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

Case Number: T 1247/03 - 3.3.3

Application Number: 93908957.9

Publication Number: 0637324

IPC: C08G 59/18

Language of the proceedings: EN

Title of invention:

Aqueous hardeners for epoxy resin systems

Patentee:

AIR PRODUCTS AND CHEMICALS, INC.

Opponent:

Prümmer, Ulf

Headword:

-

Relevant legal provisions:

EPC Art. 54, 56

Keyword:

"Novelty - (yes) "

"Inventive step (yes) "

Decisions cited:

T 0205/83, T 0355/99

Catchword:

-



Case Number: T 1247/03 - 3.3.3

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

Appellant: Prümmer, Ulf
(Opponent) Polymer-Chemie GmbH
D-88487 Mietingen-Baltringen (DE)

Representative: -

Respondent: AIR PRODUCTS AND CHEMICALS, INC.
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Decision under appeal: Decision of the Opposition Division of the
European Patent Office dated 23 September 2003
and posted 23 October 2003 rejecting the
opposition filed against European patent
No. 0637324 pursuant to Article 102(2) EPC.

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. 0 637 324 in the name of Air Products and Chemicals, Inc. in respect of European patent application No. 93 908 957.9 filed on 15 April 1993 and claiming the priority of EP patent application No. 92 201 096 filed on 21 April 1992 was announced on 28 June 2000 (Bulletin 2000/26) on the basis of 11 claims.

Independent Claims 1 and 11 read as follows:

"1. A process for the preparation of an aqueous emulsion of an active amino group-containing epoxide adduct hardener for curing epoxy resin systems, characterised by converting an aqueous solution of an active amino-group-containing hardener, which can emulsify the epoxy resin used for adduct formation, to an adduct emulsion by mixing with an epoxy resin having an epoxy functionality of 1,2-3,5 and a weight average molecular weight of at least 700, the epoxy resin in liquid form being mixed with said solution so as to be emulsified thereby as an adduct having an increased amino-H-equivalent weight.

11. Application of emulsions produced according to any preceding claim together with epoxy resins as additive for hydraulic binders such as cement."

Claims 2 to 10 were dependent claims.

- II. A Notice of Opposition was filed against the patent by Ulf Prümmer Polymer-Chemie GmbH on 27 March 2001. The Opponent requested complete revocation of the patent

based on Article 100(a) EPC (lack of novelty and lack of inventive step).

The opposition was supported by the following documents:

E1: EP-B-0 103 908;

E2: JP-A-58-23 823 (partial English translation); and

E3: Römpp's Chemie-Lexikon, 9th Edition, pages 835-83.

III. By a decision announced orally on 23 September 2003 and issued in writing on 23 October 2003 the Opposition Division rejected the opposition.

IV. According to the decision of the Opposition Division, the grounds of opposition raised by the Opponent i.e. lack of novelty and lack of inventive step did not prejudice the maintenance of the patent as granted.

The decision held that the subject-matter of process Claim 1 differed from Example 1 of document E1 in that an aqueous solution of the active amino compound was formed prior to the addition of the epoxy compound. It held that the subject-matter of Claim 1 was also novel over Example 3 of E1, since it had not been shown by the Opponent that the "Härterkomponente A" of Example 3 of E1 was water soluble. The decision further stated that, in order to come within the subject-matter of Claim 1, two selections needed to be made from the description of E1, i.e. choosing water soluble hardeners and using a surplus of hardener so that the final compound would carry active amino groups.

The decision held that the subject-matter of process Claims 1 to 10 was novel over document E2 which disclosed an aqueous dispersion of an epoxy resin hardener comprising an epoxy resin, an amine compound (e.g. cyclohexylamine), water and other additives, since cyclohexylamine was water miscible not water soluble (cf. document E3), since E2 disclosed that if water soluble amines were used they should be modified to become insoluble or hardly soluble and since, even if a water miscible amine was used, said amine was not dissolved in water to form an aqueous solution.

The decision held that the subject-matter of use Claim 11 was novel over E1, since it had been shown by the additional experiments (referred to as document E4) submitted by the Patentee with its letter dated 23 July 2003, that the aqueous hardeners of the patent in suit had different properties compared with those of the hardener of Example 1 of E1, and since no epoxy resin was present together with the hardener of Example 3 of E1. The subject-matter of this claim was also novel over E2, since E2 disclosed that only insoluble or hardly soluble amines were suitable for the preparation of the dispersion, and since no aqueous solution of the amine was disclosed in E2.

According to the decision, Examples 1 and 2 of document E1 were considered as the most relevant starting points for the assessment of inventive step.

The technical problem was seen as to provide a process for the preparation of aqueous emulsions of adduct hardeners having an improved stability and which could be diluted without phase separation. This problem was

solved by adding the amino hardener component in the form of an aqueous solution.

Since there was no indication in the cited prior art, that the addition of water before the epoxy resin was added to form the adduct would lead to said improvements, the subject-matter of Claims 1 to 11 was considered as involving an inventive step.

V. A Notice of Appeal was filed on 17 December 2003 by the Appellant (Opponent) with simultaneous payment of the requested fee. With the Statement of Grounds of Appeal filed on 20 February 2004, the Appellant submitted the following documents:

E6: Information leaflet of Akzo concerning the product Epilink[®] DP 660 and,

E7: Experimental report.

It also argued essentially as follows:

(i) Concerning novelty:

(i.1) According to E1 the amine hardener was added in an aqueous solution (cf. page 2, line 49)

(i.2) According to E1, the hardener might be used in excess over the epoxy resin (page 4, lines 35 to 39).

(i.3) Thus, the Opposition Division was wrong to apply the criteria for selection inventions, since these two features were explicitly disclosed as variants of the process of E1.

(i.4) Consequently, E1 was a novelty destroying for the subject-matter of Claims 1 and 11.

(ii) Concerning inventive step:

(ii.1) The intermediate product of Example 3 of E1 should be used as closest state of the art.

(ii.2) According to E1, the emulsions exhibited a stability between 0.5 and 8 hours. In that respect, the patent in suit contained no information concerning the stability of the claimed emulsions.

(ii.3) The annexed experimental report (E7) showed that hardener emulsions obtained by the procedure of Example 3 of E1 and using an excess of amine hardener had a stability of several weeks.

(ii.4) Furthermore, this experimental report showed that these emulsions led to the manufacture of homogenous films with good hardness.

(ii.5) Thus, the technical effect of an improved stability defined by the Opposition Division was disproved by the submitted comparative examples.

(ii.6) Consequently, the subject-matter of Claims 1 and 11 did not involve an inventive step.

VI. With its letter dated 7 July 2004, the Respondent (Patentee) submitted the following new documents:

E9: Declaration of Mr Clive Hare dated 22 June 2004;
E10: Analysis report of Dr Scott Hanton;
E11: Analysis report of Dr Michael Cook;
E12: US-A-4 569 971 (US equivalent of E1);
E13: US-A-4 415 682; and
E14: US-A-4 197 389.

It also argued essentially as follows:

(i) Concerning novelty:

(i.1) Document E1 was focussed on the preparation of emulsions of epoxy resin systems yielding as an end product a cured epoxy resin or a building element reinforced by a cured epoxy resin (cf. Examples 3 and 4).

(i.2) The term "stability" when used in connection with the emulsions of E1 referred to the pot life during which the emulsions provided by E1 could be processed.

(i.3) The possibility of using "excess or lesser amount" mentioned in E1 at page 4, lines 33 to 39 would be read by the skilled person as meaning "approximately stoichiometric amounts" (cf. E9 and E12 (column 4, lines 5 to 8)).

(i.4) Thus, the passage at page 4, lines 33 to 39 of E1 could not be interpreted as teaching the preparation of an aqueous emulsion of an adduct hardener capable to cure epoxy resins systems.

(i.5) In any case, only a multifold selection of features of E1 would lead to the subject-matter of Claim 1:

(a) using a water soluble hardener for adduct hardener formation,

(b) using an excess of hardener so that the resulting adduct would carry active amino groups, and

(c) using an epoxy resin having a molecular weight of at least 700.

(i.6) Thus, the subject-matter of Claims 1 to 10 was novel over E1.

(i.7) Concerning Claim 11, the experimental report E4 showed that the process of the patent in suit led to different products from those obtained according to E1.

(ii) Concerning inventive step:

(ii.1) E1 should be considered as the closest state of the art.

(ii.2) Starting from E1, the technical problem might be seen in the provision of adduct hardener emulsions which were stable, which could be conveniently handled, and which, when applied to an epoxy resin system led to an improved curing behaviour.

(ii.3) The experimental report E4 showed that this problem was effectively solved.

(ii.4) E1 was totally silent on the use of an aqueous solution of an active amino group containing hardener which must yield an emulsion of the adduct hardener obtained. This feature, as shown in E4, was relevant for obtaining good handling properties and an improved curing behaviour.

(ii.5) E1 was further silent on the use of an epoxy resin having a molecular weight of at least 700. This feature was particularly significant for the viscosity behaviour of the obtained emulsion.

(ii.6) Thus, inventive step of the subject-matter of Claims 1 to 11 would have to be acknowledged.

(ii.7) Example 3 of E1 could not taken as starting point since it was not concerned with the preparation of an adduct hardener.

(ii.8) The comparative examples submitted by the Appellant (E7) were not a true reproduction of Example 3, since they differed in the ratio hardener/epoxy resin, and in the epoxy resin used.

(ii.9) The epoxy resin component used in the preparation of hardeners I and II (Beckopox EP 384) would appear to contain a surfactant stabilizer. Furthermore, this compound was not part of the state of the art at the priority date of E1.

- (ii.10) The component Beckopox EH 623 used in the manufacture of hardeners III and IV contained an adduct of an epoxy resin with a polyethylene glycol. The use of such modified epoxy resin was not taught in E1.
- VII. With letter dated 9 September 2004, the Respondent submitted the following document:
- E15: Curriculum Vitae of Mr Clive Hare.
- VIII. With its letter dated 28 January 005 the Respondent informed the Board that it would be accompanied by Dr Frederik H Walker as technical expert at the oral proceedings scheduled for 3 May 2005.
- IX. With its letter dated 21 March 2005 the Appellant informed the Board that it would be accompanied by Dr Ludwig Hülskämper as technical expert at the oral proceedings scheduled for 3 May 2005.
- X. With its letter dated 5 April 2005, the Respondent submitted a set of Claims 1 to 10 as an auxiliary request.
- XI. Oral proceedings before the Board were held on 3 May 2005.

At the oral proceedings the discussion essentially focussed on (i) the assessment of novelty in view of document E1 and (ii) on the assessment of inventive step taking E1 as the closest state of the art.

The arguments presented by the Parties in that respect may be summarized as follows:

(a) Concerning novelty:

(a.1) By the Appellant:

(a.1.1) According to E1 (page 2, lines 42-48) a hardener was made by reacting a polyamine compound with an epoxy resin.

(a.1.2) According to E1 (page 2, line 49) this hardener was dissolved in water.

(a.1.3) According to E1 (page 2, lines 49-52) the aqueous solution of the hardener was mixed with an epoxy resin and a stable emulsion with a pot life of 0.5 to 8 hours was obtained.

(a.1.4) According to E1 (page 4, lines 36-37) the hardener could be used in excess.

(a.1.5) Thus, E1 disclosed an aqueous emulsion of an active amino groups containing epoxy adduct hardener.

(a.1.6) Thus, there was no structural differences between the emulsion obtained according to E1 and that obtained according to the process of Claim 1 of the patent in suit.

(a.1.7) It was further clear that other components (e.g. epoxy resins) might be added to the stable aqueous emulsion of E1 (page 2, lines 51-53).

(a.1.8) According to Example 3 of E1, an aqueous solution of the hardener was mixed with an epoxy resin. Even if it could be conceded that in this example stoichiometric amounts of hardeners and epoxy resin had been used, so that was no active amino groups in the adduct formed, it was clear that lines 36 to 37 on page 4 of E1 also taught to use an excess of hardener.

(a.2) By the Respondent:

(a.2.1) Document E1 related to the preparation of an epoxy resin system which could be used as additive in hydraulic binders (page 2, lines 1-2 and 26-29).

(a.2.2) Lines 49 to 51 on page 2 of E1 did not relate to the preparation of an hardener but to the preparation of such an epoxy resin system.

(a.2.3) The term "hardener" in E1 was only used in connection with the compound mixed with the epoxy resin.

(a.2.4) The epoxy resin system was not used as an hardener but as an additive for hydraulic binders.

(a.2.5) It belonged to the common general knowledge of the skilled person that an hardener was a compound which was added to a curable resin in order to cure it. Reference was made to the definition of "Härter" in Rompp's Chemie Lexikon.

(a.2.6) According to E1, the manufacture of the hardener was illustrated by Examples 1 and 2.

(a.2.7) Example 3 and 4 illustrated the use of these hardeners in epoxy resin systems for hydraulic binders.

(a.2.8) The tests made by the Appellant in its experimental report could not be considered as a repetition of Example 3 of E1, since they had been carried at a ratio amino groups/epoxy groups of 5:1 or 2.5:1 instead of the stoichiometric ratio of 1:1 used in Example 3. Thus no conclusion could be drawn from these examples concerning the stability of the emulsions.

(a.2.9) Example 3 would in no case result in an emulsion of an adduct since the epoxy resin would be cured by the hardener.

(a.2.10) Furthermore, it was not disclosed in Example 3 whether the hardener was in the form of an aqueous solution.

(a.2.11) Thus, E1 could not be novelty destroying for the subject-matter of the patent in suit.

(b) Concerning inventive step:

(b.1) By the Appellant:

(b.1.1) Starting from E1 the technical problem was seen in the provision of epoxy resin compositions for hydraulic binders having improved properties.

(b.1.2) In Example 3 of E1 an aqueous solution of the hardener had been used. The claimed subject-matter distinguished from Example 3 by the use of an epoxy

resin having a molecular weight of at least 700 (i.e. an equivalent weight of 350 for a bifunctional epoxy resin) and the use of an excess of hardener.

(b.1.3) According to page 3, lines 25 to 27 of E1 epoxy resins having a equivalent weight of up to 500 were preferably used.

(b.1.4) It also belonged to the general knowledge of the skilled person that a post-hardening process improved the properties of epoxy resin compositions. According to this process the hardener was reacted in a first stage with a low amount of epoxy resin (i.e. the hardener was used in excess), and in a second stage the rest of epoxy resin was added.

(b.1.5) Furthermore, it was known that it was advantageous to use an excess of amine hardener in order to improve the corrosion properties of concretes incorporating epoxy resin compositions.

(b.1.6) E1 also taught to use an excess of hardener (page 4, lines 36-37).

(b.1.7) Thus, the claimed subject-matter derived in an obvious way from E1.

(b.2) By the Respondent:

(b.2.1) Starting from E1, the technical problem was to provide low viscosity hardener emulsions being storage stable and leading to epoxy compositions hardening more rapidly and exhibiting a high hardness. Reference was

made to paragraphs [0026], [0027], and [0033] of the patent in suit.

(b.2.2) The experimental report E4 showed that the emulsions prepared according to the invention had a much lower viscosity (cf. E4, page 7, Fig. 2) and that they led to more rapid curing and to a better hardness (page 9, Table 2).

(b.2.3) Furthermore, Figure 1 of the patent in suit showed that the use of epoxy resin having a molecular weight higher than 700 was essential to the viscosity profile of the emulsions.

(b.2.4) The composition of Example 3 would, as conceded by the Appellant cure within 2 hours. It was clear that Example 3 was directed to the obtaining of a solid product. Therefore, there would have been no hint to use an excess of amine hardener, which would deteriorate this solidification process.

(b.2.5) Only Examples 1 and 2 of E1 were directed to the manufacture of an hardener. It was however evident that the amine compound used for making the hardener was added neat (Example 1) or dissolved in an organic solvent (Example 2) to the epoxy resin.

(b.2.6) E1 did not rely on a post hardening process. Example 3 which illustrated a best mode to carry out the process of E1 did not disclose such a two step process.

(b.2.7) It was clear that the use of an aqueous solution of the amine hardener, of an excess of amine

hardener over the epoxy resin, and of an epoxy resin having a molecular weight of at least 700 were essential to solve the technical problem.

(b.2.8) The combination of these features could not have been suggested by E1.

XII. The Appellant requested that the decision under appeal be set aside and the European patent No. 637 324 be revoked.

The Respondent requested that the appeal be dismissed, or in the alternative, that the decision under appeal be set aside, and the patent be maintained on the basis of the auxiliary request submitted with the letter of 5 April 2005.

Reasons for the Decision

1. The appeal is admissible.

Main request

2. *Novelty*

2.1 Document E1 is the only document on the basis of which lack of novelty of the subject-matter of Claims 1 to 11 has been alleged by the Appellant during the appeal procedure.

2.2 Document E1 relates to epoxy resin systems emulsifiable with water comprising a liquid epoxy resin and a

hardener component characterized in that the hardener component comprises:

(a) 65 to 95% by weight of adduct containing free amino groups of 35 to 94% by weight of at least one member of the group consisting of polyamines, polyaminoamides and polyaminoimidazolines and 5 to 30% by weight of at least one glycidyl compound, based on the total hardener composition weight (i.e. containing free amino groups),

(b) 0.1 to 5% by weight of at least one aliphatic or aromatic carboxylic acid and

(c) 0.9 to 30% by weight of a phenol-modified aromatic hydrocarbon resin with a hydroxyl group content of 0.9 to 6% (Claim 1).

These epoxy resin systems are used as additives in hydraulic binders (page 2, lines 1-2, lines 26 to 29). The building materials obtained are pore-free and exhibit excellent strength, good resistance to frost and good adhesion to the respective substrate (page 2, line 61 to page 3, line 2).

According to E1, the hardener component is dissolved in water or emulsified with water and then mixed with vigorous agitation with the corresponding amount of epoxy resin without the addition of a tenside or any other emulsifier or dispersing agent. The aqueous emulsion prepared by this method has a pot life of approximately 1/2 to 8 hours depending on the combination and can be mixed within this time with hydraulic binders and, if needed, fillers and aggregate. The addition to the hydraulic binders can be carried

out by adding the epoxy resin/hardener emulsion to the complete construction mix premixed with water, or by mixing the epoxy resin emulsion first with the mixing water and then adding the binder and aggregate materials (page 2, lines 49-56).

According to E1, preferred glycidyl compounds are bisphenol A and bisphenol F based resins with an epoxy equivalent weight of 175 to 500 (page 3, lines 26-27). As indicated in E1, the hardener and the epoxy resin are preferably used in approximately equivalent amounts, calculated with respect to active hydrogen atoms in the amine and reactive epoxy groups for this purpose, but it is also possible to use hardener and epoxy resin component in excess or lesser amount (page 4, lines 35-37).

- 2.3 More precisely E1 discloses in its Examples 1 and 2 the manufacture of the hardener component. According to Example 1, a mixture of 700 g of a commercially available polyaminoamide containing polyaminoimidazole with an amine equivalent of 95 and 100 g of a diglycidyl ether of bisphenol-A with an epoxy equivalent of 190 g was stirred at 90°C for two hours and then 10 g of lactic acid and 190 g of a phenol-modified aromatic hydrocarbon resin with a hydroxyl content of 3% were added to the mixture which was then cooled to obtain a light-brown, liquid product with a viscosity of 8600 mPa.s at 25°C which was designated hardener A.

According to Example 2, a mixture of 495 g of a commercially available polyaminoamide containing polyaminoimidazoline and 55 g of tetraethylenepentamine

having an amine equivalent of 77 was reacted at 80°C with stirring for two hours with a solution of 150 g of solid diglycidyl ether of bisphenol A with an epoxy equivalent of 190 in 15 g of ethylhexyl glycidyl ether. The resulting adduct was mixed with 5 g of acetic acid and 292 g of a phenol-modified cumarone-indene resin with a hydroxyl content of 2.5% and the mixture was cooled to obtain a dark-brown mixture with a viscosity of 21 000 mPa.s at 25°C. The mixture was emulsified with 1000 g of water with stirring to obtain hardener B emulsion.

- 2.4 E1 further discloses the use of epoxy resin systems comprising hardener A (Example 3) and hardener B (Example 4) as additives in hydraulic binders compositions. According to Example 3, 195 g of hardener A were added with stirring to 330 g of water and then 250 g of a bisphenol-A epoxy resin with an epoxy equivalent of 190 and a viscosity of 12,000 mPa.s at 25°C were added thereto. The mixture was emulsified with vigorous stirring and then 5 kg of Portland cement PZ 35, 15.5 kg of standard sand according to DIN 1164 and 1,450 g of water were added to the epoxy resin emulsion with vigorous stirring. The water to cement ratio was 0.36 and the resulting mixture was a properly fluid material that could be pumped. The material had a density of 2,270 kg/m³ and had a value of 160 mm in the spreading test of DIN 1164. Samples were prepared from the mixture and the hardened mortar was tested outdoors for strength using the test of part 7 of DIN 1164 for 12 months.

According to Example 4 a mixture of 400 g of hardener B emulsion and 250 g of a bisphenol-A epoxy resin with an

epoxy equivalent of 190 and a viscosity of 12,000 mPa.s at 25°C was emulsified with vigorous stirring and using the procedure of Example 3, the emulsion was admixed with 5.0 kg of Portland cement PZ 35, 15.5 kg of standard sand and 1,600 g of water (water-cement ratio of 0.360) to form a mortar which was fluid and could be pumped. The mixture had a density of 2,285 kg/m³ and had a value of 170 mm in the spreading test of DIN 1164.

2.5 In this connection, the Board notes that Claim 1 of the main request requires, explicitly, that

(a) the active amino-group adduct containing epoxide adduct hardener is made by reacting an aqueous solution of an active amino-group containing hardener with an epoxy resin; and

(b) that the epoxy resin has a molecular weight of at least 700;

(c) that the obtained active amino-group adduct containing epoxide adduct hardener be emulsified in water; and, implicitly, that

(d) the amino-group containing hardener is reacted in excess in respect to the epoxy resin.

2.6 According to the decision T 355/99 of 30 July 2002 (not published in OJ EPO), it is not sufficient for a finding of lack of novelty that the claimed features could have been derived from a prior art document, there must have been a clear and unmistakable teaching of the claimed features (Reasons, point 2.2.4).

2.7 Thus, the question boils down as to whether there is in E1 a clear and unmistakable teaching of the combination of features mentioned above in paragraph 2.5 taking into account that the enabling disclosure of a document is not restricted to its worked examples.

2.8 In that respect, it is evident (cf. paragraph 2.3, above) that Examples 1 and 2 of E1 cannot destroy the novelty of the subject-matter of Claim 1 of the patent in suit, since they disclose neither the use of an aqueous solution of an amino-group active hardener for the manufacture of the amine epoxy adduct hardener, nor the use of an epoxy resin having a molecular weight of at least 700.

2.9 Nor could Example 3 be novelty destroying for the subject-matter of Claim 1, even if one would consider, as submitted by the Appellant, that Hardener A obtained in Example 1 has been added in form of a solution in water,

(i) firstly, since, it is, in the Board's view, evident that Example 3 is directed to the manufacture of a cement composition comprising as additive a **solid epoxy resin** which has been cured by hardener A, so that it must be concluded that Example 3 is not concerned at all with the manufacture of an aqueous emulsion of an active amino-group containing epoxide adduct;

(ii) secondly, since, as conceded by the Appellant, the hardener A and the epoxy resin are used in a stoichiometric amount, while a large excess of amine hardener would have been necessary to obtain an active amino group containing epoxide adduct; and, thirdly

- (iii) since the molecular weight of the epoxy resin used in this example is lower than 700.
- 2.10 Example 4 is even less relevant than Example 3, since it is immediately evident that the hardener B is added in form of an aqueous emulsion instead of in form of an aqueous solution as required by Claim 1 of the patent in suit.
- 2.11 When trying to challenge the novelty of the subject-matter of Claim 1 of the patent in suit, the Appellant relied on the description of E1 (cf. paragraph XI a.1; above), and submitted that the process disclosed in E1 for making the epoxy/hardener aqueous emulsion inevitably resulted in the manufacture of an active amino groups containing epoxy adduct emulsified in water as claimed in Claim 1 of the patent in suit.
- 2.12 While it might be true that E1 teaches that an aqueous solution of the amine hardener might be mixed with an epoxy resin in order to obtain an epoxy resin/hardener aqueous emulsion having a pot life of 0.5 to 8 hours (page 2, lines 49 to 52), that E1 indicates that the epoxy resin has preferably an equivalent weight of 180 to 500 (page 3, line 26-27), and that it mentions that an excess of hardener might be used (page 4, lines 36-37), it is nevertheless clear, based on an objective reading of E1, that all these considerations are made in the context of obtaining a **solid** epoxy resin cured by the hardener component as further illustrated by the Examples 3 and 4, so that the skilled person would not derive from these passages of E1 that they relate to the preparation of an aqueous emulsion of active-amino

group containing epoxy adduct hardener as claimed in Claim 1 of the patent in suit.

2.13 Furthermore, even if one would disregard the objective finality of the aqueous epoxy resin/hardener emulsion of E1, and if one would literally consider the process steps as such, it remains indisputable that E1 offers several options for the preparation of this aqueous emulsion:

(a) the addition of the amine hardener (a.1) either in form of an aqueous solution or (a.2) in form of an aqueous emulsion (page 2, line 49);

(b) the choice of an epoxy resin having an equivalent weight between 190 and 500; and

(c) the use of the amine hardener (c.1) in stoichiometric amounts with the epoxy resin, (c.2) in excess to the epoxy resin, or (c.3) in a lower amount than the epoxy resin.

2.14 Thus, in view of the several options which can be chosen for the preparation of the aqueous emulsion, it cannot be concluded that, when an aqueous solution of the amine hardener is used, it will be inevitably combined with the epoxy resin using an excess of hardener to epoxy resin, let alone that the epoxy resin used would inevitably have a molecular weight of at least 700.

2.15 Consequently, the Board comes to the conclusion that E1 does not directly and unambiguously disclose the process of Claim 1 of the main request, and that the

- subject-matter of Claim 1 and by the same token that of dependent Claims 2 to 10 is novel over document E1.
- 2.16 The subject-matter of Claim 11 is directed to the application of the emulsions produced according to the process of Claim 1 together with an epoxy resin as additive for hydraulic binders.
- 2.17 As indicated above in paragraph 2.2, E1 deals with the manufacture of an hardener component and application thereof either in form of a solution or of an emulsion together with epoxy resins as additive for hydraulic binders.
- 2.18 It follows from these considerations that the subject-matter of Claim 11 can only be novel over the disclosure of E1 provided the aqueous emulsions of an active amino group containing epoxide adduct hardener obtained according to the process of Claim 1 are different from, i.e. novel over the aqueous emulsions of an active amino group containing epoxide adduct hardener according to E1.
- 2.19 In this context, it is firstly noted by the Board that the hardener component according to E1 is prepared by reacting the active amino group containing hardener either neat (Example 1) or in a solvent (Example 2) with the epoxy resin, and that the hardener is, in a further step, stirred (Example 3) or emulsified (Example 2) in water.
- 2.20 This implies that the preparation of the aqueous emulsions of hardener component according to the patent in suit differs from that of the aqueous emulsion of

- the hardener component according to E1 at least in that the active amino group containing hardener is added to the epoxy resin in form of an aqueous solution.
- 2.21 In this connection it is established case law of the Boards of Appeal, that process features can only contribute to the novelty of the product obtained insofar as they give rise to a distinct and identifiable characteristic of the product.
- 2.22 In decision T 205/83, (OJ EPO 1985, 363; Reasons 3.2.1) this concept was developed by stating that "to establish novelty [of the polymeric product of a process], it will be necessary to provide evidence that modification of the process parameters results in other products" and by pointing out that such evidence may be constituted by "conclusive considerations which accord with the general state of the art" or by demonstrating "distinct differences in the products' properties", because "differences in the properties of products indicate a structural modification."
- 2.23 In that respect, the Board observes, in view of document E4, that the aqueous hardener emulsions prepared according to the patent in suit have a much lower viscosity than those prepared according to the process of Example 2 of E1 (cf. E4, page 7, Figure 2), and that they lead to epoxy compositions having a faster curing and an increased hardness in comparison to those obtained according to the process of Example 2 of E1.

2.24 Since the preparation of the respective emulsions only differ in that the amino group containing hardener has been added in the form of an aqueous solution (according to the patent in suit) instead of being reacted in a solvent (according to E1), the Board, following the principles set out in decision T 205/83, can only come to the conclusion that the aqueous emulsions prepared according to the process of the patent in suit exhibit some "fingerprints" resulting from the admission of the active amino-group containing hardener in form of an aqueous solution during their preparation, so that they represent different products from the hardener emulsions according to E1.

2.25 Consequently, the subject-matter of Claim 11 must be regarded as novel over E1 (Article 54 EPC).

3. *Problem and solution*

3.1 The patent in suit concerns the manufacture of aqueous emulsions of active amino group containing epoxy adduct hardeners which are suitable together with epoxy resin as additives for hydraulic binders.

3.2 Such a process is known from document E1. Although there was an agreement between the Parties to consider E1 as the closest state of the art, the Appellant submitted that Example 3 thereof would constitute the best starting point for assessing inventive step, while the Respondent regarded Examples 1 or 2 as the only valid starting points in that respect.

3.3 According to the Appellant, starting from Example 3, the technical problem would be hence to improve the final properties of the cured epoxy compositions used as additive in hydraulic binders.

3.3.1 In this connection, the Board, however, notes that Example 3 of E1 relates to the use of the hardener prepared in Example 1 for curing an epoxy composition used as additive in an hydraulic binder.

3.3.2 Even if one would accept that the hardener of Example 1 is in the form of an aqueous solution, it is evident that the intermediate emulsion with the epoxy resin is an unstable product which reacts to form a solid crosslinked epoxy resin, so that it is evident that Example 3 cannot be considered as teaching the preparation of a stable emulsion of an active amino group containing epoxy adduct hardener, while an object of the patent in suit is to provide storable and transportable emulsions (cf. patent in suit paragraph [0014]). Consequently, Example 3 cannot constitute a valid starting point for the assessment of inventive step.

3.4 On the contrary, Examples 1 and 2 relate to the preparation of an amino active group containing epoxy adduct hardener which can be dispersed into water for further use. Among Examples 1 and 2, Example 2 is the only one which explicitly refers to the preparation of an aqueous emulsion of the hardener, and it, hence, represents the more appropriate starting point for the assessment of inventive step.

- 3.5 Starting from Example 2 of E1, the technical problem may be seen in the preparation of aqueous emulsions of active amino group containing epoxy adduct hardeners having a lower viscosity, good stability, and leading to epoxy compositions having reduced curing time, and, when cured having improved strength (patent in suit, paragraphs [0025], [0026], and [0033]).
- 3.6 According to Claim 1 of the main request, this problem is solved by using an aqueous solution of the amino group containing hardener to be reacted with the epoxy resin having a molecular weight of at least 700 in the preparation of the aqueous emulsion of the active amino group containing epoxy adduct hardeners.
- 3.7 As indicated above in paragraph 2.23, document E4 shows that the use of an aqueous solution of the amino group containing hardener obtained according to the process of the patent in suit leads to aqueous emulsions having a much lower viscosity and to epoxy resin compositions having a faster curing and an increased hardness in comparison to the hardener emulsions prepared according to the process of Example 2 of E1. Furthermore, Figure 1 of the patent in suit shows that the use of an epoxy resin having a molecular weight of at least 700 is essential to the obtaining of an aqueous emulsion of low viscosity. Thus, the Board is satisfied that the technical problem is effectively solved by the claimed measures.
- 3.8 This conclusion cannot be altered by the comparative tests carried out in Experimental Report E7 submitted by the Appellant with its Statement of Grounds of Appeal.

- 3.8.1 This is, primarily, because, being presented as repetitions of Example 3 of E1, these tests are *de facto* irrelevant, since, as indicated above, this example is not concerned at all with the manufacture of an aqueous emulsion of an active amino group containing epoxy adduct hardener but relates to the use of the hardener prepared in Example 1 for curing an epoxy composition used as additive in an hydraulic binder.
- 3.8.2 Furthermore, it is evident that these comparative tests cannot be considered as a repetition of Example 3 of E1, since they have been carried out at ratios amino groups/epoxy groups (5:1 or 2.5:1) which do not correspond to the ratio used in Example 3 (1:1).
- 3.8.3 In this connection, it belongs, however, to the general knowledge of the skilled person that stoichiometric or approximately stoichiometric amounts of hardener and epoxy resin should be used to obtain a cured epoxy resin, as illustrated in Example 3. A substantial deviation from the preferred stoichiometric amounts would evidently not only vitiate the curing function of the hardener in the example, but would also cause the hardener to become something else, since the final product would then itself be a hardener.
- 3.8.4 It thus follows that the use of very large excess of hardener to epoxy resin (i.e. 5:1 or 2,5:1), as done in the experimental report E7, clearly represents a distortion of the teaching of Example 3 of E1, so that these comparative tests of E7 cannot be used for comparative purposes between the hardener emulsions

prepared according to the patent in suit and those of E1.

3.9 Inventive step

It remains to be decided whether this solution was obvious to a person skilled in the art having regard the art relied upon by the Appellant.

3.9.1 Document E1 teaches to react the amino group containing hardener with the epoxy resin during several hours at a temperature between 60 to 100°C (page 3, lines 63-65), and, as illustrated in the examples, this reaction is carried either with the neat components (Example 1) or in an organic solvent (Example 2). E1 does not mention, even in passing, the use of an aqueous solution of the amino group containing hardener for making the adduct. Furthermore, while E1 indicates that epoxy resins having an epoxy equivalent weight of 175 to 500 are preferably used, it does not put a specific emphasis on the use of epoxy resin having a molecular weight of at least 700, and can, hence, even less suggest the drastic effect of the choice of the molecular weight of the epoxy resin on the viscosity of the obtained aqueous emulsion.

3.9.2 The further reference made by the Appellant to the use of a post hardening process is, independently of the fact that E1 is totally silent on that process, beside the point, because the use of such process would, in any case, not be directed to the manufacture of a stable and storable aqueous emulsion of the hardener component, but to the improvement of the curing of epoxy resin by the hardener component.

3.9.3 Consequently, E1 itself cannot suggest the solution of the technical problem.

3.9.4 Although the Appellant no longer relied on document E2 when challenging inventive step during the appeal procedure, it is also evident, in the Board's view, that document E2 could not have suggested the proposed solution, since it teaches to use amino group containing hardeners which are insoluble or hardly soluble in water for preparing the amino group containing epoxy adduct hardener (Claim 1; page 5, lines 19-21).

3.9.5 Thus, in view of the above, the Board comes to the conclusion that the subject-matter of Claim 1 and by the same token that of Claims 2 to 11 do not arise in an obvious manner from the cited prior art.

3.9.6 Consequently, the requirements of Article 56 EPC are met by all the Claims 1 to 11.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

E. Görgmaier

R. Young