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**Datasheet for the decision
of 19 March 2021**

Case Number: T 1220/17 - 3.3.03

Application Number: 04748700.4

Publication Number: 1644428

IPC: C08G18/02, C08G18/28

Language of the proceedings: EN

Title of invention:

PROCESS FOR THE PREPARATION OF STABLE POLYCARBODIIMIDE
DISPERSIONS IN WATER, WHICH ARE FREE OF ORGANIC SOLVENTS AND
MAY BE USED AS CROSSLINKING AGENT

Patent Proprietor:

STAHL INTERNATIONAL B.V.

Opponent:

Covestro Deutschland AG

Relevant legal provisions:

RPBA Art. 13(1)

EPC Art. 56

Keyword:

Experimental reports submitted in reply to the Board's
communication - admitted (yes)

New item of evidence - admitted (no)

Inventive step - improvement credible - solution suggested by
the prior art (main request - yes - auxiliary request - no-)



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Case Number: T 1220/17 - 3.3.03

D E C I S I O N
of Technical Board of Appeal 3.3.03
of 19 March 2021

Appellant: Covestro Deutschland AG
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Decision under appeal: **Interlocutory decision of the Opposition
Division of the European Patent Office posted on
22 March 2017 concerning maintenance of the
European Patent No. 1644428 in amended form.**

Composition of the Board:

Chairman D. Semino
Members: F. Rousseau
R. Cramer

Summary of Facts and Submissions

I. The appeal lies against the interlocutory decision of the opposition division posted on 22 March 2017 according to which European patent No. 1 644 428 as amended according to the set of claims of the First Auxiliary Request filed at the oral proceedings on 15 March 2017 and pages 2 to 4 of the patent specification met the requirements of the EPC. The contested decision was also based on the patent as granted as Main Request, i.e. rejection of the opposition.

II. Claim 1 of the granted patent read as follows:

"A process for the preparation of stable aqueous polycarbodiimide dispersions, to be used as crosslinking agent, which are free of organic solvents, characterised in:

- reacting a polyisocyanate in the presence of a carbodiimide catalyst to form a polycarbodiimide,
- terminating and/or chain extending the polycarbodiimide chain by the addition of a compound containing a hydrophilic group and one or more amine and/or hydroxy functions during or after the polycarbodiimide formation
- dispersion of the resulting compound in water, wherein the pH is adjusted to a value between 9 and 14 by the addition of a base and/or a buffer to the water used for the dispersion and/or to the obtained aqueous dispersion."

The additional claims of the granted patents were claims 2 to 11 dependent on claim 1, claim 12 directed to a coating mixture comprising the polycarbodiimide

dispersions obtained according to claims 1-11 as crosslinking agent and an aqueous resin containing carboxylic acid functions and claim 13 directed to the cured material obtained by applying the coating mixture of claim 12 to a substrate, and evaporating the water.

III. The decision was taken having regard *inter alia* to the following evidence:

D1: EP 0 792 908 A1

D2: US 5,117,059

D5: F. Kurtzer et al, "Advances in the Chemistry of Carbodiimides", CHEMICAL REVIEWS, vol. 67, no. 2, 1967, page 117

D6: A. Williams and I. Ibrahim, CHEMICAL REVIEWS, vol. 81, no. 4, 1981, pages 599-600

D7: EP 2 552 982 B1

D7b: Experimental report submitted by the opponent with letter of 10 February 2017

D8: Experimental data submitted by the patent proprietor with letter of 3 March 2017.

IV. According to the reasons for the contested decision:

(a) documents D7, D7b and D8 were admitted into the proceedings.

(b) The Main Request was not allowable as the product of claim 13 lacked novelty over D1.

(c) The First Auxiliary Request corresponding to the main request from which claim 13 had been deleted was admitted into the proceedings. The sole objection raised against the First Auxiliary Request was that the process for the preparation of stable aqueous polycarbodiimide dispersions

according to claim 1 lacked an inventive step over the disclosure of D1 taken as the closest prior art. The process of claim 1 differed from those disclosed in D1 in that the pH of the aqueous polycarbodiimide dispersions prepared was adjusted, i.e. increased to a value between 9 and 14 by addition of a base and/or buffer.

- (d) Even if the data of experimental report D7b submitted by the opponent potentially showed an improvement in storage stability associated with an increase of the pH in very similar aqueous systems, these data were first disregarded as their meaningfulness had been questioned by the patent proprietor. On that basis and in the absence of a comparison with the method of D1 in the experimental part of the patent in suit, the problem successfully solved by the claimed method over D1 resided in the provision of an alternative method for obtaining an organic solvent-free aqueous dispersion of a polycarbodiimide crosslinking agent.
- (e) It was held that the skilled person would not have concluded that the teaching of D2 according to which the pH should be adjusted to a value greater than 8 to impede hydrolysis of the carbodiimide groups was applicable to D1, since D2 contrary to D1 did not concern purely aqueous dispersions, but systems also containing organic solvent. Moreover, as shown by D5 and D6, it was common general knowledge that hydrolysis of carbodiimides in aqueous systems was catalysed both by acids and bases. Therefore, a single, isolated incentive in one prior art document relating to a different solvent system was not sufficient to prompt the

skilled person to the solution defined in claim 1 of the First Auxiliary Request. An inventive step was therefore acknowledged for the subject-matter of the First Auxiliary Request.

- V. The opponent (appellant) lodged an appeal against the above decision.
- VI. The patent proprietor (respondent) submitted with its rejoinder to the statement of grounds of the opponent (letter of 7 December 2017) a Main Request, corresponding to the First Auxiliary Request underlying the contested decision and and Auxiliary Request I, as well as the following item of evidence:
- D9: Experimental report by A. Derksen.
- VII. In preparation of oral proceedings foreseen for 23 June 2020, the Board issued a communication dated 24 March 2020.
- VIII. The respondent replied to the Board's communication with letter of 22 April 2020 and submitted with said letter an additional experimental report by A. Derksen (D10) and Auxiliary Requests I to III in replacement of the previous auxiliary request. Claim 1 of Auxiliary request II differed from claim 1 of the Main Request in that it contained in the last paragraph the following amendment (for ease of understanding the Board has indicated the modifications in underlined and strike through):

" - dispersion of the resulting compound in water, wherein the pH is adjusted to a value between ~~9~~11 and 14 by the addition of a base and/or a buffer to

the water used for the dispersion and/or to the obtained aqueous dispersion."

- IX. As the consequence of the COVID-19 pandemic situation, oral proceedings before the Board were postponed.
- X. Two further experimental reports D11 and D12, both by A. Derksen were submitted with respondent's letters of 20 May 2020 and 23 October 2020, respectively.
- XI. The Board taking into account the partie's submissions made after the Board's communication issued a supplementary communication dated 14 December 2020.
- XII. The respondent submitted with letter of 12 March 2021 the following document:
- D13: I. Ibrahim & A Williams, Journal of the American Chemical Society, 100(23), 7420-7421, 1978.
- XIII. Oral proceedings before the Board were held by videoconference on 19 March 2021, in the course of which Auxiliary Request I was withdrawn.
- XIV. The appellant's submissions, in so far as they are pertinent, may be derived from the reasons for the decision below. They are essentially as follows:
- (a) D10 to D13 should not be admitted into the proceedings.
- (b) Claim 1 of both the Main Request and Auxiliary Request II lacked an inventive step having regard to the combined teaching of D1 taken as the closest prior art and of that of documents D2, D5 and D6.

XV. The respondent's submissions, in so far as they are pertinent, may be derived from the reasons for the decision below. They are essentially as follows:

(a) D10 to D13 should be admitted into the proceedings.

(b) The subject-matter of claim 1 of both the Main Request and Auxiliary Request II involves an inventive step over the methods described in D1, taken as the closest prior art.

XVI. The appellant requested that the decision under appeal be set aside and that the patent be revoked.

XVII. The respondent requested that the appeal be dismissed, or in the alternative that the decision under appeal be set aside and that the patent be maintained in amended form on the basis of of Auxiliary Request II, or of Auxiliary Request III, both submitted with letter of 22 April 2020.

Reasons for the Decision

Admittance of D10 to D12

1. D10 to D12 are items of evidence filed by the respondent after issuance of the first summons to oral proceedings on 2 July 2019, i.e. before the date of entry into force of the RPBA 2020. Their admission to the proceedings, which was contested by the appellant is therefore subject to the discretionary power of the Board in accordance with Article 13 RPBA 2007 which applies in view of the transitional provisions in Article 25(3) RPBA 2020.

1.1 Experimental report D10 was submitted by the respondent with letter of 22 April 2020, i.e. less than one month after issuance of the first communication of the Board sent in preparation for the oral proceedings. It concerns an aqueous polycarbodiimide dispersion as prepared in Example 1A of the patent in suit whose stability has been studied in a pH range of 6 to 9. These experimental results have been provided in addition to those already submitted with D9 which concerned the stability of the same dispersion in a pH range of 8,95 to 12,95.

It is immediate and uncontested that D10 was submitted in direct response to a new point raised by the Board in point 6.4 of its first communication according to which the absence of data for pH values outside of the claimed range raised the question whether a particular effect could be associated with said range.

The appellant however submitted that it was not justified to file D10 as this stage of the procedure, as it was common practice in view of the Case Law to support the existence of an inventive step by showing that an effect occurred only within, i.e. not outside, a claimed range.

This is not convincing. It can only be taken from Article 12(2) RPBA 2007 which stipulates that the statement of grounds of appeal and the reply shall contain a party's complete case that the respondent is expected to rebut the objections raised by the appellant, but that there is no requirement to address other objections or arguments which in view of the Case Law of the Boards of appeal could have been expected to be submitted against their case, but which were not. In

the present case the appellant essentially argued in the statement of grounds of appeal that the alleged stability in accordance with a specific interpretation of that term (see point 5.1 below) was only evidenced for a very limited portion of the claimed pH range. This constitutes a different point from that addressed by the Board in point 6.4 of its first communication.

On that basis, the submission of D10 represents not only a direct, but also a legitimate attempt to answer the new point raised by the Board. The appellant's additional argument that the evidence submitted could not show the purported effect, as the experiments were not complete or would have been carried out at a slightly different temperature, is of no relevance when deciding on the admittance of experimental report D10, whose admittance is based on the procedural principle of the right to be heard which has to be safeguarded, irrespective of the merits of the respondent's present *bona fide* submissions.

Exercising its discretionary power under Article 13(1) RPBA 2007 the Board therefore admits document D10 into the proceedings.

- 1.2 D11 and D12 are two experimental reports which contain supplementary data regarding the stability in a pH range of 6 to 9 of an aqueous polycarbodiimide dispersion as prepared in Example 1A of the patent in suit. Whereas D11 was submitted two months after issuance of the Board's first communication with letter of 20 May 2020, D12 was submitted about 5 months after D11 with letter of 23 October 2020. The delayed submissions of D12 was explained by the fact that it was deemed necessary by the respondent to test the stability of a freshly prepared aqueous

polycarbodiimide dispersion, since the test of D11 had been performed with an aged master batch kept during one year at a pH of above 11 and which was the only master batch available at the time the Board's communication had been received. In addition, the stability test reported in D12 had to be carried out over a period of 6 weeks. On that basis the Board also concludes that the filing of D11 and D12 also represented a legitimate and timely reaction to the new point raised in point 6.4 of the Board's first communication.

Accordingly, the reasons for admitting D10 into the proceedings equally apply in respect of D11 and D12 which are therefore admitted into the proceedings (Article 13(1) RPBA 2007).

Admittance of D13

- 1.3 Document D13 was filed by the respondent one week before the oral proceedings. Considering that the rescheduling of the oral proceedings to 19 March 2021 with an Office letter of 10 June 2020, i.e. after the date of entry into force of the RPBA 2020, was merely due to the COVID-19 pandemic situation, the admittance of D13 should not be decided based on the provisions of Article 13(2) RPBA 2020, but rather on those of Article 13 RPBA 2007 which applies taking into account the issuance on 2 July 2019 of the first summons to oral proceedings and the transitional provisions in Article 25(3) RPBA 2020.

D13 is indicated by the respondent to correspond to reference 234 cited in a passage of D6 (page 600, right-hand column, second full paragraph) which reads "*Comparison of the reactivity to hydrolysis of the*

water-soluble carbodiimide (1-ethyl-3-[3-(dimethylamino)propyl]carbodiimide with that of the quaternary ammonium derivative indicates that the carbodiimide form is only involved in the hydroxide-catalyzed hydrolysis.²³⁴ Hydrolysis at neutral and acid pH involves attack on the cyclic tautomer (eq 71)".

The appellant argued that D6 was an excerpt of a review article and that any document referred to in such type of document would be consulted by the reader, in particular D13 as it would constitute a highly relevant reference thereof. There is however no general rule as to which document referred to in a review article would be consulted by the skilled reader and in the affirmative as to which extent the information provided therein would be looked up. This rather depends on the specifics of said review article. In the present case the passage on page 600, right-hand column, second full paragraph, is understood to convey the information of document D13 which the authors of D6 see as relevant and sufficient for this review article. There is no apparent particular reason which would render necessary for the reader of D6 to consult D13, let alone any particular part of it.

Most importantly, up to one week before the oral proceedings the sole passage of this review article cited by the respondent in its submissions was the paragraph bridging pages 599 and 600 which concerns the teaching of two other articles and whose technical content therefore did not relate to D13. The respondent did not provide any justification for addressing the technical information provided in D13 in this phase of the appeal proceedings. Thus, already the absence of any justification for submitting this document at this stage of the appeal procedure is sufficient for holding

it inadmissible. Accordingly, the Board does not admit D13 into the proceedings (Article 13(1) RPBA 2007).

Main Request

2. The sole substantive issue in dispute is whether the subject-matter of claim 1 which concerns the preparation of aqueous polycarbodiimide dispersions involves an inventive step.

Background of the invention

3. Polycarbodiimides are well known crosslinking agents for aqueous resins containing carboxylic acid functions (paragraph [0001] of the patent in suit). Commercially available polycarbodiimide crosslinkers are mostly dissolved in an organic solvent and need to be mixed with either water, or water and a surfactant, before they can be added to the aqueous resin (paragraph [0001] of the patent in suit). However, these aqueous dispersions have to be freshly prepared, as they lack stability under storage. This lack of stability is expressed in paragraph [0002] of the patent in suit by a reduction of the amount of carbodiimide groups originally available. The patent in suit aims therefore at improving the stability of aqueous polycarbodiimide dispersions (paragraph [0004]).

Closest prior art

4. D1 also describes the preparation of polycarbodiimide aqueous dispersions used as crosslinkers for resins having carboxylic groups (claim 1, Example 1 on page 10 and page 4, lines 28 to 32 and lines 49-50). D1 describes in particular the preparation of polycarbodiimides from isophorone diisocyanate or 4,4'-

dicyclohexylmethane diisocyanate, the polycarbodiimides being made self-emulsifying or self-solubilizing by introduction of a hydrophilic segment in their molecular structure (passage from page 3, line 44 to page 4, line 27 and Synthesis Examples 8-11, 14-17 and 20 to 23 from page 6 to page 9). Said segment is introduced by reacting a polycarbodiimide produced in a first step with a compound having a hydrophilic segment (anionic, cationic or nonionic) and a functional group reactive with an isocyanate group.

- 4.1 It is a matter of consensus that the methods of preparing the aqueous polycarbodiimide dispersions described with Examples 8-11, 14-17 and 20 to 23 of D1 represent the closest prior art. Despite the fact that D1 does not address storage stability of said polycarbodiimide dispersions, it is reasonable for the skilled person to chose the methods described in the above examples as starting point for the present invention, because they concern the same polycarbodiimide dispersions, used in the same technical field, and because aqueous dispersions of polycarbodiimides are known to the skilled person to generally lack stability (see above point 3). Under these circumstances and in agreement with the parties, the Board is satisfied that any of the above mentioned exemplified methods of D1 represents a suitable starting point for the present invention.
- 4.2 It is also undisputed that the process for the preparation of an aqueous polycarbodiimide according to claim 1 of the main request differs from said starting point only in that the pH value of the dispersion is adjusted by raising it to the range of 9 to 14 by the addition of a base and/or a buffer to the water used for the dispersion and/or to the obtained aqueous

dispersion. The fact that this sole distinguishing feature corresponds to the solution of the claimed invention which is identified in paragraph [0006] of the specification confirms that the methods identified above represent a realistic point for assessing inventive step of the subject-matter of claim 1.

Problem successfully solved

5. Having regard to the disclosure of the closest prior art, the appellant and the respondent are divided as to which problem could be considered to be successfully solved by the method of operative claim 1. The appellant takes the position that the problem solved over the closest prior art is the mere provision of a further method for the production of polycarbodiimide dispersions, as the alleged stability of the polycarbodiimide dispersion is not obtained over the whole pH range claimed, whereas the respondent formulates the technical problem as the provision of an aqueous dispersion of polycarbodiimide, free of organic solvents, which dispersion exhibits an improved storage stability such as sufficient crosslinking activity is preserved.

5.1 The appellant's stand is based on an interpretation of the term stable which in their opinion would imply that either no decrease or a decrease of less than 5% of the carbodiimide concentration takes place over a period of 8 weeks under storage at 50°C, reference being made to paragraph [0006] of the specification, and on the experimental report D7b which would show that such stability is obtained at most only at pH 12. The appellant also argues that the test results of D9 to D12 do not show the level of stability obtained after 8

weeks of storage and/or do not concern the full range of pH defined in claim 1.

5.2 While attributing a particular and therefore restrictive meaning to the term "stable" in operative claim 1, which term according to the appellant implies a minimum level of stability under certain test conditions, the appellant is however imposing a limitation to the subject-matter of claim 1 which does not follow from its wording, nor is justified by the common general knowledge in the field. This understanding would impose that the claimed methods are arbitrarily limited to those which are stable within the meaning attributed to that term by the appellant. Already for this reason the appellant's argumentation concerning the technical problem successfully solved by the claimed method which is based on the necessity to obtain a minimum absolute level of stability fails to convince. The appellant's considerations would be at most relevant for assessing sufficiency of disclosure of the claimed invention and/or the clarity of the subject-matter defined with operative claim 1. However, in the absence of corresponding objections by the appellant, and considering that the problem to be defined is that solved over or in comparison with the closest prior art, the question to be addressed is rather whether the stability of the dispersion obtained by the method of operative claim 1 is increased relatively to the closest prior art when the pH of the dispersion is raised to the range of 9 to 14, as alleged by the respondent.

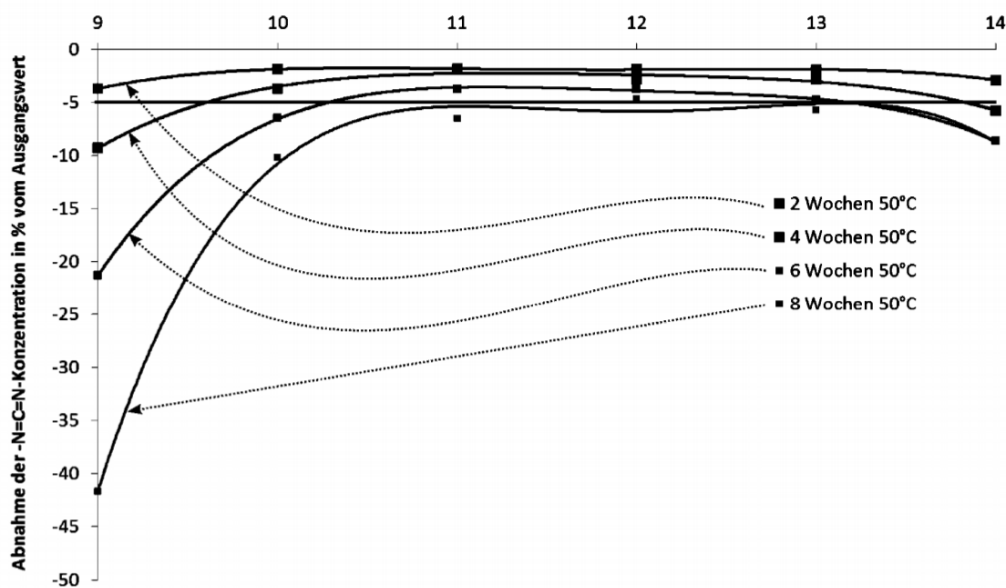
Meaning of the term "stable"

5.3 As shown in what follows the reasoning of the Board is independent from the level of stability which would be

implied by the term "stable" in operative claim 1. It is therefore not necessary for the Board to rule on whether it constitutes a limiting feature of claim 1 and in that case which level of stability would be implied by said term.

Experimental report D7b

5.4 Experimental report D7b submitted by the appellant before the opposition division concerns the stability of a polycarbodiimide dispersion obtained from 4,4'-dicyclohexylmethane diisocyanate, which is capped with MPEG 750 and butoxyethanol. Figure 2 of that report which is reproduced below shows the stability of said dispersion (expressed as the reduction in % of the initial concentration of carbodiimide groups) as a function of the pH of the dispersion in the range of 9 to 14 for various storage times at 50°C, in particular for a 6 and 8 weeks storage time. Under the test conditions used in D7b which are the same as those used in the patent in suit (paragraph [0006] and Examples) that test represents an accelerated testing for the long term storage stability which obviously is done at lower temperature.



It can be seen for a 6 and 8 weeks storage time at 50°C that a sharp increase of the stability is obtained in a pH range of 9 to 10, the stability remaining in the pH range of 10 to 14 at a level over that obtained at about pH 10. Considering the steepness of the stability curve as a function of the pH in the range of 9 to 10, it is reasonable to consider that an increase of the pH value so as to obtain a pH value in the range of 9 to 14, which constitutes the feature distinguishing the process of present claim 1 from that of the prior art, leads to a stability increase of the aqueous polycarbodiimide dispersion over the whole range of pH claimed.

The respondent argues that the dispersion synthesized in D7b comprises 1% by weight of unreacted butoxyethanol used as capping agent for the preparation of said dispersion. The respondent's contests on that basis the pertinence of the results shown with this test report, since butoxyethanol would lead to a swelling of the particles facilitating an access of the aqueous solution into the core of the particles and therefore hydrolysis of the carbodiimide groups. Even,

if, following the respondent's argument, one considered that the presence of butoxyethanol would facilitate the hydrolysis of the carbodiimide bonds, it should be concluded that D7b represents a test report using more stringent conditions under which the hydrolysis of the carbodiimide groups is accelerated. This, however, would by no means impair the conclusions which can be drawn up from that experimental report that higher pH values result in a slowdown of the hydrolysis of the carbodiimide groups, which conclusion remains valid for solvent free dispersions as required by present claim 1.

Accordingly, the results shown in D7b render credible that the step of raising the pH to the range of 9 to 14 in the method of the closest prior art leads to an improvement of the long term stability of the polycarbodiimide dispersion.

Experimental reports D10 to D12

5.5 D10 to D12 are additional test reports concerning the stability at 52°C of a polycarbodiimide dispersion (as prepared in Example 1A of the patent in suit), i.e. with an isocyanate content of 8.20 obtained from 4,4'-dicyclohexylmethane diisocyanate and capped with M-PEG-350. These tests which use a slightly higher temperature than in test D7b also represent an accelerated test for long term storage stability of the polycarbodiimide dispersion. The results shown in D11 (page 2, Graph 1) and D12 (page 2, Graph 1) demonstrate that under the same conditions (i.e. same dispersion, same temperature and storage time) an increase of the pH from 6 to 10 provides a steady increase of the stability. The same effect is shown with D10 in the pH range of 6 to 9 (Figure 2 and Graph 1). Accordingly,

the tests results of D10 to D12 confirm not only the increase in stability shown in D7b when raising the pH from 9 to 10, but also what should be expected based on an extrapolation of the results shown in D7b, namely that addition of a base and/or a buffer to the water used for the dispersion and/or to the obtained aqueous dispersion so as to raise the pH to a value between 9 and 14 brings about higher long term stability of the polycarbodiimide dispersion.

Experimental report D9 and D8

5.6 The results shown in D9 (Graphs 1 and 2) are more difficult to interpret than those shown in D7b and D10 to D12 because the curves expressing the percentage of remaining carbodiimides group as a function of the storage time and pH value exhibit for unknown reasons a less homogeneous trend. The Board, however, has no reason to consider that experimental report D9 casts doubts on the validity of conclusion which can be drawn from the other experimental results submitted both by the appellant with D7b and the respondent with D10 to D12, which as shown above provide a consistent picture about the relationship between stability of the carbodiimide groups in an aqueous dispersion and the pH of the latter.

5.7 As to experimental report D8, it was not disputed during the oral proceedings that the results presented in that report concern various aqueous dispersions which differ in more than one variable (storage time, initial pH, type of polycarbodiimide) so that any meaningful conclusion about the influence of those variables on the stability of the polycarbodiimide dispersions cannot be drawn. Accordingly, D8 also

cannot lead to a conclusion different from that arrived at on the basis of D7b and D10 to D12.

Level of crosslinking activity

5.8 Having regard to the respondent's allegation that the method of claim 1 would result in the preservation of sufficient crosslinking activity, it goes without saying that the crosslinking activity is directly related to the amount of crosslinking groups, i.e. carbodiimide groups, so that an improved stability of the carbodiimide groups in the aqueous dispersion vis-à-vis the closest prior art also expresses for the skilled person an improved crosslinking activity. However, it cannot be considered that the improved storage stability resulting from raising the pH value to a range of 9 to 14 is such that sufficient crosslinking activity is preserved, since the remaining level of crosslinking activity after storage does not only depend on the storage time envisaged, but in addition among others on the type of polymeric composition to be crosslinked and the conditions for said reaction for which no limitation is provided in operative claim 1.

5.9 From the considerations in above points 5.1 to 5.8 it is concluded that the problem successfully solved by the subject-matter of claim 1 resides in the provision of a method for preparing an aqueous dispersion of polycarbodiimide having improved stability.

Obviousness of the solution

6. It remains to be decided whether or not the solution to the above problem defined in operative claim 1, i.e. a step of adjusting the pH to a value between 9 and 14 by

the addition of a base and/or a buffer to the water used for the dispersion and/or to the obtained aqueous dispersion was obvious to the skilled person in view of the prior art. The appellant argues that this was the case having regard to the disclosure of D2, D5 and D6.

- 6.1 D2 like D1 concerns polycarbodiimides used as crosslinking agents for carboxyl-containing organic resins, preferably latex resins, or neutralized, carboxylated water-soluble resins (column 1, lines 13-19; Formula (I) in columns 1 and 2; column 8, lines 18-24). According to column 7, lines 49-54 and in line with column 4, lines 47-52 the multifunctional carbodiimides are to be converted into a form which is usable in water-borne systems, whereby for example, a multifunctional carbodiimide solution, water, and optional ingredients such as surfactants and stabilizers are mixed to yield an emulsion. In addition, D2 specifies in the same passage bridging columns 7 and 8 that volatile amines are sometimes employed to ensure that the pH of the emulsion is maintained adequately high (column 7, lines 63-65). It is added at the end of the paragraph (column 8, lines 2-6) that the pH of the polycarbocarbodiimide emulsion should be above " ~ 8 , preferably ~ 8 to ~ 10 , most preferably ~ 8 to ~ 8.5 , to enhance stability, i.e., to impede hydrolysis of the carbodiimide groups".
- 6.2 On that basis, the skilled person seeking to provide a method for the preparation of an aqueous dispersion of polycarbodiimide having improved stability would have been prompted not only to consult D2, but having regard to the structural similarities between the polycarbodiimides of D1 and those of D2, also to apply the measures recommended in that document, i.e. to add volatile amines to bring the pH value of the

polycarbodiimide dispersion of D1 to values recommended in D2, for example up to ~10.

6.3 Moreover, D5 and D6, although they do not concern the hydrolysis of polycarbodiimides, but rather that of mono carbodiimides compounds, underline the involvement of both OH^- and H^+ ions in the hydrolysis reaction of mono carbodiimides compounds. On that basis, the skilled person would have expected also that those ions and therefore their concentration, meaning the pH of the emulsion, would play a role in the stability of polycarbodiimides emulsions. This would provide higher motivation for the skilled person to apply the teaching of D2 in the context of the polycarbodiimides of D1 which are structurally close to those of D2.

6.4 The Board does not share the respondent's opinion that consulting D2 would be the result of an unallowable *ex post facto* analysis when D1 does not provide any indication of the desire to reduce the hydrolysis of the carbodiimide groups. This argument boils down to the objection that D1 is not a suitable starting point for assessing inventive step, as D1 would not address the need to reduce the hydrolysis of the carbodiimide groups.

This view would not only be in contradiction with the respondent's own choice of the methods of D1 as the closest prior art, but would also fail to convince for the reasons provided in above points 4.1 and 4.2, in particular because aqueous dispersions of polycarbodiimides were known to the skilled person to generally lack stability. Having regard to the teaching of document D2 which indicates in passing in column 8, lines 2-6 that enhancing stability of the polycarbodiimide emulsion means impeding hydrolysis of

the carbodiimide groups, the teaching of both D5 (page 117, section A of part V) and D6 (paragraph bridging pages 599 and 600) which both address the hydrolysis of mono carbodiimides, it can be deduced that it belonged to common general knowledge at the date of the invention under examination that the sensitivity to hydrolysis of carbodiimide compounds, in particular polycarbodiimides, led to their lack of stability in an aqueous medium.

6.5 The respondent also argued that the skilled person would not have applied the teaching of D2 to D1, since D2 was concerned with polycarbodiimides in organic solvents that were emulsified in water prior to a use with aqueous resins, whereas no organic solvent, but solely water was used in D1. It is stating the obvious that the hydrolysis reaction of polycarbodiimides involves water and said compounds as reactants and this reaction is expected in view of D5 and D6 to be pH dependent. The respondent did not provide any reason, and the Board sees none, as to why the skilled person would consider that an organic solvent, i.e. an inert compound in the context of said reaction, would be a major cause for the lack of stability addressed in D2. On that basis the skilled person in a reasonable expectation of success would have applied the pH range recommended in D2 to improve the stability of the polycarbodiimide emulsion.

6.6 Accordingly, the skilled person wishing to solve the problem identified in above point 5.9 would have found in D2 the suggestion to adjust the pH to a value up to to ~10 by the addition of a volatile amine, arriving thereby in an obvious manner at subject-matter falling within the ambit of present claim 1.

7. Consequently, the subject-matter of claim 1 of the main request does not involve an inventive step and this request cannot be allowed.

Auxiliary request II

8. The appellant withdrew during the oral proceedings its request not to admit Auxiliary Request II into the proceedings. The Board has no reason to make use of its discretionary power under Article 12(4) RPBA 2007 (in conjunction with Article 25(2) RPBA 2020) to disregard Auxiliary Request II. It is therefore in the proceedings.

Inventive step

9. Claims 1 of Auxiliary Request II corresponds to claim 1 of the Main Request in which the pH range has been limited to 11-14, compared to 9 to 14 for the Main Request.
 - 9.1 It is undisputed that this amendment does not result in a different choice of the closest prior art.
 - 9.2 Having regard to the above conclusion concerning the problem effectively solved by the subject-matter of claim 1 of the Main Request over its whole breadth, i.e. the provision of a method for preparing an aqueous dispersion of polycarbodiimide having improved stability, the same conclusion necessarily apply in respect of claim 1 of Auxiliary Request II whose subject-matter is encompassed by that of claim 1 of the Main Request. In fact, in comparison to the use of a pH below 11, selecting a pH in the range of 11 to 14 even ensures an additional gain of stability as is shown by

experimental report D7b (see graph reproduced in above section 5.4).

9.3 D2 does not disclose to raise the pH of the polycarbodiimide emulsion above the value of 10, the maximum value of the preferred ranges being indicated to be 10, or more preferably below that value. Based on the explicit teaching of D2 concerning the maximum values for the pH recommended to increase the stability of the polycarbodiimide emulsions and the structural similarities between the polycarbodiimides of D1 and those of D2, the skilled person would not find any suggestion to raise the pH of the polycarbodiimides emulsions of D1 to a value comprised between 11 and 14. Hence, that modification of the methods disclosed in D1 cannot be held to be obvious in the light of D2. The same applies a fortiori in the light of D5 and D6 which documents only confirm that the pH of the emulsion would play a role in the stability of polycarbodiimides (see above section 6.3), but does not suggest any pH range to be used for that purpose.

9.4 The appellant's argument that it can be inferred from D5 that aliphatic substituents would in comparison to aromatic substituents be more stable in a basic environment, leading the skilled person to adapt the pH value of the dispersion in D1 to a basic region in order to improve stability does not change the above conclusion, even if the interpretation of the teaching of D5 made by the appellant were considered to be correct. The teaching provided in D2 as to the range of pH values to be selected in order to impede hydrolysis of the carbodiimide groups is made without any restriction as to the nature of the polycarbodiimides, i.e. whether they are aliphatic or aromatic, whereby D2 is mostly concerned with polycarbodiimides of the

aliphatic type as shown by the examples of D2. Most importantly, D5 does not concern polycarbodiimides, but only mono carbodiimides. There is therefore no apparent reason for the skilled person to ignore the clear teaching provided in D2 for compounds which are structurally close to those used in D1, while speculating on the applicability of theoretical considerations made in the context of compounds structurally more remote. Such alleged applicability was even not explained by the appellant, let alone evidenced.

10. For these reasons, the Board concludes that the appellant's objection that the subject-matter of claim 1 of Auxiliary Request II does not involve an inventive step within the meaning of Articles 52(1) and 56 EPC fails to convince.

11. In the absence of other objections, Auxiliary Request II is considered to be allowable.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the department of first instance with the order to maintain the patent on the basis of the claims of Auxiliary Request II filed with the letter of 22 April 2020, after any necessary consequential amendment of the description.

The Registrar:

The Chairman:



A. Pinna

D. Semino

Decision electronically authenticated