crosslinking component of said coating composition to form a pot mix, said polymeric component comprising an oxidative polymer having oxidatively crosslinkable functional groups, wherein said oxidative polymer is polymerized from at least one ethylenically unsaturated monomer, and said crosslinking component comprising a catalytic amount of an oxidizing enzyme; applying a layer of said pot mix over said substrate; and crosslinking said oxidatively crosslinkable functional groups on said oxidative polymer to form said coating on said substrate.

10. A two-pack coating composition comprising:

a first container containing a polymeric component, which comprises an oxidative polymer having oxidatively crosslinkable functional groups wherein said oxidative polymer is polymerized from at least one ethylenically unsaturated monomer; and a second container containing a catalytic component, which comprises a catalytic amount of an oxidizing enzyme sufficient to crosslink said oxidatively crosslinkable functional groups on said oxidative polymer, when said polymeric component is mixed with said catalytic component.

The remaining Claims 2 to 8 were appendant to Claim 1.

In this decision, references to passages in the patent in suit as granted will be given underlined in squared brackets, eg [Claim 1], those to the application text as originally filed will be shown in underlined italics, eg page 1, lines 1 to 5. "EPC" refers to the revised text of the EPC 2000, the previous version is identified as "EPC 1973".

II. On 1 June 2005, a Notice of Opposition was filed, in which the revocation of the patent in suit in its entirety was requested on the basis of Article 100(a)

EPC 1973 and the assertion of lack of novelty and lack of inventive step, respectively, with regard to the following four documents:

- D1: Ju Kumanotani, "*Enzyme-catalyzed durable and authentic oriental lacquer - a natural microgel-printable coating by polysaccharide-glycoprotein-phenolic lipid complexes*", Proceedings 23, of the XXIIIrd International Conference in Organic Coatings, July 7-11, 1997, Vouliagmeni (Athens), Greece, pages 281 to 294;
- D2: JP-A-01-163272 (English translation);
- D3: JP-A-57-141458 (English translation) and
- D4: "*Metaalvrije drogers*", Dr. H.P. Theunissen, Verfkroniek Mei 1952 (May 1952), Summary, page 138.

III. In the decision announced at the end of oral proceedings on 31 May 2006 and issued in writing on 13 June 2006, the Opposition Division rejected the opposition, because none of the grounds for opposition raised by the Opponent prejudiced the maintenance of the patent as granted.

(1) In particular, the Opposition Division held that none of the above documents anticipated the claimed subject-matter (Nos. 2.1 to 2.3 of the reasons):

Thus, neither D1 nor D2 disclosed a method in which urushiol was polymerised and subsequently oxidatively crosslinked by the action of an enzyme.

D3 taught, according to the decision under appeal, only the addition of polymerised linseed oil or of alkyd resin as film-forming extenders to Oriental lacquer, whereas their crosslinking was not even suggested. Furthermore, the Opponent had not shown that polyphenol

oxidase (a further additive to the Oriental lacquer of D3) would be active towards the oxidative groups of the alkyd resin or the polymerised linseed oil, and would, as argued by the Opponent, thus cause the crosslinking of these extenders.

D4 was a summary of an article on non-metallic driers reviewing 14 theories about oxidation and polymerisation of drying oils which, according to the Opposition Division, were not polymers, but only monomers. Moreover, mention had, according to the Opposition Division, been made therein only of enzymes, but neither of oxidising enzymes, nor of crosslinking.

(2) With regard to inventive step, the Opposition Division did not concur with the Opponent's opinion that D1 was the closest state of the art and that the claimed subject-matter of the patent in suit was obvious with regard to D1 itself or D1 in combination with D4. Rather, the Opposition Division held that none of D1 to D4 would form an appropriate starting point for an objection of lack of inventive step. Instead, it considered paragraphs [0002] to [0004], wherein the oxidative polymers crosslinked by means of heavy metals was discussed, as representing the closest prior art.

(3) The problem to be solved with regard to this closest prior art was seen in the provision of an environmentally acceptable alternative to the use of heavy metal catalysts for crosslinking oxidative polymers.

(4) According to the decision under appeal, this problem was effectively solved by using oxidative enzymes as catalysts for the crosslinking reaction as demonstrated in the [examples].

(5) More particularly, D1 to D3 related, according to the decision under appeal, only to specific coating materials, namely Oriental lacquers, and to a technology remote from the oxidative polymer coatings of the patent in suit, because Oriental lacquers did not contain any oxidative polymer in the sense of the opposed patent, but related to urushiol based products and did not suggest that enzyme catalysts were applicable outside the field of Oriental lacquers.

D4 related, in the Opposition Division's view, to drying oils and reviewed 14 theories of how to promote the oxidation or polymerisation of drying oils, whilst oxidative polymers were not mentioned. Nor did D4 suggest that oxidative polymers could effectively be crosslinked by using enzymes as catalysts.

IV. On 10 August 2006, a Notice of Appeal was filed against the above decision by the Opponent/Appellant. The prescribed fee was paid on the same day. The Statement of Grounds of Appeal (SGA) was received on 3 October 2006, in which the Appellant requested that the decision under appeal be set aside and the patent in suit be revoked in its entirety.

(1) The Appellant maintained that each of the four cited documents would anticipate the subject-matter of at least some of the claims, to wit the methods of [Claims 1 and 9]. Moreover, both D2 and D3 would also anticipate the coating composition of [Claim 10].

(2) More particularly, the Appellant argued that D1 related to Japan lacquers, the curing of which involved a complex process of different types of reactions and that "*urushiol monomers having unsaturated side chains*

are dimerized under the influence of laccase and polymerized to form phenolic resins, the laccase still being present" (SGA, page 2, "D1", paragraph 1). The Appellant saw this view confirmed by the explanations of "the three involved reactions" on page 286 of D1. Whilst the Opposition Division had held that D1 did not disclose that the polymerised urushiol was subsequently oxidatively crosslinked by the action of an enzyme (section III(1), above), the Appellant argued that polymerised urushiol was a polyphenol resin and that, "With the laccase still present, this does result in crosslinking, according to the teachings of the opposed patent" (SGA, page 2, "D1", paragraph 2). Furthermore, D1 taught, in the Appellant's opinion, on page 292, under the heading of "What Can We Know from Oriental Lacquer?" that coatings based on phenolic resins were oxidised by phenol oxidase (laccase) to form rigid crosslinks. This would be exactly the basic thought behind the patent in suit. Moreover, the heading quoted above implied, according to the Appellant, that "the effect of laccase catalyzed crosslinking of phenolic resins was actually observed with the poly-urushiols in the Japan lacquers described in the rest of D1", and that these resins were polymerised urushiol building blocks comprising ethylenic unsaturation in their side chains as shown in Fig. 5 of D1. Moreover, the application of the lacquer to a substrate was additionally referred to in D1. Therefore, the methods of [Claims 1 and 9] lacked novelty over D1.

(3) Whilst accepting that the starting formulation in D2 was monomeric and different from the starting formulations described in the patent in suit, the Appellant further argued that the crosslinking method of [Claim 1] and the coating method of [Claim 9] would

lack novelty with regard to D2, because the curing process might require a polymerisation step before crosslinking could take place, but it would, in any case, involve a phase where poly-urushiol was contacted with a catalytic amount of peroxidase, which would inevitable result in crosslinking. Moreover, according to page 5 of D2 (3rd paragraph), peroxidase could be added as a separately prepared component in the form of an aqueous solution. Therefore, the composition of [Claim 10] would also lack novelty.

(4) In D3, a polyphenol oxidase was used for oxidatively drying Japan lacquers, which was mixed with film forming extenders, such as linseed oil (optionally polymerised) or alkyd resins. Like the poly-urushiol, linseed oil polymers and alkyds were, according to the Appellant, oxidatively drying polymers polymerised from at least one ethylenically unsaturated fatty acid monomer. Hence, D3 would anticipate the methods of [Claims 1 and 9]. Moreover, the oxidase would be added as a separate component, which would additionally anticipate the composition of [Claim 10] (SGA, page 4, lines 1/2).

(5) D4 discussed, in the Appellant's view, the use of enzymes to cure oxidatively drying paints on an oil basis. Since in the curing process of drying oils, polymerisation and crosslinking were not essentially different, distinguishable processes and since drying oils had more than two crosslinking functionalities, the polymerisation step would gradually turn into a crosslinking process, so that at a certain moment during the curing process, polymerised drying oils would be in contact with a catalytic amount of enzymes and would undergo oxidative crosslinking. Hence, the

Appellant concluded that D4 would anticipate the methods of [Claims 1 and 9].

(6) The Appellant also reiterated its objection of lack of inventive step on the basis of D1 as the closest prior art and that the subject-matter of the patent in suit would be obvious with regard to this document.

Thus, the Appellant disputed the finding in the decision under appeal that none of D1 to D3 could be regarded as the closest state of the art. Instead, it maintained that D1 was the closest piece of prior art, because it explicitly mentioned the use of enzymes to crosslink phenolic resins. Moreover, the knowledge derived from Japan lacquer chemistry could also be applied in, eg, coatings based on phenolic resins. The problem to be solved by the patent in suit was to provide an environmentally acceptable alternative to the use of heavy metal catalysts for crosslinkable oxidative polymers. The solution of using enzymes was, according to the Appellant already given in D1, so that there was no inventive step.

V. In its rejoinder, dated 26 January 2007, the Respondent pointed out that Claim 1 concerned a method of cross-linking an oxidative polymer in the presence of an oxidising enzyme catalyst, whereby the oxidative polymer had been polymerised from at least one ethylenically unsaturated monomer, that Claim 9 dealt with a method of applying a coating on a substrate and that Claim 10 concerned a two-pack coating composition. The methods and the composition were not, in its opinion, disclosed in any of the prior art documents.

(1) Thus, D1 did not disclose the use of such an oxidative enzyme for catalysing the crosslinking of a

polymer as defined in Claim 1, but was only concerned with Oriental (or Japanese) lacquer, derived from a naturally occurring tree sap and comprising urushiol, polysaccharides and laccase, and processes involved in the film formation thereof. Moreover, urushiol being "*a phenolic lipid comprising a mixture of 3-substituted catechol derivatives with n-15 carbon chains with 0 to 3 olefins*" was not a polymer, but a monomer. The drying process involved the initial dimerisation of urushiol either (1.) by laccase-catalysed oxidation of catechol nuclei to give semiquinone radicals or (2.) the aerobic oxidation of the side chains which occurred in the presence of metal ions such as those of Fe, Ca and Zn acting as catalyst for this reaction.

(2) The Respondent then referred to the complexation of the metal ions by the urushiol semiquinone radicals as explained on page 286 of D1, lines 7 to 10, so that the complexed metal ions would not be available until after the catechol groups had dimerised to form urushiol dimer or had formed monomeric urushiol quinone (page 2 of the rejoinder, last two complete paragraphs). The film formation of Oriental lacquer did not, in the Respondent's view, involve crosslinking of an oxidative polymer with an oxidizing enzyme as required in the patent in suit. Instead, D1 taught a metal-ion catalysed polymerisation (or crosslinking) of the unsaturated side chains of urushiol monomer or urushiol dimer, the latter being formed by laccase catalysed dimerisation of urushiol.

(3) Furthermore, the Respondent argued that the interpretation of the concluding section of D1 on page 292 by the Appellant ("What Can We Know from Oriental Lacquer?") did not match with the process

described in the preceding pages of D1 (as referred to in section V(2), above).

(4) D2 was concerned, according to the Respondent, with a method for accelerating the dry film formation of Japanese lacquer. The mechanism was explained to be the oxidative polymerisation of urushiol and analogues by the trace enzyme laccase. However, the explanations in D1 would have made clear, that urushiol and its analogues were monomers, not polymers and the oxidative polymerisation of urushiol with laccase formed dimers, not polymers. Furthermore, no reference in D2 either to "*poly-urushiol*" or to what that material might be could be found, let alone that such a material was contacted with a catalytic amount of peroxidase.

(5) With regard to D3, the Respondent again referred to the explanations given in D1 and questioned whether polyphenol oxidase, as used in Example 3 of D3, would react differently from laccase as referred to in D1. Moreover, it disputed the Appellant's arguments that the disclosure of Japanese Lacquer being mixed with film forming extenders such as (optionally polymerised) linseed oil or alkyd resins would constitute a novelty destroying disclosure, because they were only optional ingredients and it would not be inevitable that they were subject to oxidative crosslinking. A single embodiment comprising one of the extenders was illustrated in Example 3 of D3. However, the polymerised linseed oil was not defined in sufficient detail for a person skilled in the art to determine whether it was an oxidative polymer. It would be far from clear what process reaction actually took place in the composition of the example. Nor did D3 disclose or suggest that the polyphenol oxidase acted on the

polymerised linseed oil to crosslink it. A similar conclusion had to be reached for a composition containing the alkyd resin mentioned without explicit disclosure (rejoinder, page 3, last paragraph and page 4).

(6) In summary, the Respondent argued with regard to each of D1 to D3 that no evidence had yet been provided by the Appellant which would have supported its assertions concerning the disclosure of an oxidative crosslinking process of a polymer as defined in the [claims]. Moreover, it invited the Appellant to provide evidence for its position if it intended to challenge, in particular, the Respondent's interpretation of D3.

(7) Furthermore, the Respondent argued that the summary D4 of a review article referred to non-metallic driers described to promote oxidising and/or (thermal) polymerisation of drying oils. These oils per se were monomers, not polymers. *"The mechanism of action of the 'groups reviewed' appears to be based upon one of fourteen theories. The skilled person could not expect, from the 7 'groups' and 14 'theories' to find clear direction to teaching of oxidative crosslinking of relevant oxidative polymer using enzymes. No method is disclosed in D4. No oxidatively crosslinkable groups are disclosed in D4. D4 does not mention crosslinking as a term."* D4 could not, therefore, be considered as anticipating the claimed subject-matter.

(8) The findings of the Opposition Division as regards inventive step were supported by the Respondent, who, furthermore, considered the arguments provided by the Appellant in this respect as being neither new nor advancing the Appellant's position sufficiently to even

suggest, let alone conclude, that the decision of the Opposition Division regarding inventive step was wrong.

(9) Nevertheless, the Respondent filed an Auxiliary Request I, which did not, however, play a role in the further proceedings.

VI. The oral proceedings held before the Board on 26 June 2009 focused completely on the Main Request.

(1) The Appellant focused only on D1 when reiterating its novelty objection, in particular with reference to the abstract, the explanations on pages 286 and 292 and Figures 5 and 6 of the document.

Whilst accepting that the natural chemistry involved in the preparation of coatings of Oriental lacquer as a natural product on substrates was, in fact, complex and that the document offered three possibilities in which two different reactions could take place, ie either one after the other or both at the same time, the message of D1 would be loud and clear that these two possible reactions resulted in crosslinking and polymerisation of the coating material and were a laccase catalysed oxidation and an aerobic oxidative polymerisation (cf. page 286). Moreover, the abstract referred already to the question of what the skilled person could carry from the known technique to present coatings, and this question was answered, in the Appellant's opinion, in item 1 of the conclusion formulated on page 292, in which the skilled reader was informed that phenolic resins could be oxidised by phenol oxidase or laccase to make rigid crosslinks which might raise the Tg effectively. This meant, in the Appellant's view, that D1 taught the subject-matter of [Claim 1].

(2) By contrast, the Respondent referred to its written arguments (sections V, V(1) to V(7), above) and further argued that D1 did not provide a clear teaching what to do. In its opinion, D1 dealt only with the chemistry of Oriental lacquer and the different reactions taking place in the preparation of coatings thereof. D1 would even confuse the meaning of the terms of polymerisation and crosslinking. Moreover, the Respondent stressed that the laccase-catalysed oxidative reaction yielded only dimers, not polymers and that the aerobic oxidative polymerisation required, according to D1, the activity of the metal catalysts mentioned on page 286, item 2. The statements in the conclusion on page 292 of D1 would not fit with its preceding disclosure.

Furthermore, the Respondent pointed out that the Appellant had only repeated its arguments which it had provided from the beginning of the discussion in the opposition proceedings and that it (as the Respondent) had suggested in its rejoinder to the SGA that the Appellant should, in view of the weak points in its written arguments, submit evidence for its assertions. However, nothing of this kind had been provided.

In any case, D1 did not provide a disclosure which would anticipate the subject-matter of Claim 1 in a clear and unambiguous way or would allow directly to derive the claimed subject-matter therefrom.

(3) After deliberation of the Board and the announcement of the decision that novelty of the claimed subject-matter was acknowledged, the Appellant was invited to present its case as regards inventive step.

(4) At the beginning of the presentation of its case, the Appellant announced that it would use two different approaches, one based on D1 as the closest state of the art, ie along the lines of its arguments presented before in writing, and the other starting from the prior art as described in [0004] and as used by the Opposition Division in the decision under appeal.

(5) With regard to the latter approach based starting from [0004], the Appellant saw the technical problem to be solved in the provision of an environmentally acceptable replacement for the heavy metal catalysts hitherto used as catalyst for crosslinking oxidative polymers and referred to the last paragraph of its SGA and to the assessment of inventive step in the decision under appeal. Whilst the use of an enzyme was identified by the Appellant as being the asserted solution of this problem, it pointed out that no evidence had been provided proving a technical effect based on this change of catalyst. The only comparative results to be found in the [patent] were based, in the Appellant's view, on experiments carried out in the absence of enzyme and others wherein enzyme had been used. No comparison had, however, been provided with experiments wherein metallic catalyst had been used.

In the Appellant's opinion, the use of enzymes had, however, already been foreshadowed in D4 and in D1. Thus, D4 referred to the use of enzymes as a replacement of metallic driers and in D1, page 292, item 1 of the conclusion (section VI(1), above, paragraph 2), mention had been made of an oxidation of phenol or catechol groups by means of phenol oxidase or laccase to make rigid crosslinks.

Nothing else would be done in the [patent], where, in [Claim 5] and in [0032], mention was also made of phenolic oxidatively crosslinkable functional groups. Consequently, the combination of the closest prior art as described in [0004] with the teaching in D1 would make the claimed subject-matter obvious.

(6) On the other hand, although D1 concerned a study of the mechanism of Japanese lacquer, it nevertheless carried on to modern coating systems as addressed in the abstract of D1 and as concluded on page 292, item 1 that phenolic resins could be crosslinked by using enzymatic catalysts. Moreover, whilst the functional groups of the polymers crosslinked by means of the enzymatic catalyst had been phenolic in D1 (ie urushiol) and in the [examples], as could be seen on pages 286 and 292 of D1 and in [Examples 1, 2 and 3], the only technical difference between these polymers was the nature of the backbone of the individual polymers used, which according to [Claim 1] were derived from ethylenically unsaturated monomers. However, a technical effect based on this difference was neither known, nor shown in the [patent]. It was, therefore, clear to the person skilled in this art that the selection of a backbone was not crucial, provided it contained the functional groups necessary for the oxidative crosslinking. Consequently, the choice of an oxidative polymer polymerised from at least one ethylenically unsaturated monomer lacked, in the Appellant's view, inventive step over D1 itself, where in the abstract reference had been made to present coatings. Moreover, these oxidatively crosslinkable polymers had been well-known in the art as acknowledged in the description of the patent in suit with regard to the technical background and in [0043] and [0044].

More particularly, the polymers used in the available examples, eg in [Examples 1, 2 and 3] (cf. [page 11, line 49] and [page 12, lines 34 and 50]) were of the same types of phenolic resins as those considered on page 292, item 1 of D1, and the results presented in the tables on [pages 14 and 15] demonstrated in the Appellant's opinion that even the experiments carried out in the absence of enzyme catalysts had shown "*no bad swelling*" in comparison with the evaluation of the swell ratio in [0081], meaning a high degree of cross-linking. Hence, it could be said that no evidence had been provided that the heavy metal catalysts had found an appropriate replacement by the oxidising enzymes.

Furthermore, the Appellant did not see a principal (chemistry-based) difference between the coatings in D1 and in the [patent]. In both instances, the aim had been to protect a substrate, irrespective of the specific polymer (backbone) used, which was the only difference between D1 and the [patent]. The general principle for achieving the goal was based on the use of high molecular weight polymers having viscosities being so low that they could easily and well be coated on the substrate and on the subsequent crosslinking of the liquid after its application. The actual nature of the polymer or resin binders would make no significant difference for the skilled person.

Upon reading D1, the person skilled in the art was, in the Appellant's opinion, interested in what (s)he could learn from the old lacquer in a more general concept for the coatings of today.

(7) Apart from the reference of the Appellant to the aim of the patent in suit to replace the hitherto used

heavy metal catalysts for crosslinking polymers having oxidatively crosslinkable functionalities, as mentioned in [0004], the Respondent contested all the arguments brought forward by the Appellant at the hearing.

Thus, D1 did not, in its opinion, provide a clear teaching to replace heavy metal catalysts for the oxidative polymerisation. Nor did the cited passage on page 292 of D1 indicate which part of the preceding remarks in that document should be transferred to "*100% solid coatings-Phenolic resins*" in order to obtain rigid crosslinks. In any case, D1 neither disclosed oxidative polymers, as defined in [Claim 1], in its Figure 6, nor taught to look at a certain passage of D1 and to combine it with other prior art.

Document D4 referred to enzymes in general, not to *oxidizing* enzymes, only within a long list of possible non-metallic driers for drying oils. Whilst some from amongst the different types of compounds referred to as non-metallic driers in D4 might, in fact, be oxidising, others were not. Nor did D4 teach that oxidising enzymes might be sufficiently active for achieving the required degree of crosslinking of the polymers concerned.

As regards the Appellant's argument that no evidence had been made available in the [patent] for any effect achieved by means of oxidising enzymes instead of metal catalysts, the Respondent pointed out that, according to established procedural rules and case law at the EPO, the onus of proof for its assertions and allegations had been on the opposing Appellant. Furthermore, the Respondent criticised that the person skilled in the art could not learn from the cited prior

art which type of comparative examples (s)he should carry out, because there was no sign post in the cited art. Nor had there been any teaching to make the system to be crosslinked less harmful.

(8) When it became apparent that the parties did not wish further to comment on the Main Request, the debate was closed with regard to this request, the requests of both parties at this stage were again established and the oral proceedings were interrupted for the deliberation of the Board on the Main Request.

VII. At this stage of the proceedings, the Appellant requested that the decision under appeal be set aside and the patent in suit be revoked.

The Respondent requested that the appeal be dismissed, or, in the alternative, that the patent be maintained on the basis of Claims 1 to 10 filed with the letter dated 26 January 2007 as Auxiliary Request I.

Reasons for the Decision

1. The appeal is admissible.

Main Request

2. *Novelty*

2.1 The arguments of the Appellant with regard to novelty and inventive step were, namely at the oral proceedings before the Board, based to a large extent on some passages of D1. D1 concerns "*Enzyme-Catalyzed Durable and Authentic Oriental Lacquer · Microgel Printable Coating by Polysaccharides-Glycoproteins-Phenolic Lipids Complexes*".

2.1.1 More particularly, the Appellant referred to the abstract of D1 reading: "*The practice of oriental lacquer in Japan and the chemistry in it, durability of the lacquer due to the shell-core structured microgel made of polysaccharides, glycoproteins and phenolic lipids complexes, properties of the complexes, capability of renewable oriental lacquer, and what we can carry to the present coatings from oriental lacquer will be reviewed.*" and to the conclusion:

What Can We Know from Oriental Lacquer ?

1. Laccase or phenol oxidase catalyzed 100% solid coatings-Phenolic resins are effective to protect corrosion of irons, in addition, when phenol or catechol group is introduced into oligomer, it may be oxidized by phenol oxidase or laccase to make rigid crosslinks which may raise Tg effectively.

2.1.2 On page 283, more detailed explanations are given concerning the composition of the sap as recovered from the lacquer trees in the form of a "*water/oil type emulsion*". From this emulsion, a lacquer having a residual water content of 3% is obtained by evaporation of the water from the sap. This lacquer is then applied to a substrate in repeated sequences of coating, drying and polishing steps to get high gloss and a durable coating surface (D1, page 283, paragraph 1).

2.1.3 According to Fig. 3 and the further paragraphs on page 283, the sap contains (i) mono-, oligo- and polysaccharides dissolved in water, (ii) glycoproteins in urushiol and (iii) laccase, which may be contained in both phases. The compositions of the polysaccharides and of urushiol are further explained with reference to structures depicted in Fig. 4 and 5. Thus, the lacquer polysaccharides are in a highly branched acid form and fractioned into two molecular weight fractions by GPC and "*involved as Ca, Mg and Na (3:2:1) salts in the native sap*". The glycoproteins had been identified by chemical analysis of amino acids and sugar components. The laccase is referred to as "*copper glycoprotein blue*"

enzyme" and urushiol as a "*phenolic lipid*" being "a mixture of 3-substituted catechol derivatives with n-15 carbon chains with 0 to 3 olefins".

- 2.1.4 The chemical mechanisms occurring during the formation of the lacquer films are then explained on page 286 as the "*Dimerisation of Urushiol*" proceeding in two ways: (1.) a laccase catalysed oxidation of the catechol nucleus to a semiquinone radical and (2.) an aerobic oxidation of the side chain. These two reactions "*may be intercrossed*" (page 286, lines 5/6).

Before dealing with these "*two ways*", the author then addressed the possibility of side reactions or interactions of the urushiol semiquinone radicals with the other components of the sap or lacquer which may cause steric effects or which, in the case of a formation of complexes with metal ions such Ca^{2+} , Mg^{2+} , Fe^{2+} and Fe^{3+} , may lead to a variation of the reactivity of the intermediates.

- 2.1.5 According to the passage "*1. Laccase-catalyzed Oxidation*" on page 286, this oxidation leading to the intermediate semiquinone product may proceed further in different ways. The semiquinone may either attack a further urushiol nucleus to give biphenyl compounds and dibenzofuran compounds or it may disproportionate to give urushiol quinone, which in turn may react with the unsaturated side-chains to give coupling products. Moreover, a further dimerisation reaction is referred to, which is based on the oxygenation of the side chain of monomeric urushiol followed by its absorption on laccase and subsequent oxidative coupling to the dimer. The different product types resulting from these reactions are depicted in Fig. 6 on page 285.

2.1.6 The reactivity of the side chains of urushiol is dealt with on page 286, in the passage "*2. Aerobic Oxidative Polymerization*". Like drying oils, unsaturated side chains of urushiol may thus undergo aerobic oxidative polymerisation in the presence of metal ions such as Fe^{2+} , Fe^{3+} , Ca^{2+} and Zn^{2+} contained in the sap. Still further references are made to optional reactions of hydroperoxides of unsaturated side chains with urushiol or reactions of their unsaturated alcohols with the semiquinone radical of urushiol and to the Diels-Alder reaction "*reported to occur between the triene side chain of urushiol.*"

Finally, in the last paragraph of page 286, the possibility of further continuation of aerobic crosslinking or degradation of the side chains after film formation may continue despite the limited mobility of laccase due to its polymeric nature.

2.1.7 With regard to Figures 12 and 13, the author of D1 proposed (on page 288) a structure for the final lacquer film showing a densely packed grain structure containing fine particles, which have a core-shell with a diameter of ca. 0.1 μm , whereby the shell is composed of a polysaccharide-glycoprotein-urushiol complex and the core is "*polymerized urushiol*", which is prevented from aerobic oxidation by the shell with a high barrier towards oxygen. Nothing is said about the chemical structure of the "*polymerised urushiol*".

2.1.8 Based on these findings, the Board takes the view that the author of D1 has tried to provide explanations for reactions which may occur during the application and processing of "*Oriental Lacquer*", which is a complicated mixture of different components as obtained

from nature. The document does not, however, provide information concerning a well-defined sequence in which the above reactions may occur during the application of the raw lacquer to the surface to be coated.

2.1.9 As already established by the Opposition Division (section III(1), above), it is evident that D1 does not disclose a method in which urushiol was polymerised at first to a polymer which was subsequently oxidatively crosslinked by the action of an enzyme. In its SGA (IV(2), above), the Appellant argued that "*urushiol monomers having unsaturated side chains are dimerized under the influence of laccase and polymerized to form phenolic resins, the laccase still being present*", and "*With the laccase still present, this does result in crosslinking ...*".

2.1.10 However, D1 does not disclose that the oxidatively dimerised products of Fig. 6 would further crosslink by the action of laccase, a finding supported by the Respondent (section V(2), above).

2.1.11 Moreover, each of independent [Claims 1, 9 and 10] requires the presence of an oxidative polymer having oxidatively crosslinkable groups, which polymer has been "*polymerized from at least one ethylenically unsaturated monomer*", as further explained in great detail in [0030] to [0054].

The Board has not become aware of any reference in D1 to such a polymer as defined in Claim 1. The only information concerning the question of "*what we can carry to the present coatings from oriental lacquer*", which the Board can derive from D1 (cf. the abstract on page 281), is the reference to phenolic resins under point 1 of the conclusion on page 292 (section 2.1.1,

above). These resins are, however, generally understood in the art as being prepared by the reaction of a phenol or substituted phenol with an aldehyde, especially formaldehyde, in the presence of an acidic or basic catalyst, and hence do not correspond to an oxidative polymer being polymerised from at least one ethylenically unsaturated monomer, let alone one which when applied as a coating to a substrate, is crosslinked by means of an oxidative enzyme catalyst.

2.1.12 Nor has the Appellant provided any information as to where such a polymer would be disclosed in D1, or any proof for its allegation that the nature of the above polymer, referred to by the Appellant as "*backbone*", would have no significance for the use in the preparation of a coating and for the crosslinking involved therein. Instead, the Appellant argued that urushiol could, according to one possibility offered by D1 (section IV(2) and VI(1), above) polymerise to form phenolic resins (cf. section 2.1.11, above) which would then be crosslinked by laccase still contained in the oriental lacquer. However, this assertion is based on interpretations of D1 in the knowledge of the patent in suit combined with further assumptions, rather than on a clear, direct and unambiguous disclosure in D1.

2.1.13 Moreover, whilst a clear statement is made in the patent in suit to dispense with metal catalysts hitherto used to catalyse the oxidative crosslinking, but having adverse impact on the environment due to the incapability of being readily degraded to harmless compounds upon disposal, D1 clearly refers to the presence of such metal catalysts necessary for the aerobic oxidative polymerisation (page 286, point 2.).

2.1.14 In view of these facts and findings, the Board has concluded that the subject-matter of each of Claims 1, 9 and 10 is novel over D1.

2.2 D2 discloses a method for accelerating the formation of a dry film from Oriental lacquer having declined in quality with its enzyme deactivated during its storage (page 2, line 6 to page 3, line 4) by adding peroxidase or peroxidase and hydrogen peroxide to a raw Japanese lacquer or a dehydrated Japanese lacquer (claim 1).

Like D1, D2 also fails to disclose that an oxidative polymer as defined in Claim 1 would be present in the Japanese or Oriental lacquer. Consequently, this document does not anticipate the subject-matter claimed in the patent in suit, either.

2.3 D3 differs from D2 in that it additionally refers to the optional presence of a coating film-forming extender and identifies a specific polyphenol oxidase ("*from the cultured solution of a microbe belonging to Alternaria*") to be added for enhancing the quality of a low quality natural Japanese lacquer with low enzyme laccase activity, which may be caused by temperature changes, transport or storage (page 3, paragraph 2 of the translation). Particular reference was made by the Appellant to "*linseed oil (optionally polymerized) or alkyd resins*" and to the examples of the document wherein the oxidase was added as a separate component (section IV(4), above).

The Respondent's detailed comments on this document (section V(5) and V(6), above) disputing the Appellant's assertions concerning the alleged lack of novelty of the claimed subject-matter remained undisputed by the Appellant.

Therefore, the Board has no reason not to accept the Respondent's arguments and concludes that the findings referred to above with regard to D1 and D2 are also valid for D3 (sections 2.1.9 to 2.2, above).

- 2.4 Document D4 is a summary of a general survey "on non-metallic dryers, ie substances other than derivatives of lead, manganese and cobalt, having an analogous promoting action on the oxidation (at room temp) [sic] and/or the (thermal) polymerization of drying oils." discussed in the context of "the fourteen best-known theories about oxidation and polymerization of drying oils."

The Board concurs with the Respondent's arguments as quoted in section V(7), above. In fact, D4 provides no indication that the "enzymes" mentioned within a list of different generic groups of chemical compounds ranging from peroxides to natural products and together with a number of auxiliary substances including eg anti-oxidants should directly and unambiguously be linked to the oxidative crosslinking of polymers.

- 2.5 In view of the above facts and findings, the Board came to the conclusion that the subject-matter of each of the independent Claims 1, 9 and 10 complied with the novelty requirement of the EPC (Articles 52(1) and 54 EPC).

3. *Problem and solution*

The patent in suit relates (i) to a method of catalytic crosslinking of polymers having oxidatively cross-linkable functional groups, which polymers are derived by polymerisation of at least one ethylenically

unsaturated monomer ([0001]), (ii) to the application of this crosslinkable system for coating a substrate and (iii) to a two-pack coating composition comprising this crosslinkable system, whereby an oxidising enzyme was used as the catalyst ([Claims 1, 9 and 10]).

3.1 Closest state of the art

3.1.1 In the decision under appeal, the Opposition Division took the view that none of the cited documents could be considered as being the closest piece of the prior art (page 5, No. 3 of the reasons), because none of them referred to oxidative polymer coatings in the sense of the contested patent, but, in the case of D1, D2 and D3, related instead to Oriental lacquers, which are a specific type of coating compositions and involve a technology remote from the system used in the patent in suit. For these reasons, the Opposition Division saw the closest prior art to be represented by the oxidative polymers crosslinked by means of heavy metal catalysts as discussed in paragraphs [0002] to [0004].

3.1.2 More particularly, whilst D1 tries only to explain what is going on during the formation of solid surface coatings from Oriental lacquers, a specific class of natural products, and speculates what could possibly be derived therefrom for the crosslinking of phenolic resins, D2 and D3 deal only with solving the problem of insufficient crosslinking of aged raw Oriental lacquer by reactivating the system so as to achieve a good coating quality within reasonable time. D4 concerns only the question of how to promote the oxidation and/or (thermal) polymerisation of drying oils.

By contrast, the patent in suit refers in the introduction of its description to the disadvantages of

hitherto used methods of oxidative crosslinking of functional groups of polymers, synthesised by the polymerisation of ethylenically unsaturated monomers.

3.1.3 Therefore, the Board concurs with the finding in the decision under appeal, that none of documents D1 to D4 can be considered as representing the closest piece of prior art, but that, instead, paragraphs [0002] to [0004] must be regarded as the closest state of the art.

3.2 The problem to be solved with respect to the known systems as described in [0002] to [0004] was seen by the Opposition Division in the provision of an environmentally acceptable alternative to the use of heavy metal catalyst for crosslinking the oxidative polymers. The Board has no reason not to accept this formulation of the technical problem underlying the patent in suit.

3.3 The Board also concurs with the view of the Opposition Division that it has been shown by the swell ratio values in the [examples], that the polymers are effectively crosslinked by means of a catalytic amount of an oxidising enzyme, the solution being offered in the claims. Contrary to the Appellant's allegation (section VI(6), above), each of the examples showed clearly good swell ratios of their respective coatings.

Therefore, the Board is satisfied that the above technical problem (section 3.2, above) has been solved.

4. *Inventive step*

It remains to be decided whether the claimed solution of the above problem (section 3.2, above) can be derived in an obvious way from the cited documents in

combination with the closest state of the art as defined in section 3.1.3, above, which itself does not, however, provide any hint in the direction of the solution claimed.

- 4.1 D1 tried only to explain the reactions (in the presence of enzymatic and/or metallic catalysts) and structures occurring in and after the drying of the very specific system of Oriental lacquer (sections 2.1.4 to 2.1.7 and 2.1.13, above). It does not, however, provide any incentive for achieving a solution of the above technical problem (section 3.2, above), let alone a suggestion for finding a solution therefor. Not even the question (as raised in the abstract) of what could be carried from the complex system of the oriental lacquer to the present coatings, nor the statement in the conclusion under the heading "What Can We Know from Oriental Lacquer?" containing a reference to phenolic resins, a completely different coating system (cf. section 2.1.11, above) provide, in the Board's view, such an incentive.

The allegation that the transfer of the enzymatic system (however, without the metal ions, mentioned in D1 in the context of the aerobic oxidative polymerisation) from Oriental lacquer to the completely different system of the patent in suit was obvious can, in the Board's view, only be the result of an ex post facto-analysis of D1. In other words, it can only be derived from D1 in the knowledge of the claimed subject-matter (section 2.1.8 to 2.1.11, above).

Consequently, D1 cannot contribute to the solution of the above technical problem.

- 4.2 This finding is also valid for D2 and D3, which deal only with the specific problem of insufficient reactivity of aged Oriental lacquer.
- 4.3 As addressed in section 2.4, above, D4 is only a survey on methods and auxiliary compounds which may provide advantages in the drying of so-called drying oils, and it refers only to theories which may serve to understand those reactions.
- This disclosure does not, however, contribute to finding a solution of the above technical problem either.
- 4.4 It follows that, therefore, the subject-matter of independent Claims 1, 9 and 10 is also based on an inventive step.
- 4.5 By the same token, this finding is also valid for the elaborations of Claim 1 as defined in any one of Claims 2 to 8 appendant to Claim 1. This is also valid for the conclusion in section 2.5, above,
- 4.6 Consequently, there is not prejudice to the maintenance of the patent in suit as granted.

Auxiliary Request

5. In view of the above facts and for the above reasons, there is no need for the Board to consider the Auxiliary Request of the Respondent.
6. In view of these findings the appeal cannot be successful.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

E. Görgmaier

R. Young