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D E C I S I O N
of 3 March 2005

Case Number: T 0295/03 - 3.3.3

Application Number: 93310516.5

Publication Number: 0659793

IPC: C08G 59/40

Language of the proceedings: EN

Title of invention:

One component epoxy resin compositions containing modified epoxy-amine adducts as curing agents

Patentee:

Shikoku Chemicals Corporation

Opponent:

The Dow Chemical Company

Headword:

-

Relevant legal provisions:

EPC Art. 54, 56, 83, 100b), 123(2), 123(3)
EPC R. 71(2)

Keyword:

"Sufficiency of disclosure (yes)"
"Inventive step (yes)"

Decisions cited:

G 0009/91, G 0010/91, T 0182/89, T 0281/01

Catchword:

-



Case Number: T 0295/03 - 3.3.3

D E C I S I O N
of the Technical Board of Appeal 3.3.3
of 3 March 2005

Appellant:
(Opponent) The Dow Chemical Company
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Respondent:
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Decision under appeal: Interlocutory decision of the Opposition
Division of the European Patent Office dated
26 June 2002 and posted 9 January 2003
concerning maintenance of European patent
No. 0659793 in amended form.

Composition of the Board:

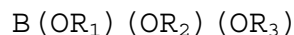
Chairman: R. Young
Members: C. Idez
H. Preglau

Summary of Facts and Submissions

I. The grant of the European patent No. 0 659 793 in the name of Shikoku Chemicals Corporation in respect of European patent application No. 93 310 516.5 filed on 23 December 1993 was announced on 6 October 1999 (Bulletin 1999/40) on the basis of 9 claims.

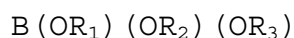
Independent Claims 1, 2, 3, 4, and 9 read as follows:

"1. An epoxy resin composition comprising, in addition to the epoxy resin, (1) an epoxy adduct obtainable by reacting an epoxy compound having one, two or more epoxy groups per molecule with a nitrogen-containing heterocyclic compound, an aliphatic amine or an aromatic amine, that is surface treated with (2) a boron compound of formula (I):



wherein R_1 to R_3 are the same or different and each is hydrogen, straight-chain, branched or cyclic alkyl or aryl, and with (3) a phenolic compound.

2. A latent epoxy curing agent or a cure accelerating agent comprising a fine granular epoxy adduct obtainable by reacting an epoxy compound having one, two or more epoxy groups per molecule with a nitrogen-containing heterocyclic compound, an aliphatic amine or aromatic amine, the surfaces of the fine granular epoxy adduct being coated with a boron compound of formula (I):



wherein R_1 to R_3 are the same or different and each is hydrogen, straight-chain, branched or cyclic

alkyl or aryl, which composition further comprises
(3) a phenolic compound.

3. The use as a surface-treating agent for an epoxy adduct, of a boron compound of formula (I):



wherein R_1 to R_3 are the same or different and each is hydrogen, straight-chain, branched or cyclic alkyl or aryl, and a phenolic compound.

4. A process for producing an epoxy resin composition according to claim 1 comprising the step of kneading an epoxy resin with the other components of the composition.
9. Use of an epoxy resin according to claim 1, a latent epoxy curing or cure accelerating agent according to claim 2 or a surface-treating agent according to claim 3 in production of a cured epoxy resin product.

Claims 5 to 8 were dependent on Claim 4.

- II. A Notice of Opposition was filed against the patent by The Dow Chemical Company, on 4 July 2000, on the grounds of lack of novelty and lack of inventive step (Article 100(a) EPC), and insufficient disclosure (Article 100(b) EPC).

The opposition was supported *inter alia* by the following documents:

- D1: EP-A-0 458 502;
D2: JP-A-03 234 727 (English translation thereof);
D4: EP-A-0 039 230;

as well as the later filed, but admitted, documents:

- D6: Kirk-Othmer, "Encyclopedia of Chemical Technology", Vol. 4, 3rd edition (1978), pages 112, 114, and
- D7: F. A. Cotton, "Advanced Inorganic Chemistry"; fifth edition, (1988), A Wiley-Interscience Publication, pages 168-172.

The objection under 100(b) EPC had been raised on the grounds that the patent in suit did not provide a disclosure which enabled the skilled person to obtain an epoxy adduct coated with unreacted boron compound as required by Claim 2.

III. By a decision announced orally on 26 June 2002 and issued in writing on 9 January 2003, the Opposition Division held that the grounds of opposition did not prejudice the maintenance of the patent in amended form.

The decision was based on the following requests of the Patent Proprietor:

- (i) A main request consisting of the set of Claims 1 to 9 as granted, and
- (ii) an auxiliary request consisting of the set of Claims 1 to 9, as submitted by the Patentee with its letter dated 26 April 2002.

Claims 1 to 8 of the auxiliary request differed from Claims 1 to 8 of the main request in that the possibility that all the radicals R_1 to R_3 were hydrogens had been excluded in formula (I) in Claims 1,

2 and 3, and that the expression "boron compound" had been replaced by "boric ester" in Claims 1, 2, 3, and 5 to 8. Claim 9 of the auxiliary request corresponded to Claim 9 of the main request.

The decision stated that the requirements of Article 123(2) and 123(3) EPC were met by the auxiliary request and that those of Article 83 EPC were met by both the main and the auxiliary request.

It also stated that the subject-matter of both requests was novel over documents D1 and D2.

The Opposition Division took the view that the subject-matter of the main request lacked inventive step.

According to the decision document D4, which was considered as the closest state of the art, disclosed epoxy/amine adduct hardeners, whose surface had been treated with an acidic substance such as boric acid or a phenol and not a combination of both as required by the main request.

The decision further held that the examples of the patent in suit did not allow a direct comparison with the compositions disclosed in D4. Therefore, the technical problem was seen as providing alternative surface treated epoxy/amine hardeners.

According to the decision, it would have been a routine laboratory work to use a combination of two known compounds as an alternative to a single compound, in as much that a combination of phenol with boric acid had been known from D2.

Concerning the auxiliary request, the decision stated that its subject-matter differed from that of the main

request in that a boric acid ester was used in the combination.

The decision held that this alternative was not obvious since in the cited literature reference was made only to boric acid and not to esters. The argument of the Opponent in view of the passage on page 3 lines 36 to 42 of the patent in suit, that the skilled person would have expected that boric acid esters would represent alternatives to boric acid, since hydrolysis took place at the surface of the hardeners, was not convincing, since the cited part of the patent in suit represented an explanation made by the inventors in the knowledge of the invention and did not demonstrate general knowledge before making the invention.

Thus, the Opposition Division came to the conclusion that the requirements of Article 56 EPC were met by the auxiliary request.

IV. A Notice of Appeal was filed on 7 March 2003 by the Appellant (Opponent) with simultaneous payment of the requested fee.

With the Statement of Grounds of Appeal filed on 14 May 2003, the Appellant submitted the following document:

D8 = JP-A-2-103224 (English translation thereof).

It also argued essentially as follows:

(i) Article 100(b) EPC:

(i.1) Document D6 showed that partially hydrolyzed borate derivatives had not been isolated,

except in special cases involving large substituents.

- (i.2) The amended claims were however not limited to these specific cases. Thus, they did not comply with Article 83 EPC.
- (i.3) No method had been disclosed for producing an epoxy adduct coated with a borate ester.
- (i.4) Since the borate esters were readily hydrolysed, the adduct would be coated with boric acid, not with boric acid esters.
- (i.5) Thus Claim 2 did not comply with Article 83 EPC.
- (ii) Article 100(a) EPC:
 - (ii.1) The Opposition Division had concluded that the solution originally proposed in the patent in suit, i.e. combination of boron compound and a phenolic compound was obvious in view of D4 alone or in view of D4 with D2.
 - (ii.2) The Patentee had not demonstrated any technical effect associated with the use of boric acid esters.
 - (ii.3) Thus, treatment of the adduct with a borate ester was equivalent to its treatment with boric acid, i.e. the borate was simply a carrier for boric acid. This was also stated in the patent in suit (cf. paragraph [0015]).

- (ii.4) It was general knowledge that borate esters hydrolyzed rapidly to boric acid (cf. D6).
- (ii.5) The Patentee's allegation that borate esters were superior to boric acid was not supported. No comparison could be made either between original Example 10 and the other examples, or between the gelation times in comparative Examples 2 and 3 of the auxiliary request.
- (ii.6) Thus, the subject-matter of the auxiliary request lacked inventive step in view of D4 alone, or in view of the combination of D4 with D2, in light of the common general knowledge represented by D6 and/or patentee's admission.
- (ii.7) Furthermore, documents D1 and D8 demonstrated that borate esters were equivalent to boric acid in the preparation of latent imidazole-containing curing agents for epoxy resins.

- V. With its letter dated 6 January 2005, the Patentee (Respondent) informed the Board that it would not be represented at the oral proceedings scheduled for 3 March 2005.
- VI. In its letter dated 23 February 2005, the Appellant essentially relied on its previous arguments presented in the Statement of Grounds of Appeal concerning the question of sufficiency and the question of inventive step.
- VII. Oral proceedings before the Board were held on 3 March 2005 in the absence of the Respondent.

At the oral proceedings, the Appellant indicated that it had no arguments under Article 123(2) EPC concerning the claims of the auxiliary request and that it did not contest the novelty of the subject-matter of this request.

Concerning the issues of insufficiency of disclosure and of inventive step, the Appellant, while essentially relying on the arguments presented in Statement of Grounds of Appeal and in its letter dated 23 February 2005, made additional submissions which may be summarized as follows:

(i) Concerning Article 100(b) EPC:

(i.1) Following preliminary observations from the Board that the objection under 100(b) EPC concerning the availability of partial esters of boric acid would appear as not being linked to the amendments made in the auxiliary request and, hence, to amount to a new objection under this article, the Appellant submitted that the lack of availability of some partial esters represented only a further aspect of the objection under Article 100(b) EPC raised with the Notice of Opposition and that this did not amount to a new objection.

(i.2) Among the methods (A), (B), (C), and (D) disclosed in the patent in suit (paragraph [0013]), the Appellant submitted that method (D) was the only method which might possibly result in a coating of the epoxy adduct, but no

evidence had been submitted by the Patentee in that respect. In any case, the adduct would be not coated with a borate in view of the hydrolysis of the borate into boric acid (cf. D6; page 112, last two lines and page 114, lines 1 to 3).

- (ii) Concerning inventive step:
 - (ii.1) It was apparent from the amended description (paragraph [0015]) that the term "borate esters" encompassed boric acid.
 - (ii.2) It was further clear in view of D1 (cf. page 17; lines 23-24; lines 37-39; Examples 129-137), D7 (page 171, paragraph "borate esters", and D8 (Claim 1) that boric esters would be equivalent to boric acid in epoxy compositions.
 - (ii.3) D1 would represent the closest state of the art, since it dealt with epoxy resin compositions comprising latent catalysts.
 - (ii.4) The compositions disclosed in the Examples of Table XVII of D1 differed from the claimed subject-matter only in that an imidazole compound was used instead of an epoxy-amine adduct. The claimed compositions would, however, represent an obvious alternative of those of D1, since D1 further disclosed that epoxy-amine adducts were preferred catalysts (page 13, line 57 to page 14, line 6).

(ii.5) D2 could also represent the closest state of the art, since an adduct would inevitably be formed in the preparation of the latent curing agent (Synthesis Example 1; Table 1-1; Example A4).

(ii.6) D4 taught to use acidic compounds for the surface treatment of amine epoxy adduct. No effect had been shown by the Patentee concerning the combination of a borate with a phenolic compound.

(ii.7) The difference in gel time at 40°C observed between Example 9 (trimethyl borate + pyrogallol) and Example 10 (boric acid + pyrogallol) could not be attributed to the presence of borate since the greater amount of pyrogallol used in Example 10 rendered the two examples not comparable.

VIII. The Appellant requested that the decision under appeal be set aside and the European patent 659 793 be revoked.

The Respondent made no request.

Reasons for the Decision

1. The appeal is admissible.

2. *Procedural matters*

As mentioned above in paragraph V, the Respondent has informed the Board that it would not be represented at

the oral proceedings. In accordance with Rule 71(2) EPC, the proceedings were continued without the Respondent.

3. *Wording of the claims*

Claims 1 to 9 of the auxiliary request on the basis of which the Opposition Division decided that the patent could be maintained differs from Claims 1 to 9 as granted in that the possibility that all the radicals R_1 to R_3 are hydrogens has been excluded in formula (I) in Claims 1, 2 and 3, and that the expression "boron compound" has been replaced by "boric ester" in Claims 1, 2, 3 and 5 to 8.

3.1 These claims were considered as meeting the requirements of Article 123(2) and 123(3) EPC by the Opposition Division and their conformity with these articles has not been challenged by the Appellant in the course of the appeal proceedings.

3.2 The Board is also satisfied that the requirements of these articles are met by all the claims in respect of the amendments made.

4. *Article 100(b) EPC*

4.1 In the Notice of Opposition, the Opponent (Appellant) argued that the opposed patent did not provide a disclosure that enabled the skilled person to carry out the invention claimed in independent Claim 2, since there was no teaching in the opposed patent as how to obtain an epoxy adduct coated with unreacted boron compound.

- 4.2 This objection of insufficient disclosure was reiterated in the appeal proceedings in view of Claim 2 of the auxiliary request, which differs from Claim 2 as granted only by a more restricted definition of the boron compound which should coat the epoxy adduct.
- 4.3 In the Statement of Grounds of Appeal, the Appellant further submitted that the skilled person was unable to carry out the method according to the claims of the auxiliary request, since more than half of the borate esters (i.e. those in which one or two R groups was hydrogen) covered by the formula (I) defined in Claim 1 were not available.
- 4.4 In this connection, it is firstly evident that the late raising of the objection of lack of sufficiency in respect of an alleged non availability of some partial boric esters is not justified as arising from the amendments made in the auxiliary request, since the formula of the boron compound indicated in granted Claim 1 already encompassed those partial boric esters whose availability is now contested.
- 4.5 It is further evident that this objection based on a non-availability of starting components is totally different from the objection originally raised in the Notice of Opposition which was directed against the coating procedure *per se* implied by granted Claim 2. Therefore, this objection put forward for the first time in the Statement of Grounds of Appeal constitutes a fresh ground for opposition, which being outside "the legal and factual framework" of the opposition, cannot be considered in the appeal proceedings without the

- approval of the patentee (see decisions of the Enlarged Board of Appeal G 9/91 and G 10/91, OJ 1993, 408 and 420, especially points 6 and 18 of the reasons; cf. also T 0281/01 of 18 November 2003; not published in OJ EPO; Reasons points 3.1 to 3.4).
- 4.6 Since such an approval has not been given by the Patentee, this late objection cannot be taken into consideration.
- 4.7 Thus, the issue of insufficient disclosure boils down only to the question as to whether the patent in suit provides sufficient information to obtain an epoxy adduct coated with a borate ester and a phenolic compound as claimed in Claim 2 of the auxiliary request.
- 4.8 In that respect, the Appellant has questioned the feasibility of method [D] (cf. paragraph [0013] of the patent in suit) but this issue is an issue which would normally be decided in the light of relevant experimental evidence. No such evidence was, however, submitted by the Appellant, which has the onus of the proof of its allegation (cf. T 182/89, OJ EPO, 1991, 391). Furthermore, the Board notes that Examples 15 and 16 of the patent in suit which illustrate the use of method [D] show that latent curing agents leading to epoxy compositions having a good storage stability (more than 30 days at 40°C) and a short curing time at a high temperature are indeed obtained.
- 4.9 Under these circumstances, the Board has no reason to doubt that method (D) would lead to an epoxy adduct coated with a boric ester and a phenolic compound and

having the expected efficiency in term of storage stability and curing properties.

- 4.10 This conclusion cannot be altered by the argument of the Appellant that the boric ester would hydrolyse into boric acid, since, on the one hand, hydrolysis reactions being equilibrium reactions, this does not preclude that some borate would still remain on the surface of the adduct, and since, in the other hand, the epoxy adduct would in any case have been at least intermediately coated with a borate compound before the postulated change of the borate into boric acid through hydrolysis.
- 4.11 Nor can the further argument of the Appellant that the boron compound might react with the epoxy adduct support an alleged lack of sufficient disclosure, since the wording "coating" does not exclude the possibility of a reaction between the surface to be coated (epoxy adduct) and the coating.
- 4.12 Thus, in summary it has not been shown to the satisfaction of the Board that there is a deficiency, in the patent in suit, in the sense of Article 100(b) or 83 EPC. Consequently, the ground of opposition under Article 100(b) EPC cannot succeed.

5. *Interpretation of the claims*

- 5.1 The language of independent Claims 1, 2 and 3 of the auxiliary request differs from that of independent Claims 1, 2 and 3 as granted in that the proviso that not all R_1 to R_3 are hydrogens in formula (I) has been incorporated in these claims and in that the expression

- "boron compound" used for designating the compound of formula (I) has been replaced by the expression "boric ester".
- 5.2 It is therefore evident that the language of the claims clearly and unambiguously excludes the use of boric acid as surface treating agent (Claims 1 and 3) and as surface coating agent (Claim 2).
- 5.3 In this context, while it is true, as mentioned by the Appellant, that paragraph [0015] of the amended description submitted with the letter of 26 April 2002 of the Patentee indicates that the boric esters "include the case where the boric acid ester is changed into boric acid through hydrolysis", this cannot, in the Board's view be interpreted as supporting the use of boric acid as surface treating or surface coating agent for the following reasons:
- 5.3.1 According to Article 69 EPC, the extent of protection conferred by a European patent is determined by the terms of the claims. As indicated above the language of the claims is perfectly clear as to the exclusion of the use of boric acid as treating or coating agent.
- 5.3.2 In any case, even if the claims would have needed to be interpreted in the light of the description, one should rule out such interpretations which are illogical, such as the one mentioned in paragraph 5.3 above which, on the one hand, would conflict with the clear exclusion of boric acid set out in Claims 1, 2 and 3, and which, on the other hand would have for its consequence that the claims of the auxiliary request would have the same scope as the main request based on the granted claims.

5.3.3 It thus follows that this passage of the amended description can only be interpreted as logically referring to the possible subsequent change of the boric ester after surface treating and/or surface coating into boric acid. This interpretation is further confirmed by the last three lines of paragraph [0015] which refer to the presence of boric acid in adduct **coated** with trimethyl borate.

6. *Novelty*

The novelty of the subject-matter of Claims 1 to 9 of the auxiliary request has been acknowledged by the Opposition Division and has not been challenged by the Appellant in the course of the appeal proceedings.

6.1 The Board is also satisfied that the requirements of Article 54 EPC are met by all the claims.

7. *Problem and solution*

7.1 The patent in suit relates to an epoxy composition containing a modified epoxy-amine adduct as curing agent having a long pot life at low temperature and curing quickly at high temperature.

7.2 Such compositions are known from document D4, which the Board in agreement with the Opposition Division considers as representing the closest state of the art.

7.3 D4 relates to epoxy resin compositions having a long pot life at room temperature and rapidly curable under heat-aging conditions. These compositions comprise (1)

an epoxy resin, (2) a hardener and (3) an epoxy compound-dialkylamine adduct as a latent hardener. The epoxy resin is one having two or more epoxy groups per molecule on average such as polyglycidyl ethers produced by reaction between polyhydric phenols or polyhydric alcohols and epichlorohydrin, polyglycidyl ether esters, polyglycidyl esters, glycidylamine compounds obtained from 4,4'-diaminodiphenyl methane, m-aminophenol or the like, epoxidized novolaks and epoxidized polyolefins.

The hardener (II) may include dicyandiamide, an organic acid hydrazide and a mixture thereof. The amount of the hardener used is 0.1 to 50 parts by weight, preferably 0.5 to 30 parts by weight based on 100 parts by weight of the epoxy resin (page 1, line 16 to page 2, line 25). The dialkylamine, in which the alkyl may be substituted, usable for the production of the present latent hardener (III) includes for example dimethylamine, diethylamine, dipropylamine, N-methylethylamine, N-ethylisobutylamine, diallylamine, dibenzylamine, N-ethylethanolamine and diethanolamine and the epoxy compound to be brought into reaction with these dialkylamines are, for example, monoepoxy compounds and the epoxy resins mentioned above (page 3, lines 1-10).

For the purpose of improving the storage stability of the curable compositions, the pulverized alkyl amine-epoxy adduct is preferably surface-treated with acidic substances such as sulfurous acid gas, hydrochloric acid, carbon dioxide gas, sulfuric acid, phosphoric acid, **boric acid**, formic acid, oxalic acid, acetic acid, propionic acid, lactic acid, caproic acid, salicylic acid, tartaric acid, succinic acid, adipic acid, sebacic acid, p-toluenesulfonic acid, **phenol**,

pyrogallol, tannic acid, rosin, polyacrylic acid, polymethacrylic acid, alginic acid, **phenol resins and resorcinol resins** (emphasis by the Board). The acidic substance is used in amounts enough to neutralize the amino groups which are present at the surface of the pulverized adduct. The amount of the powdery latent hardener used is preferably 0.1 to 30 parts by weight based on 100 parts by weight of the epoxy resin (page 4, lines 1-27). According to the examples of D4, the storage stability is greater than 14 days at 40°C and the gel time at 130°C is comprised between 5 and 14 minutes.

- 7.4 Starting from D4 the technical problem might be seen in the provision of epoxy resin compositions containing epoxy-amine adducts having an improved storage stability at low temperature and a short curing time at high temperature.
- 7.5 According to the patent in suit, this problem is solved by treating (Claims 1, 3) or coating (Claim 2) the surface of the epoxy-amine adduct with a composition comprising a boric ester as defined by formula (I) and a phenolic compound.
- 7.6 In view of the storage stability (greater than 25 days at 40°C) and the gel time (between 22 seconds and 330 seconds) of the exemplified compositions according to the patent in suit, the Board is satisfied that the technical problem is effectively solved by the claimed measures.

8. *Inventive step*

8.1 It remains to be decided whether the proposed solution was obvious having regard to the prior art relied upon by the Appellant (i.e. D4, D1, D2, and D8).

8.2 While it is true that D4 teaches to use acidic compounds such as boric acid and phenolic compounds to increase the storage stability of the epoxy composition comprising an epoxy-amine adduct, and that it could have been expected, as argued by the Appellant in view of document D6, that boric esters would work as carriers for boric acid, the comparison between the composition of Example 9 of the patent in suit (using 0.50 parts trimethyl borate, i.e. corresponding to 0.31 parts of boric acid in case of a complete hydrolysis) and that of Example 10 of the patent in suit (using 0.33 parts of boric acid) shows that a much better storage stability (i.e. greater than 30 days instead of 17 days) while maintaining a comparable curing time is obtained with the composition comprising the boric ester, despite a lower content of pyrogallol (acidic substance in the sense of D4). The argument of the Appellant that the presence of a greater amount of pyrogallol in the composition of Example 10 destroys the comparability with Example 9 (Section VII (ii.7) above) is not convincing to the Board, because pyrogallol on its own is taught in D4 to improve the storage stability. Consequently, the storage stability of the composition of Example 10 would be expected to be greater than that of Example 9, and the gel time at 40°C consequently longer, whereas the opposite is in fact the case. Hence, it is evident that, unexpectedly, boric esters do not behave as mere carriers for boric

acid in epoxy resin compositions comprising epoxy-amine adducts.

- 8.3 Furthermore, even if boric esters were considered as potential acidic substances in the sense of D4, the comparison between Examples 8, 9, 12, 13, 14 and 15 of the patent in suit (all using 1 part in total of boric ester + phenolic compound) with comparative Example 1 (1 part boric acid, i.e. an acidic substance according to D4) further shows that the compositions according to the patent in suit exhibit a superior storage stability (more than 30 days instead of 1 day) and a short curing time (i.e. between 22 and 26 seconds), i.e. in other words that the combination of a boric ester with a phenolic compound leads to an unexpected improvement of the storage stability with respect to the use of boric acid alone.
- 8.4 Consequently, D4, which does not refer to the use of boric esters, let alone to a combination of a boric ester with a phenolic compound, cannot itself give a hint to the solution proposed in the patent in suit.
- 8.5 Document D1 relates to a composition for curing a polyepoxide resin which contains an inhibiting amount of boric acid or maleic acid or a mixture of boric acid with at least one acid having a weak nucleophilic anion; a curing agent and optionally a catalytic amount of a catalyst useful for accelerating the reaction of a polyepoxide with the curing agent (page 4, lines 25-30). Preferred curing agents are the aromatic hydroxyl containing compounds, anhydrides of polybasic acids, polyamines and amides (page 12, lines 32-33).

Catalysts useful in this invention are catalysts which catalyze the reaction of a polyepoxide with a curing agent, and which remain latent in the presence of the inhibitor at lower temperatures. Examples of preferred catalysts are compounds containing amine, phosphine, heterocyclic nitrogen, ammonium, phosphonium, arsonium or sulfonium moieties (page 12, lines 41-49). Examples of preferred amine containing compounds are the adducts of any aliphatic, cycloaliphatic, aromatic or heterocyclic secondary amine compounds and an epoxy resin having an average of more than one vicinal epoxide group per molecule (page 13, lines 57-58). According to D1, the term "boric acid" used therein is intended to refer to boric acid and derivatives and boric acid might be added to the epoxy composition in form of a solution in a lower alcohol (e.g. methanol) (page 17, lines 23-24; lines 30-39).

- 8.6 More precisely, D1, in its Examples 130 to 133, 135 to 137, discloses compositions comprising an epoxy resin, a phenolic novolak curing agent, an imidazole catalyst and boric acid added in form a methanol solution.
- 8.7 While one might consider that D1 implicitly discloses the use of a boric ester since boric acid is added in form a methanol solution (cf. also D7 referred to by the Appellant in that respect), and that therefore the compositions disclosed in these examples only differ from those of the patent in suit by the use of an imidazole instead of epoxy-amine adduct, the Board, however, observes that these compositions exhibit a rather long curing time at 170°C comprised between 153 seconds (Example 136) and 348 seconds (Example 133),

and that no information is given on their storage stability.

- 8.8 The Board further notes that, in D1, the inhibition of the reaction of the polyepoxide resin with the curing agent is only related to the use of boric acid or a derivative thereof (page 17, lines 23-26), and that the phenolic compounds which might be used in the compositions of D1 are only presented as curing agents among others against which the inhibiting activity of the boric acid is directed. Thus the Board can only come to the conclusion that D1 contains absolutely no suggestion that a combination boric ester/phenolic compound would have a stabilizing effect on polyepoxide compositions comprising further curing agents, let alone that the use of a borate ester in association with a phenolic compound would allow the preparation of epoxy resin compositions containing an epoxy-amine adduct having a very good storage stability at 40°C (more than 25 days) in combination with a short curing time at the lower temperature of 150°C (between 22 seconds to up to 330 seconds) as shown by the examples according to the patent in suit.
- 8.9 Consequently, D1 cannot provide any assistance to the solution of the technical problem.
- 8.10 Document D2 relates to latent curing agent for epoxy resins which allow the preparation of epoxy resin compositions exhibiting a rapid curing at temperatures between 120 and 130°C and excellent long-term storage stability at room temperature. The latent curing agent is obtained by reacting a polyfunctional epoxy compound, with an imidazole compound, an acidic compound selected

from the group comprising boric acid, pyrogallol and gallic acid, and optionally an accelerating compound such as a polyvalent phenolic compound (page 4, line 1 to page 5, line 4).

8.11 More precisely, in its Examples A-4 (Table 1-1) and B-4 (Table 1-2) D2 discloses latent curing agents obtained by reacting an epoxy resin with an imidazole component, boric acid, and pyrogallol. While these specific curing agents lead to epoxy compositions having a good storage stability at 40°C, e.g. respectively greater than 25 and 30 days, the Board however notes that the respective curing times at 120°C are 20 and 40 minutes (Tables 3-1 and 3-2).

8.12 In this connection, Comparative Example 3 of the patent in suit (curing time greater than 1800 seconds i.e. 30 minutes at 150°C) which exemplifies the use of a latent curing agent prepared according to D2 further confirms that the epoxy compositions according to D2 lead to compositions having a drastically longer curing time than those observed for the compositions according to the patent in suit.

8.13 Thus, even if one would assume, in favour of the Appellant (Section VII (ii.5), above) that an epoxy-amine adduct would necessarily be formed during the preparation of the latent curing agent according to D2, document D2, which does not refer at all to the use of boric esters, nevertheless cannot suggest that the use of a boric ester instead of boric acid would allow the manufacture of epoxy compositions comprising an epoxy-amine adduct curing agent having a much faster curing at high temperature while maintaining a long storage

stability at low temperature. Hence, D2 would not offer to the skilled person a hint to the solution of the technical problem.

8.14 Document D8 has been cited by the Appellant in order to support, in its view, a well known interchangeability of boric acid with boric esters in epoxy compositions. Independently of the fact that D8 does not relate to epoxy compositions comprising epoxy-amine adducts, it is further evident as shown (cf. paragraph 8.2 above) that boric acid and boric esters are clearly not interchangeable in epoxy resin compositions comprising epoxy-amine adducts. Consequently, document D8 cannot lead to the solution of the technical problem.

8.15 It follows from the above that the solution of the technical problem does not arise in an obvious way from the state of the art.

8.16 This conclusion would not be altered if one would have taken, as successively done by the Appellant, document D1 and document D2 as closest state of the art instead of document D4 for the following reasons:

(i) The line of argument of the Appellant starting from D1 was that it would have been obvious to replace the imidazole component used in the compositions disclosed in the Examples 130 to 133, 135 to 137 of D1 by an epoxy-amine adduct since these adducts belong to the preferred catalysts according to D1.

(ii) As indicated above in paragraph 8.7, the compositions disclosed in these examples

exhibit a rather long curing time at 170°C, and no precise indication is given on their storage stability.

- (iii) Thus, starting from D1, the question is not merely whether the skilled person could have replaced the imidazole compound by an epoxy-amine adduct in these exemplified compositions, but indeed whether he would have carried out this change with the aim to obtain epoxy resin compositions comprising an epoxy-amine curing agent having a good storage stability (more than 25 days at 40°C) and a reduced curing time at high temperature.

- (iv) Since D1 is indisputably focussed on the use of boric acid or a derivative thereof as inhibiting component in epoxy resin compositions comprising a curing agent, it is evident that it could not itself suggest that the association of a boric ester with a phenolic compound, i.e. a further curing agent in the sense of D1, would allow the production of such epoxy compositions comprising an epoxy-amine adduct having the requested storage stability and curing properties.

- (v) Consequently, the argument of the Appellant based on D1 as closest state of the art cannot succeed.

- (vi) The line of argument of the Appellant starting from D2 was that an epoxy-amine adduct would be inevitably produced in the process for making

the latent curing agent of D2, and that it would have been obvious to replace the boric acid by a boric ester in view of their known interchangeability in epoxy resin compositions.

- (vii) Even if one would admit that an epoxy-amine is inevitably formed in the process disclosed in D2 for the preparation of the latent curing agent, it has been shown (cf. paragraphs 8.2 and 8.12 above) that there is no such interchangeability of boric acid with boric ester so that the argument of the Appellant must fail.

8.17 Consequently the subject-matter of Claims 1, 2 and 3, and by the same token that of Claim 9, which is directly related to that of these claims involve an inventive step. Furthermore, the subject-matter of Claims 4 to 8 which are directed to methods for obtaining an epoxy composition according to Claim 1 also involve an inventive step (Article 56 EPC).

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The President:

E. Görgmaier

R. Young