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Datasheet for the decision of 6 December 2012

Case Number: T 0008/10 - 3.3.07

Application Number: 04251951.2

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Language of the proceedings: EN

Title of invention:
Curable aqueous composition and use as heat-resistant nonwoven binder

Patent Proprietors:
ROHM AND HAAS COMPANY

Opponents:
BASF Aktiengesellschaft

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (no) - obvious solution (all claims requests)"

Decisions cited:
-

Catchword:
-

Case Number: T 0008/10 - 3.3.07

DECISION
of the Technical Board of Appeal 3.3.07
of 6 December 2012

Appellants: (Opponents)
BASF Aktiengesellschaft
-Patentabteilung - C6-
Carl-Bosch-Strasse 38
D-67056 Ludwigshafen (DE)

Representative:
Horler, Hans
BASF SE
Global Intellectual Property
GVX - C6
D-67056 Ludwigshafen (DE)

Respondents: (Patent Proprietors)
ROHM AND HAAS COMPANY
100 Independence Mall West
Philadelphia,
Pennsylvania 19106-2399 (US)

Representative:
Buckley, Guy Julian
Patent Outsourcing Limited
1 King Street
Bakewell
Derbyshire DE45 1DZ (GB)

Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted 28 October 2009 rejecting the opposition filed against European patent No. 1510618 pursuant to Article 101(2) EPC.**

Composition of the Board:

Chairman: J. Riolo
Members: G. Santavicca
M.-B. Tardo-Dino

Summary of Facts and Submissions

I. The appeal by the opponents lies from the decision of the Opposition Division, posted on 28 October 2009, rejecting the opposition against European patent n° 1 510 618.

II. The patent was granted on European patent application n° 04 251 951.2 and comprised 10 claims. Independent claims 1, 8 and 10 read as follows:

"1. A curable aqueous composition comprising
(a) a polyacid comprising at least two carboxylic acid groups, anhydride groups, or salts thereof
(b) a polyol comprising at least two hydroxyl groups; and
(c) an emulsion polymer comprising, as copolymerized units, greater than 30% by weight, based on the weight of said emulsion polymer solids, ethylenically unsaturated acrylic monomer comprising a C_5 or greater alkyl group;
wherein the ratio of the number of equivalents of said carboxylic acid groups, anhydride groups, or salts thereof to the number of equivalents of said hydroxyl groups in the curable aqueous composition is from 1/0.01 to 1/3, and wherein said carboxylic acid groups, anhydride groups, or salts thereof are neutralized to an extent of less than 35% with a fixed base."

"8. A method for treating a substrate comprising:
(a) forming a curable aqueous composition comprising admixing
(1) a polyacid comprising at least two carboxylic acid groups, anhydride groups, or salts thereof;

(2) a polyol comprising at least two hydroxyl groups; and
(3) an emulsion polymer comprising, as copolymerized units, greater than 30% by weight, based on the weight of said emulsion polymer solids, ethylenically unsaturated acrylic monomer comprising a C_5 or greater alkyl group;
wherein the ratio of the number of equivalents of said carboxylic acid groups, anhydride groups, or salts thereof to the number of equivalents of said hydroxyl groups in the curable aqueous composition is from 1/0.O1 to 1/3, and wherein said carboxylic acid groups, anhydride groups, or salts thereof are neutralized to an extent of less than 35% with a fixed base, and
(b) contacting said substrate with said curable aqueous composition; and
(c) heating said curable aqueous composition at temperature of from 120 DEG C to 400 DEG C *[sic]*."

"10. A heat-resistant nonwoven obtained by the method of claim 9."

III. The patent was opposed in its entirety on the grounds of lack of novelty and of an inventive step (Article 100(a) EPC), having regard to documents D1 (WO 99/09100) and D2 (EP-A-0 651 088), as well as of insufficiency of the disclosure (Article 100(b) EPC).

IV. In the decision under appeal, it was *inter alia* held that:

(a) The claimed subject-matter of the Main Request was sufficiently disclosed.

(b) As to novelty, Examples 1 and 2 of D1 illustrated mixtures solution of polymers comprising as monomers methyl methacrylate, ethyl or butyl acrylate. The allegation that the skilled person would replace any of them with 2-ethylhexyl acrylate, mentioned together with the illustrated acrylates in a single list of preferred monomers, was not convincing. The skilled person had to decide which component of the examples was to be replaced and then choose a substitute between the preferred monomers. Also, D1 gave no hint at an amount greater than 30% by weight of an acrylate monomer comprising a $C_{\geq 5}$ alkyl group. As to D2, its general disclosure was not directed to a curable composition comprising compounds a), b) and c) as defined in Claim 1 of the Main Request. Its Example 6 disclosed an emulsion polymer comprising ethyl and butyl acrylates, i.e. no $C_{\geq 5}$ monomer as defined in Claim 1. There was no hint in D2 at replacing the acrylates of the emulsion polymer of Example 6 with 2-ethylhexyl acrylate, let alone at using an amount thereof greater than 30% by weight. The claimed subject-matter was novel over D1 and D2.

(c) Having regard to the problem stated in the patent in suit, i.e. to provide suitable compositions for higher level of water-proofing for heat-resisting fibres and nonwovens, D2 rather than D1 disclosed the closest prior art. The claimed subject-matter differed from the solution proposed by D2 in the use of an emulsion polymer comprising an acrylate monomer having a $C_{\geq 5}$ alkyl group. The arguments by the opponents that no technical effect was attainable over the whole breadth of Claim 1 were not convincing, as the skilled person interpreted the patent as a whole in order to provide curable compositions having the desired properties. Also, the comparative data provided by the opponents, in order to show that there was no different technical effect attained when using emulsion polymers with acrylates including a C_4 or a C_5 alkyl group, did not clearly reproduce the conditions of the patent in suit, nor D1, the emulsion polymer of which did not contain greater than 30% by weight of an acrylate monomer with a C_4 alkyl group. Since there was no hint in D2 at using an emulsion polymer as defined in combination with a polyacid and a polyol, the claimed composition was not obvious.

(d) Therefore, the opposition was to be rejected.

V. In their statement setting out the grounds of appeal, the opponents (appellants) maintained the grounds of opposition and enclosed further comparative tests (D3). In their letter of 14 October 2010, they submitted arguments *inter alia* on the auxiliary requests enclosed in the patent proprietors' letter of 8 July 2010.

VI. In their response to the statement setting out the grounds of appeal (letter of 8 July 2010), the patent proprietors (respondents) *inter alia* contested the latest comparative tests D3 and submitted Auxiliary Requests I to VI. Then, in their letter of 5 October 2012, the respondents enclosed new Auxiliary Requests I to VI and two further Auxiliary Requests A and B, in order to replace all auxiliary requests on file.

VII. Claims 1 and/or 7 or 8 of each Auxiliary Requests I to VI, A and B, compared to Claims 1 and/or 8 as granted (*supra*), respectively contain the following amendments:

Auxiliary Request I

(e) Claim 1 of Auxiliary Request I includes, as its last feature, the amendment "and wherein said emulsion polymer is present in an amount of from 1% to 10% by weight based on the sum of the weight of the polyacid and the weight of the poylol, all weights being taken on a solids basis".

(f) Claim 7 of Auxiliary Request I too includes the above amendment and, at its very end, the further amendment "to effect drying and curing".

Auxiliary Request II

(g) Claim 1 of Auxiliary Request II contains the following amendments:

(i) [*at the end of feature (a)*] "selected from citric acid, butane tricarboxylic acid, cyclobutane tetracarboxylic acid and addition polymers or oligomers including, as polymerized units, carboxylic acid-functional monomers, wherein the addition polymers include 25-100% by wt, ethylenically unsaturated carboxylic acids";

(ii) [*at the end of feature (c)*] "and 0-10% by wt monomer bearing a carboxylic acid group, anhydride group, or salt thereof or hydroxyl group, based on the weight of the emulsion polymer solids".

(h) Claim 8 of Auxiliary Request II includes the above two amendments and additionally, at its very end, the amendment "to effect drying and curing".

Auxiliary Request III

(i) Claims 1 of Auxiliary Request III includes the amendments contained in Claim 1 of Auxiliary Requests I and the amendments contained in Claim 1 of Auxiliary Request II. Claim 7 too includes all amendments contained in Claims 7 of Auxiliary Requests I and II.

Auxiliary Request IV

(j) Claim 1 of Auxiliary request IV includes, at its very end, the additional feature: "and wherein the curable aqueous composition is formed by adding the emulsion polymer to a mixture of the polyacid and the polyol".

(k) Claim 8 of Auxiliary Request IV contained, at its very end, the additional feature "to effect drying and curing".

Auxiliary Request V

(l) Claim 1 of Auxiliary Request V includes the additional features included in Claim 1 of Auxiliary request II and the additional features included in Claim 1 of Auxiliary request IV.

(m) Claim 8 of Auxiliary Request V is identical to Claim 8 of Auxiliary Request II.

Auxiliary Request VI

(n) Claim 1 of Auxiliary Request VI contains the following amendments and additional features:

  (i) [*at the end of feature (a)*] "selected from addition polymers including, as polymerized units, carboxylic acid-functional monomers, wherein the addition polymers include 25-100% by wt, ethylenically unsaturated carboxylic acids";

  (ii) [*at the end of feature (c)*] "and 0-10% by wt monomer bearing a carboxylic acid group, anhydride group, or salt thereof or hydroxyl group, based on the weight of the emulsion polymer solids";

  (iii) [*at the end of Claim 1*], "and wherein the curable aqueous composition is formed by adding the emulsion polymer to a mixture of the polyacid and the polyol".

(o) Claim 8 of Auxiliary Request VI includes the above two amendments to features (a) and (c) of Claim 1 and additionally, at its very end, the amendment "to effect drying and curing".

Auxiliary Request A

(p) Claim 1 of Auxiliary Request A is identical to Claim 8 of Auxiliary Request IV.

Auxiliary Request B

(q) Claim 1 of Auxiliary Request B includes all the features of Claim 1 of Auxiliary Request A and, at the beginning of its feature (3), the additional feature "1-10% by wt based on the sum of the weight of the polyacid and the weight of the polyol, all weights being taken on a solids basis of".

VIII. In a communication in preparation for the oral proceedings, faxed on 21 November 2012, the Board indicated the issues that needed debate and decision.

IX. Oral proceedings were held on 6 December 2012. After deliberation by the Board, the decision was announced.

X. As far as relevant for the remaining issues dealt with in the present decision, the appellants' arguments as put forward in writing and in the oral proceedings before the Board can be summarized as follows:

Main Request

Closest prior art

(a) The patent in suit dealt with curable aqueous compositions comprising a polyacid, a polyol and an emulsion polymer, wherein more than 30% of the monomers of the emulsion polymer were $C_{\geq 5}$ alkyl acrylates. The compositions were suitable for imparting higher water-proofing properties to high temperature resistant fibres and nonwovens.

(b) D1 *inter alia* addressed the problems of providing climatic resistance, i.e. stability, as well as high strength in wet and dry state to shaped articles such as glass fibre webs. Hence, D1 addressed the same problems addressed by the patent in suit. In its Examples 1 and 2, D1 illustrated curable aqueous compositions containing all elements of the claimed compositions, such as polyacid, polyol and emulsion polymer. Therefore, D1 disclosed the closest prior art.

(c) The claimed compositions were distinguished from D1 in that the alkyl acrylates co-polymerised in the emulsion polymer were not $C_{\geq 5}$ alkyl acrylates.

Problem solved by the claimed subject-matter

(d) The description of the emulsion polymers in the patent in suit was not sufficiently detailed. The examples of the patent in suit did not make clear what polyacid and what polyol had been used. There was no disclosure on the surfactants used, if any, which however influenced the properties of the curable composition. Also, the patent in suit had not only to do with heat resisting nonwovens but concerned usual substrates too. As regards the sought-for effect, water resistance meant that the web was not affected by water, whereas water-proofing meant that the web was impenetrable by water. Hence, water-proofing properties depended on how the web/substrate was made, i.e. the distance between the fibres, which was not given. The examples of the patent in suit were not probative.

(e) Instead, in D1 the webs were immersed in water, to assess swelling, hence the quantity of water which penetrated into the web. This was a measure of water penetration. The examples of D1, in particular Example 1 and Comparative 1 and 3, showed that also the emulsion polymers with $C_{\leq 5}$ alkyl acrylates imparted excellent properties to the curable compositions. Polymer solution A1 contained styrene, ethyl acrylate and acrylic acid. Polymer dispersion A2 contained styrene, methyl methacrylate and butyl acrylate. Since the polymer solutions/dispersions A1 and A2 contained different components, a comparison of the results thereof as done by the respondents during the oral proceedings before the Board was not appropriate.

(f) The appellants had carried out further tests in which C_4 and C_8 alkyl acrylates were copolymerised in the emulsion polymer of curable compositions applied on glass fibre samples, which were then dried and cured. The conditions of curing had been indicated. By use of the test methods specified in the patent in suit it was established that there were no differences in properties between the samples. So the alleged distinction imparted by a $C_{\geq 5}$ alkyl acrylates was arbitrary, i.e. no technical effect was attained thereby.

(g) The respondents had not carried out any tests, not even in order to disprove what had been proven by the appellants.

(h) Hence, having regard to the examples carried out by the appellants, which were more probative than those included by the respondents in the patent in suit, the problem effectively solved by the claimed subject-matter over D1 was to impart water-proofing properties without using water-proofing agents.

Obviousness

(i) The disclosure of D1 was not too broad as asserted by the respondents. Although D1 dealt with several methods it preferred emulsion polymerization. D1 (page 7, last paragraph) mentioned as preferred monomers for the emulsion polymers a number of alkyl acrylates, *inter alia* 2-ethylhexyl acrylate, which was a $C_{\geq 5}$ alkyl acrylate.

(j) It was generally known that an increase in the number of the carbon atoms of the alkyl chain of the acrylate improved hydrophobicity. Hence, the skilled person wishing to impart water-proofing properties to the curable composition would use $C_{\geq 5}$ alkyl acrylates in the emulsion polymer thereof.

(k) As regards the lower limit of at least 30% of $C_{\geq 5}$ alkyl acrylates required by Claim 1, it was always fulfilled in the examples of D1, e.g. in Polymer composition A1, which contained more than 50% of ethyl acrylate.

(l) So the obvious replacement of ethyl acrylate with 2-ethylhexyl acrylate, or of all the acrylates of Example 2 of D1 with 2-ethylhexyl acrylate, led to the very broad claimed subject-matter.

Auxiliary Requests

(m) Since the closest prior art, still D1, and the problem solved remained the same, the arguments submitted for the Main Request applied *mutatis mutandis* to the auxiliary requests.

XI. As far as relevant for the remaining issues dealt with in the present decision, the respondents' arguments as put forward in writing and in the oral proceedings before the Board can be summarized as follows:

Main Request

Closest prior art

(a) D1 generally dealt with curable aqueous compositions comprising polyacid, polyol and emulsion polymer. As regards the emulsion polymer, its disclosure was very broad, with pages and pages of different compositions from different monomers, i.e. almost any monomer could be used.

Problem solved by the claimed subject-matter

(b) The patent in suit addressed the problem of improving water-proofing properties of heat-resisting fibres. In the examples of the patent in suit, water-proofing was evaluated as surface wetting of a sample relative to a control containing only polyacid and polyol, i.e. adsorption rather absorption was assessed on a scale going from 0 (readily adsorbed) to 5 (resists adsorption). The same property was not assessed in D1, in which climatic resistance was measured, such as flexural strength, swelling and climatic stability. In particular climatic stability was determined in a cabinet at 80°C at 90% humidity, i.e. in the absence of water sitting, so absorption of humidity was determined. The compositions of

Examples 1 and 2 of D1 attained better results than those of the Comparative examples. The comparison between Examples 1 and 2, wherein Example 1 did not contain butyl acrylate and Example 2 contained butyl acrylate, however showed that the composition of Example 2 was not as effective as that of Example 1, i.e. that the longer the alkyl chain of the acrylate the worse the water resistance.

(c) The examples in the patent in suit were not particularly helpful against D1. The composition of Comparative Example A was similar to that of D1 and gave no good results. However, a comparison between the compositions of Example 2 and Comparative Example G, having the same composition apart from the butyl acrylate of the emulsion polymer of Comparative Example G being replaced with 2-ethylhexylacrylate, showed that better results were attained by the use of more than 30% of $C_{\geq 5}$ alkyl acrylates as required by Claim 1.

(d) In opposition proceedings the onus to demonstrate lack of an inventive step lay on the opponents, who, however, had not provided comparative examples over D1, although they could simply have replaced in the examples of D1 the illustrated acrylates with 2-ethylhexylacrylate. Instead, the appellants had carried out tests at the edge of the invention (e.g. by using tartaric acid), wherein it was not clear whether the tested compositions were curable aqueous compositions, i.e. whether they contained accelerators and were actually cured. Nor was it clear what control, if any, and temperature was used. These comparative tests were not probative.

(e) Therefore, the problem solved over D1 was the attainment of a higher level of water-proofing properties for heat resisting fibres.

Non obviousness

(f) Among the 18 most preferred monomers only one (2-ethylhexyl acrylate) fulfilled the definition of Claim 1, i.e. was a $C_{\geq 5}$ alkyl acrylate. D1 gave no suggestion to its use in the emulsion polymer, let alone in an amount at least 30%. D1 did not contain any incentive to increase the alkyl chain length of the acrylate of the emulsion polymer, e.g. to the use of 2-ethylhexylacrylate, let alone in order to improve water-proofing properties. The only disclosure in D1 concerning water-proofing properties (page 26, lines 3-6) was a suggestion to use hydrophobing agents such as paraffines and silicones as hydrophobing agents. Thus, water resistance in D1 was attained not by increasing the alkyl chain length of the acrylates but by adding hydrophobing agents in the composition. So, D1 ignored the common general knowledge of increasing the alkyl chain length of the acrylate to increase hydrophobicity. If the skilled person started from Example 2 of D1 and replaced butyl acrlylate with 2-ethylhexyl acrylate, he would arrive at 20% of 2-ethylhexyl acrylate. If D1 were considered on its own by a skilled person using common general knowledge, it would not suggest to impart water-proofing properties by using at least 30% of $C_{\geq 5}$ alkyl acrylates. Without hindsight, the skilled person would not come to the claimed subject-matter.

Auxiliary Requests

(g) The breadth of the independent claims of the auxiliary requests had been restricted by defining e.g. the nature of the polyacid or how to carry out the curing. The respondents specified during the oral proceedings that, in general, the arguments offered for the Main Request still applied *mutatis mutandis*.

XII. The appellants (opponents) requested that the decision under appeal be set aside and that European patent No. 1 510 618 be revoked.

XIII. The respondents (patent proprietors) requested that the appeal be dismissed or that the patent be maintained on the basis of one of the First to Sixth, or A and B Auxiliary Requests.

Reasons for the Decision

1. The appeal is admissible.

Procedural matters - Amendments to parties' cases

2. The submission of Comparative Test Report D3 was in reaction to the decision under appeal, in which the arguments by the then opponents that no technical effect was attained over the whole breadth of Claim 1 as well as that no different technical effect was attained by C_5 alkyl acrylates over C_4 alkyl acrylates were rejected. Auxiliary Requests I to VI were

submitted by the respondents in reaction to the allegation of insufficiency maintained in the statement setting out the grounds of appeal and the submission of D3. Auxiliary Requests A and B were submitted in preparation for oral proceedings. All these amendments to parties' cases concentrate on facts under dispute without raising issues that could not be dealt with by the parties during the oral proceedings. Thus, all amendments are admitted for consideration by the Board.

Main Request (patent as granted)

Novelty

3. The Board is satisfied that the subject-matter of Claim 1 is novel over D1. The distinguishing features will be apparent from the assessment of inventive step (Point 4.7, *infra*). The Board need not give further details on novelty, as it appears from the following discussion that inventive step was the real issue of this case.

Closest prior art

3.1 The patent in suit concern curable aqueous compositions and their use as binders for heat-resistant fibres and nonwovens (Title; Paragraph [0001]). Still according to the patent in suit (Paragraphs [0002], [0004] and [0028]), these curable compositions are substantially free from formaldehyde or do not liberate substantial formaldehyde as a result of drying and/or curing, and are suitable for imparting a higher level of water-proofing to heat-resistant nonwovens than provided by the known compositions, acknowledged in Paragraph [0003] thereof (i.e. US Patents No. 5,427,587 and 5,661,213).

3.2 As the closest prior art documents, the decision under appeal and the respondents considered D2, because it allegedly dealt with the same problem as the patent in suit. The appellants considered D1 as the closest prior art document. The Board, as also indicated in its communication in preparation for oral proceedings, considers that D1 rather than D2 deals with the closest prior art according to the problem solution approach, for the following reasons:

3.3 D2 concerns a method for strengthening a cellulosic substrate comprising treating said substrate with a formaldehyde-free curable aqueous composition comprising (a) a polyacid containing at least two carboxylic acid groups, anhydride groups , or salts thereof; and (b) a phosphorous-containing accelerator, wherein said carboxyl group, anhydride groups, or salts thereof are neutralized to less than 35% with a fixed base (Claim 1).

3.3.1 The method of D2 has the following objectives: increasing solvent- and water-wet strength and dry strength of a cellulosic non-woven wipe (Claim 5); increasing the delamination resistance of laminating stock or a laminate comprising multiple lies of said laminating stock (Claim 7); improving the permanent-press performance of cellulosic woven fabrics (Claim 8); and, improving the water resistance of a consolidated wood product (Claim 9).

3.3.2 Hence, D2 does not concern heat-resisting fibres nor any improvement of water-proofing properties thereof. Also, the compositions of D2 mandatorily require a phosphorous-containing reaction accelerant but need not contain a polyol or an emulsion co-polymer having more than 30% of a $C_{\geq 5}$ alkyl monomer.

3.3.3 Since D2 lacks the objective to impart water-proofing properties to heat-resisting fibres, the fact that the curable aqueous composition of D2 can further comprise:

(a) at least one active hydrogen compound having at least two active hydrogen groups selected from the group consisting of hydroxyl, primary or secondary amino and mixtures thereof, wherein the ratio of the number of equivalents of said carboxylic acid groups, anhydride groups, or salts thereof to the number of equivalents of said active hydrogen groups is from 1/0.01 to 1/3 (Claim 2); and,

(b) as the polyacid, a copolymer prepared by emulsion polymerization of at least two ethylenically-unsaturated monomers and containing at least two carboxylic acid groups or the salts thereof; wherein said copolymer has a Tg between 60°C and -50°C (Claim 4),

i.e. that the compositions of D2 can be structurally close to the compositions as claimed (as illustrated in Example 6 of D2) is in the present case not decisive for the choice of D2 as the closest prior art.

3.4 D1 (Claim 1; page 26, line 25) concerns formaldehyde-free thermally curable aqueous compositions, as well as their use as binders for heat-resistant fibres and nonwovens (Claim 25; Page 26, line 25,31, lines 5-42). D1 (page 2, lines 12-14) acknowledges D2 in its description of the background art, i.e. D1 represents a further improvement over D2. The compositions of D1 and those of the patent in suit require a polyacid, a polyol and an emulsion polymer comprising alkyl groups e.g. acrylates, and do not mandatorily require a phosphorous-containing reaction accelerant. Hence, D1 addresses the same problem of the patent in suit and discloses compositions that are structurally similar.

3.5 It follows from the foregoing that D1 discloses the closest prior art.

The disclosure of D1

4. D1 discloses (Claim 1) the use of a thermally hardenable (i.e. curable) aqueous composition, comprising:

A) at least one polymer, obtained by radical polymerization, which comprises ≤ 5% by weight of an α,β-ethylenically unsaturated mono- or dicarboxylic acid, in copolymerized form,

B) at least one polymer, obtained by radical polymerization, which contains ≥ 15% by weight of an α,β-ethylenically unsaturated mono- or dicarboxylic acid, in copolymerized form, and

C) at least one alkanolamine having at least two hydroxyalkyl groups.

As regards Component A) of the curable composition of D1, it can contain: an acrylic or methacrylic acid in copolymerized form (Claim 2); and, as the **principal** (emphasis added) monomer, an ester of acrylic or methacrylic acid with a C_1-C_{12}-alkanol (Claim 3).

The most preferred esters of acrylic acid are C_1-C_8-alkyl esters (page 6, line 44), in particular methyl, ethyl, butyl and 2-ethylhexyl acrylates (page 7, lines 40-42). The polymer making Component A is generally (page 5, lines 17-18) and preferably (page 8, lines 10-15) obtained by emulsion polymerization, preferably in an aqueous medium, and used as dispersion obtained from the emulsion polymerization (page 5, lines 24-26). Hence, Component A) of D1 corresponds to emulsion polymer (c) of Claim 1 of the Main Request.

4.1 Component B) can contain, as mono- or dicarboxylic acid, in copolymerized form, at least one compound selected from the group consisting of acrylic, methacrylic, crotonic, fumaric, maleic, 2-methylmaleic and itaconic acid (Claim 5). Hence, Component B) of D1 corresponds to polyacid (a) of Claim 1 of the Main Request.

4.2 Component C) can be selected from a group consisting of *inter alia* diethanolamine and triethanolamine. Hence, Component C) of D1 corresponds to polyol (b) of Claim 1 of the Main Request.

4.3 The composition disclosed by D1 can comprise Components A) and B) in a weight ratio (based on solids) of from 50:1 to 1:50 and Components B) and C) in a weight ratio of from 100:1 to 1:1 (Claim 17), wherein the molar ratio of the carboxyls of Components A) and B) to the hydroxyls of C) can be in the range from 20:1 to 1:5 (Claim 18). Hence, the molar ratio between carboxyls of polyacid and hydroxyls of polyol falls within the range 100/1 to 1/3 as defined in Claim 1 of the Main Request.

4.4 It follows from the foregoing that D1 discloses a thermally curable composition that can comprise the components as defined in Claim 1 of the Main Request, as well as which fulfils the carboxyl to hydroxyl ratio as defined. As regards the further condition of the maximum extent of the neutralization of the carboxylic acids, in the compositions illustrated by D1 (*infra*), the carboxylic acid groups are not neutralized. So also this further condition of Claim 1 is fulfilled.

4.5 D1 also discloses (Claim 23) a binder comprising the thermally curable aqueous composition as well as (Claim 24) a shaped article, obtained by impregnating a substrate with the thermally curable aqueous compositions and curing the impregnated substrate by heat. The substrate can comprise finely divided material (Claim 21) e.g. insulating fibres or webs (Claim 25) comprising inorganic fibres such as mineral fibres and glass fibres (page 31, lines 5-7).

4.5.1 Once the thermally curable composition has been applied on the fibrous insulating substrate, on heating, the water present in the composition evaporates and the composition undergoes curing, i.e. the composition undergoes chemical alteration (paragraph bridging pages 26 and 27). Hardening (i.e. curing) is carried out at temperatures of greater than 100°C up to 200°C for fibres (page 31, lines 5-19, 28-33 and 40-42) or up to 400 °C, when applied to fibrous webs (page 32, lines 9-13) for 10 seconds to 10 minutes. So, D1 also discloses the conditions defined in Claim 8 of the patent in suit.

4.6 The examples of D1 illustrates thermally curable compositions made up as follows:

Example 1:

(Component A) 200 g of aqueous polymer solution A1, in which polymer solution A1 is 39 wt.% aqueous dispersion of terpolymer styrene/ethylacrylate/acrylic acid with 48.5% of styrene and 48.5% of ethyl acrylate;

(Component B) 470 g of aqueous Polymer solution B1, in which Polymer solution B1 is 50% by weight solution of copolymer made up of 55% by weight of acrylic acid (Molecular Weight (MW) = 72,1 g/mol) and 45% by weight of maleic acid (MW = 116.1 g/mol) (i.e. Polymer solution B1 consists of 0.50*470=235 g copolymer, which corresponds to 235*(0.55/72.1 + 0.45*2/116.1)=3.61 mol carboxyl groups;

(Component C) 70 g triethanolamine (TEA) (molecular weight 149.2 g/mol), corresponding to 70*3/149.2=1.41 mol hydroxyl groups.

The solids content of the composition of Example 1 is 53%, its pH 3.1, its viscosity 190 mPas.

Example 2:

(Component A) 200 g of polymer solution A2, in which polymer solution A2 is a 45.2% by weight aqueous dispersion of terpolymer styrene/methylmethacrylate/n-butylacrylate acid containing 50% of styrene, 30.1% of methylmethacrylate and 19,9% n-butlyacrylate;

(Component B) 400 g polymer solution B2, in which Polymer solution B2 is a 35% by weight solution of polyacrylic acid (MW=72,1 g/mol) (i.e. Polymer solution B2 consists of 0.35*400=140 g polymer, corresponding to 140*1/72.1=1.94 mol carboxyl groups);

(Component C) 85 g triethanolamine (MW=149.2 g/mol), corresponding to 85*3/149.2=1.71 mol hydroxyl groups.

The solids content of the composition of Example 2 is 46%, its pH 3.6, its viscosity 110 mPas.

No neutralization step is carried out in the modes illustrated by Examples 1 and 2 of D1.

4.7 Therefore, The subject-matter of Claim 1 is distinguished from D1 by the following features:

(a) Over Claim 3 of D1, by at least 30% of a $C_{\geq 5}$ alkyl monomer in an emulsion polymer;
(b) over Example 1 of D1, by a $C_{\geq 5}$ alkyl monomer in the emulsion polymer; and,
(c) over Example 2 of D1, by at least 30% of a $C_{\geq 5}$ alkyl monomer in the emulsion polymer, if only butyl acrylate is considered, or by a $C_{\geq 5}$ alkyl monomer if also methylmethacrylate is considered.

4.8 Examples 1 and 2 of D1 thus represent the closest embodiments to the claimed subject-matter.

Problem solved by the claimed subject-matter

5. The technical problem stated in the patent in suit (Paragraph [0004]) was to provide a curable aqueous composition being formaldehyde-free and imparting higher level of water-proofing properties to heat-resistant nonwovens.

5.1 According to the patent suit (Paragraphs [0006] to [0008]), the problem is *inter alia* solved by a curable aqueous composition as defined in Claim 1 (Point II, *supra*).

5.2 Since D1 is not acknowledged in the application as originally filed, and on which the patent in suit was granted, the problem stated in the patent in suit did not consider D1. Hence, the problem effectively solved over D1 has to be established on the basis of the results attained over the compositions of D1, if any.

5.3 During the oral proceedings before the Board the respondents argued that the claimed compositions are advantageous also over those disclosed by D1. In particular, the respondents referred to Example 2 and Comparative Example G as illustrated in the patent in suit, allegedly showing an improvement.

5.4 Example 2 of the patent in suit (Paragraph [0035] and Table 1.1) is based on an emulsion polymer having the following composition: 60 MMA/39EHA/1MAA (wherein MMA = methylmethacrylate; EHA = ethylhexylacrylate and MAA = methacrylic acid). Comparative Example G of the patent in suit (Paragraph [0035] and Table 1.1) is based on an emulsion polymer having the following composition: 58 MMA/41BA/1MAA (wherein BA=butylacrylate). Both emulsion polymers were added at a concentration of 5 wt.% solids based on polyacid and polyol to a solution containing a mixture of an unspecified polyacrylic acid and an unspecified polyol with the optional addition of sulphuric acid to yield a concentrated solution (>40% solids) at pH 2.8-4.5. This solution, which might additionally contain an unspecified surfactant to stabilize the hydrophobic acrylic latex, was then diluted with water to 5% solids.

5.4.1 Water-proofing properties were evaluated on glass microfiber filter paper sheets, which were dipped in the above solutions of binder and thereafter run through a roll padder with roll pressures of 22 kg (10 lbs) *[sic]*. Then, the coated sheets were dried at 90°C for 90 seconds in a Mathis oven, and subsequently cured at 210°C for 1 minute. The total add-on of curable composition solids based on the fibreglass solids was from 10 to 11%.

5.4.2 Water was added dropwise to the cooled sheets to assess water wetting by comparison with a control which did not contain an emulsion polymer. The wetting was assigned a value based on the rapidity of adsorption. The water-proofing level, measured on a scale ranging from 0 (readily adsorbed) to 5 (resists water adsorption over an extended period of i.e. 24 hours), attained by the sheet of Example 2 is 4 and by the sheet of Comparative Example G is 1.

5.5 Still according to the respondents, the same result was apparent from Comparative Example A of the patent in suit, the curable aqueous composition of which contained an emulsion polymer with 20.0% butyl acrylate, i.e. as in Example 2 of D1, and exhibited poor water-proofing properties (note 1).

5.6 According to the respondents, these results showed that replacing the C_{1-4} acrylates illustrated by D1 with more than 30% of 2-ethylhexyl acrylate improved water-proofing properties of glass fibres. Thus, the problem solved over D1 was the attainment of a higher level of water-proofing properties for heat resisting fibres.

5.7 However, none of the comparative examples of the patent in suit, let alone Comparative Examples A and G, are a reproduction of an example of D1, at least in view of the unspecified items of information such as polyacid, Polyol, surfactant, etc.

5.8 Also, as established in the Case Law of the Boards of Appeal of the EPO (6th edition 2010, I.D.4.4), it should be plausible that the effect alleged in opposition appeal proceedings (improvement over D1) is achieved across the whole scope of Claim 1.

5.9 Even if the comparison based on the examples of the patent in suit and invoked by the respondents were accepted, it could only prove that in a context of 99% alkyl acrylates the replacement of butyl acrylate thereof with 2-ethylhexyl acrylate improves water-proofing properties. Apart from that, there is still no comparison over e.g. Example 1 of D1. Thus, the invoked comparison cannot prove an improvement attained over the whole breadth of Claim 1.

5.10 The comparative examples submitted by the appellants, confirm this conclusion. As apparent from the Table on page 7 of the statement setting out the grounds of appeal, composition M1 (which is incontestably according to the patent in suit) and comparative composition MV1 attain the same water-proofing level. However, composition MV1 contains tartaric acid, diethanolamine and emulsion polymer V1 (which does not contain ethylhexyl acrylate but only butyl acrylate). The argument that MV1 is an example at the edge of Claim 1, i.e. a non-polymeric diacid, is not convincing, as Claim 1 encompasses all diacids.

5.11 Therefore, the problem solved over D1 was the provision of further thermally curable aqueous compositions suitable for binding heat-resisting fibres and imparting sufficient water-proofing properties.

Obviousness

6. According to D1 (Claim 3), the principal monomer of copolymer A) can be a C_1-C_{12}-alkyl esters, and the most preferred esters are C_1-C_8-alkyl esters of acrylic acid (page 6, lines 44-46), in particular methyl, ethyl, butyl and 2-ethylhexyl acrylates (page 7, lines 40-42).

6.1 The general disclosure of D1 relating to C_8- and C_{12}-alkyl esters and the particular disclosure of D1 relating to 2-ethylhexyl acrylate essentially correspond to the features distinguishing the subject-matter of Claim 1 from D1.

6.2 Hence, the subject-matter of Claim 1 is encompassed by the disclosure of D1, albeit it is not directly and unambiguously disclosed.

6.3 The fact that the features of Claim 1 are disclosed in different parts of D1, which per se only shows that the claimed subject-matter is novel over D1, has as such no bearing on the question of whether or not it was obvious for the skilled person to combine the above different parts of D1, unless the skilled person had an incentive, a motivation to do it.

7. The question which arises next is thus whether the skilled person wishing to solve the problem stated above had a motivation at using a $C_{\geq 5}$ alkyl monomer in

e.g. the emulsion polymer of Example 1 of D1 or e.g. at least 30% by weight of a $C_{\geq 5}$ alkyl monomer in the emulsion polymer of Example 2 of D1.

7.1 To answer the question, the following is considered:

(a) The patent in suit and D1 indisputably belong to the same technical field.

(b) The emulsion polymer of the compositions of D1, like those of the patent in suit, can comprise as principal copolymerized unit, based on the weight of the solid emulsion polymer, an acrylic monomer such as a C_{12} (Claim 3) or C_8 (page 6, lines 44-46) alkyl acrylate, e.g. 2-ethylhexyl acrylate (page 7, line 41).

(c) The most preferred alkyl acrylates mentioned in D1 (Page 7, lines 40-42), ethyl and butyl acrylates, 2-ethylhexyl acrylate, are usual, i.e. known alkyl acrylates typically used in emulsion polymers for aqueous curable compositions, which fact is also apparent from D2 (Page 3, lines 47-49).

(d) As asserted by the appellants, it is generally known that the hydrophobicity of alkyl acrylates, hence of the emulsion polymer containing them, increases with an increase of the alkyl chain length.

(e) This assertion per se was not contested by the respondents, who instead maintained that it is not applied in D1, as apparent when comparing the results of Examples 1 and 2 thereof. Instead, still according to the respondents, D1 suggested the use of hydrophobing agents to improve water resistance.

(f) However, the general disclosure in D1 (page 26, first paragraph) that its compositions may contain additional components *inter alia* hydrophobing agents (page 26, lines 4-6) cannot overcome the specific disclosure of D1 that 2-ethylhexyl acrylate is one of the most preferred monomer for its principal copolymerized unit nor the undisputed knowledge of the skilled person that 2-ethylhexyl acrylate is more hydrophobic than e.g. methyl-, ethyl or even butylacrylate, i.e. that it is suitable to impart more hydrophobicity to the emulsion polymer containing it, as well as to the finished coating obtained by the application of the emulsion polymer.

7.2 It is apparent from the foregoing that the skilled person starting from D1 in order to solve the problem posed did not face any disincentive at trying also the use of 2-ethylhexylacrylate. In fact, the replacement of methyl- or ethylacrylate with 2-ethylhexylacrylate lies close to an analogous substitution of chemical substances within a disclosed group thereof.

7.3 Incidentally, the arguments by the respondents that D1 did not apply the general knowledge that hydrophobicity of alkylacrylates increases with increasing alkyl chain length, as apparent from the comparison of the results of Examples 1 and 2 thereof, are not convincing, as:

(a) the only alkyl acrylate used in the emulsion polymer of Example 1 of D1 is ethyl acrylate, in an amount of greater than 30% by weight, hence a greater than 30% by weight of a C_2 alkyl acrylate;

(b) two alkyl acrylates are used in the emulsion polymer of Example 2 of D1, namely about 30% of methyl methacrylate and about 20% of butyl acrylate, i.e. a C_1 alkyl acrylate is predominant;

(c) thus, a comparison between the results of Examples 1 and 2 of D1 does not disconfirm the assertion of the general knowledge made by the appellants.

7.4 Therefore, the general knowledge that an increase in the alkyl chain length of an acrylate monomer improves its hydrophobicity applies also in the context of D1.

7.5 Since the skilled person expected that the replacement of lower alkyl acrylates such as methyl or ethyl acrylates with higher alkyl acrylates such as 2-ethylhexyl acrylate in emulsion polymers of thermally curable compositions led to further compositions providing coatings with water-proofing properties to heat resistant fibres, the subject-matter of Claim 1 of the Main Request was obvious.

Auxiliary Requests I to VI

8. Regarding the submission of these requests, no particular arguments in respect of inventive step were given in writing by the respondents. Nor is it in dispute that the amendments contained in Auxiliary Requests I to VI do not change the closest prior art (D1) nor the problem effectively solved by the claimed subject-matter over the whole breadth of Claim 1 (as reformulated for the Main Request).

8.1 Also not in dispute is the fact that D1 discloses that:

(a) as regards the weight ratio, emulsion polymer A) can be 1/50 or preferably 1/20 of Component B) (polyacid), which polyacid can be from 100:1 to 1:1 of Component C) (ethanolamine) (Claims 17 and 18);

(b) Component B) of D1 (Claim 1) must contain 15% or more by weight of an ethylenically unsaturated carboxylic acid;

(c) Component A) of D1 (Claim 1) must contain at most 5% by weight monomer bearing an a carboxylic acid group;

(d) the compositions of D1 can be prepared by mixing Components A, B and C at room temperature, whereby Component (A) can be an aqueous dispersion, Component (B) an aqueous solution and Component (C) undiluted or an aqueous solution (paragraph bridging pages 24 and 25). The curable aqueous composition can be formed by adding emulsion polymer A to mixture of polyacid B) and triethanolamine C) (Examples 1 and 2 of D1).

8.2 Hence, the modifications in Claim 1 of Auxiliary Requests I to VI do not overcome the lack of inventive step decided for the Main Request. Therefore, the claimed subject-matter of Auxiliary Requests I to VI does not fulfil the requirements of the EPC.

Auxiliary Requests A and B

9. The respondents had submitted these claims requests for the event that any request including a claim to a curable aqueous composition could not be maintained.

9.1 However, in spite of the change in category, Claim 1 of Auxiliary Requests A or B still relates exactly to the same aqueous curable composition as the Main Request, in particular to its general use for which it has been acknowledged in the reformulated technical problem for the Main Request (Point 5.11, *supra*).

9.2 The appellants have decided in view of this not to present any different arguments for Claim 1 of Auxiliary Requests A and B, but to refer to the arguments already presented for the Main Request.

9.3 The respondents have not argued that D1 should no longer be considered.

9.4 The Board considers, as also acknowledged in Paragraph [0030] (last sentence) of the patent in suit, that apart from the aqueous curable composition the process per se follows conventional techniques. The aqueous curable composition is however still the composition of the Main Request, which has been found to be obvious.

9.5 Under such circumstances, the Board does not see any reason to come to a different conclusion as regards the appreciation of inventive step with respect to the same prior art and does not see any need to analyse the issue in any further detail.

9.6 The subject-matter of Claim 1 of any of Auxiliary Requests A and B does therefore not involve an inventive step.

Conclusions

10. One of the grounds of opposition prejudices maintenance of the patent as granted.

10.1 The patent in the amended form of any of the Auxiliary Requests I to VI or Auxiliary Requests A and B does not fulfil the requirements of the EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent in revoked.

The Registrar:	The Chairman:
S. Fabiani	J. Riolo