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**Datasheet for the decision  
of 23 June 2022**

**Case Number:** T 2865/19 - 3.3.03

**Application Number:** 09792317.1

**Publication Number:** 2337809

**IPC:** C08G64/02, C08G64/34

**Language of the proceedings:** EN

**Title of invention:**

POLYCARBONATE POLYOL COMPOSITIONS AND METHODS

**Patent Proprietor:**

SAUDI ARAMCO TECHNOLOGIES COMPANY

**Opponent:**

Econic Technologies Limited

**Relevant legal provisions:**

EPC Art. 123(2), 84, 83, 56

**Keyword:**

Amendments - allowable (yes)  
Claims - clarity - main request (yes)  
Sufficiency of disclosure - (yes)  
Inventive step - (yes)



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**Case Number: T 2865/19 - 3.3.03**

**D E C I S I O N**  
**of Technical Board of Appeal 3.3.03**  
**of 23 June 2022**

**Appellant :** Econic Technologies Limited  
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**Decision under appeal:** **Interlocutory decision of the Opposition  
Division of the European Patent Office posted on  
22 August 2019 concerning maintenance of the  
European Patent No. 2337809 in amended form.**

**Composition of the Board:**

**Chairman** D. Semino  
**Members:** D. Marquis  
R. Cramer

## Summary of Facts and Submissions

I. The appeal lies against the decision of the opposition division concerning maintenance of European patent No. 2 337 809 in amended form according to the claims of auxiliary request 4 filed with letter of 24 May 2019 and an amended description filed at the oral proceedings before the opposition division.

II. Claims 1, 5 and 6 of auxiliary request 4 read as follows:

"1. A polycarbonate polyol composition comprising an epoxide CO<sub>2</sub> copolymer **characterized in that** the copolymer has:

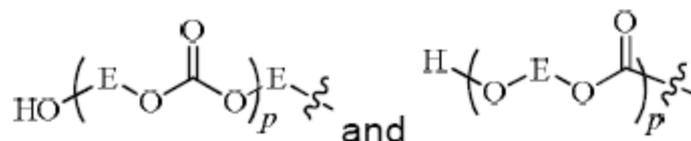
an Mn, as determined by gel permeation chromatography, between 400 and 4,000,

greater than 90% carbonate linkages, and

at least 90% of the end groups are hydroxyl groups,

**characterized in that:**

the polycarbonate polyol composition comprises polymer chains denoted P<sup>1</sup> having the formula T-Y-A-(Y-T)<sub>n</sub>, derived from a chain transfer agent (CTA) having the formula Y-A-(Y)<sub>n</sub>, with Y as defined below, wherein: each -T is a polycarbonate chain having a formula independently selected from the group consisting of:



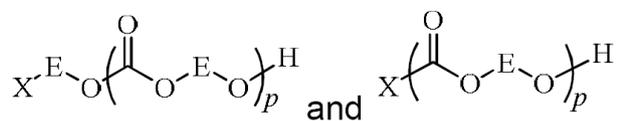
wherein:

p ranges from 5 to 10,000;

each -Y group is independently a functional group capable of initiating chain growth of epoxide CO<sub>2</sub>

copolymers selected from the group consisting of: -OH,

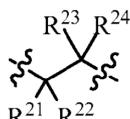
-C(O)OH, -C(OR<sup>Y</sup>)OH, -OC(R<sup>Y</sup>)OH, -NHR<sup>Y</sup>, -NHC(O)R<sup>Y</sup>, -NHC=NR<sup>Y</sup>; -NR<sup>Y</sup>C=NH; -NR<sup>Y</sup>C(NR<sup>Y</sup><sub>2</sub>)=NH; -NHC(NR<sup>Y</sup><sub>2</sub>)=NR<sup>Y</sup>; -NHC(O)OR<sup>Y</sup>, -NHC(O)NR<sup>Y</sup><sub>2</sub>; -C(O)NHR<sup>Y</sup>, -C(S)NHR<sup>Y</sup>, -OC(O)NHR<sup>Y</sup>, -OC(S)NHR<sup>Y</sup>, -SH, -C(O)SH, -B(OR<sup>Y</sup>)OH, -P(O)<sub>a</sub>(R<sup>Y</sup>)<sub>b</sub>(OR<sup>Y</sup>)<sub>c</sub>(O)<sub>d</sub>H, -OP(O)<sub>a</sub>(R<sup>Y</sup>)<sub>b</sub>(OR<sup>Y</sup>)<sub>c</sub>(O)<sub>d</sub>H, -N(R<sup>Y</sup>)OH, -ON(R<sup>Y</sup>)H; =NOH, =NN(R<sup>Y</sup>)H, where each occurrence of R<sup>Y</sup> is independently -H, or an optionally substituted radical selected from the group consisting of C<sub>1-20</sub> aliphatic, C<sub>1-20</sub> heteroaliphatic, 3- to 12-membered heterocyclic, and 6- to 12-membered aryl, a and b are each independently 0 or 1, c is 0, 1 or 2, d is 0 or 1, and the sum of a, b, and c is 1 or 2 and where an acidic hydrogen atom bound in any of the above functional groups may be replaced by a metal atom or an organic cation, and each Y group may be the same or different, -A- is a covalent bond or a multivalent moiety; and n is an integer between 1 and 10 inclusive; further comprising polymer chains denoted P<sup>2</sup> having a formula selected from the group consisting of:



wherein

X is a bound form of an anion capable of initiating only one polymer chain, comprising a halogen atom, an azide, an ester group, an ether group, or a sulfonic ester group,

-E- is an optionally substituted C<sub>2</sub> unit derived from an epoxide, where E may represent a monomer unit derived from one type of epoxide, or a mixture of two or more types of epoxide,



wherein each -E- is  $R^{21}R^{22}$ , where R<sup>21</sup>, R<sup>22</sup>, R<sup>23</sup>, and R<sup>24</sup> are each independently selected from the group consisting of: -H; and an optionally substituted group

selected from C<sub>1-30</sub> aliphatic; C<sub>6-14</sub> aryl; 3- to 12-membered heterocycle, and 5- to 12-membered heteroaryl, where any two or more of R<sup>21</sup>, R<sup>22</sup>, R<sup>23</sup>, and R<sup>24</sup> can be taken together with intervening atoms to form one or more optionally substituted 3- to 12-membered rings, optionally containing one or more heteroatoms, wherein -E- comprises predominantly -CH<sub>2</sub>CH<sub>2</sub> - units derived from ethylene oxide or comprises -CH<sub>2</sub>CH(CH<sub>3</sub>)- groups derived from propylene oxide; wherein the ratio of P<sup>1</sup> polymer chains to P<sup>2</sup> polymer chains is greater than 40:1; and wherein the polycarbonate polyol composition does not comprise the product of Preparation Example 2 of EP 2 258 745 A1".

"5. An article of manufacture comprising the polycarbonate polyol composition of claim 1".

"6. A method of forming a polyurethane composition by reacting one or more isocyanates with one or more aliphatic polycarbonate polyol compositions of claim 1".

III. The following documents were cited in the opposition procedure:

D1: English translation of JP 2008-81518  
D2: JP 2008-81518  
D3: EP 2 258 745 A1  
D4: English translation of JP 2008-280399  
D5: JP 2008-280399  
D6: Inoue, S., J. Polym. Sci. Part A: Polym. Chem.: Vol 38 (2000), pages 2861-2871, "Immortal Polymerization: The Outset, Development, and Application"  
D10: EP 0 222 453 A2

D11: "Chemistry and Technology of Polyols for Polyurethanes" Mihail Ionescu, Rapra Technology Limited, 2005

D14: WO 99/00444

D15: Noordover, B. A. J. (2008), Biobased step-growth polymers : chemistry, functionality and applicability. Technische Universiteit Eindhoven, <https://doi.org/10.6100/IR631662>.

IV. As far as it is relevant to the present appeal, the decision of the opposition division can be summarized as follows:

- Claims 1, 5 and 6 of auxiliary request 4 fulfilled the requirements of Article 123(2) EPC. Claim 1 of auxiliary request 4 also met the requirements of Articles 84 and 83 EPC.
- Claim 1 of auxiliary request 4 differed from examples 6-8 of D1 chosen as the closest prior art in the ratio of P<sup>1</sup> polymer chains to P<sup>2</sup> polymer chains. The problem was the provision of further polycarbonate polyols suitable for the production of polyurethanes. None of D1, D11 or D15 rendered claim 1 of auxiliary request 4 obvious. Claim 1 of auxiliary request 4 was therefore inventive.

V. Both the opponent and the patent proprietor lodged an appeal against the decision of the opposition division. The appeal lodged by the patent proprietor was withdrawn at the oral proceedings before the Board.

VI. The parties were summoned to oral proceedings and a communication pursuant Article 15(1) RPBA 2020 indicating specific issues to be discussed at the oral

proceedings was sent to the parties.

VII. Oral proceedings were held on 23 June 2022 in the presence of both parties.

VIII. The final requests of the parties were as follows:

(a) The opponent (appellant) requested that the decision of the opposition division be set aside and that the patent be revoked.

(b) The patent proprietor (respondent) requested that the appeal of the opponent be dismissed.

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

(a) Claims 1, 5 and 6 of the main request did not meet the requirements of Article 123(2) EPC.

(b) Claim 1 of the main request did not fulfill the requirements of Article 84 EPC.

(c) The subject matter of claim 1 of the main request lacked sufficiency of disclosure.

(d) Claim 1 of the main request lacked an inventive step over the closest prior art D1.

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

- (a) Claims 1, 5 and 6 of the main request met the requirements of Article 123(2) EPC.
- (b) Claim 1 of the main request fulfilled the requirements of Article 84 EPC.
- (c) The subject matter of claim 1 of the main request was sufficiently disclosed.
- (d) Claim 1 of the main request involved an inventive step over the closest prior art D1.

## **Reasons for the Decision**

### Main request

- 1. Added matter
- 1.1 Claim 1 of the main request relates to a polycarbonate polyol composition comprising an epoxide CO<sub>2</sub> copolymer characterized in that the copolymer has, among other features, polymer chains denoted P<sup>1</sup> of a formula comprising a group defined as Y, polymer chains denoted P<sup>2</sup> of a formula comprising a group defined as X, an Mn, as determined by gel permeation chromatography, between 400 and 4000 and wherein the polycarbonate polyol composition does not comprise the product of Preparation Example 2 of EP 2 258 745 A1.
- 1.2 The appellant argued in appeal that claim 1 of the main request did not fulfill the requirements of Article 123(2) EPC because:
  - (i) the limitations performed in the definitions of the group Y in P<sup>1</sup> and the group X in P<sup>2</sup> in combination did not find a basis in the application as filed,

- (ii) the amendment of the upper value of the numerical range defining Mn of the polycarbonate polyol composition was not disclosed in combination with the amended definitions of P<sup>1</sup> and P<sup>2</sup> in the application as filed,
- (iii) the undisclosed disclaimer was not disclosed in combination with the amended definitions of P<sup>1</sup> and P<sup>2</sup> and Mn in the application as filed,
- (iv) the application as filed did not disclose that GPC was the technique used to determine Mn.

The appellant also argued that the application as filed did not contain a basis for the combination of features defining claims 5 and 6 of the main request.

- 1.3 The Board however finds that claims 1, 5 and 6 of the main request meet the requirements of Article 123(2) EPC.
- 1.4 In the application as originally filed, claims 124 and 126 both depend on claim 122 which itself depends on claim 118, dependent on claim 115 which depends on claim 114 which in turn depends on claim 100. The subject-matter of operative claim 1 thus corresponds to claims 124 and 126 in which Y and X are more specifically defined, the range of 400 to 20000 defining Mn (as defined in claim 100) is limited to the range of 400 to 4000 and the undisclosed disclaimer is added.
- 1.5 Objection (i)
  - 1.5.1 It is apparent from claim 115 referring back to claim 114 in the application as filed that the polymer chains P<sup>2</sup> and P<sup>1</sup> containing the groups X and Y respectively were generally disclosed in combination with one

another in the application as filed. The opposition division also found in their contested decision that the definitions of the groups X and Y in polymer chains P<sup>1</sup> and P<sup>2</sup> as they are defined in claim 1 of the main request found a basis in the application as filed (Sections 4.1.1.2 to 4.1.1.5).

1.5.2 In particular, the limitation of X, a bound form of an anion capable of initiating only one polymer chain, present in the polymer chain P<sup>2</sup> defined in claim 115 to one "comprising a halogen atom, an azide, an ester group, an ether group, or a sulfonic ester group" finds a basis on page 69, lines 23/24 of the application as filed. Also, the limitation of Y, a group which is independently a functional group capable of initiating chain growth of epoxide CO<sub>2</sub> copolymers wherein each Y group may be the same or different, to one "consisting of: -OH, -C(O)OH, -C(OR<sup>Y</sup>)OH, -OC(R<sup>Y</sup>)OH, -NHR<sup>Y</sup>, -NHC(O)R<sup>Y</sup>, -NHC=NR<sup>Y</sup>; -NR<sup>Y</sup>C=NH; -NR<sup>Y</sup>C(NR<sup>Y</sup><sub>2</sub>)=NH; -NHC(NR<sup>Y</sup><sub>2</sub>)=NR<sup>Y</sup>; -NHC(O)OR<sup>Y</sup>, -NHC(O)NR<sup>Y</sup><sub>2</sub>; -C(O)NHR<sup>Y</sup>, -C(S)NHR<sup>Y</sup>, -OC(O)NHR<sup>Y</sup>, -OC(S)NHR<sup>Y</sup>, -SH, -C(O)SH, -B(OR<sup>Y</sup>)OH, -P(O)<sub>a</sub>(R<sup>Y</sup>)<sub>b</sub>(OR<sup>Y</sup>)<sub>c</sub>(O)<sub>d</sub>H, -OP(O)<sub>a</sub>(R<sup>Y</sup>)<sub>b</sub>(OR<sup>Y</sup>)<sub>c</sub>(O)<sub>d</sub>H, -N(R<sup>Y</sup>)OH, -ON(R<sup>Y</sup>)H; =NOH, =NN(R<sup>Y</sup>)H, where each occurrence of R<sup>Y</sup> is independently -H, or an optionally substituted radical selected from the group consisting of C<sub>1-20</sub> aliphatic, C<sub>1-20</sub> heteroaliphatic, 3- to 12-membered heterocyclic, and 6- to 12-membered aryl, a and b are each independently 0 or 1, c is 0, 1 or 2, d is 0 or 1, and the sum of a, b, and c is 1 or 2 and where an acidic hydrogen atom bound in any of the above functional groups may be replaced by a metal atom or an organic cation" finds a basis on page 23, lines 9-17 of the application as filed.

1.5.3 Both groups X and Y in claim 1 of the main request are limited by shrinking their respective original

definitions to a list of groups that nonetheless retain a generic character since the lists of groups chosen for X and Y in claim 1 of the main request maintain a level of generality, a situation referred to as a "generic shrinking" by the respondent.

- 1.5.4 The Board also finds that the lists chosen to define X and Y in claim 1 of the main request do not result from singling out a combination of specific meanings but maintain the remaining subject-matter as a generic group of compounds differing from the original group only by its smaller size. This is all the more true as the definitions in claim 1 are the broadest structural definitions underlying the functional ones in claims 114 and 115 with no singling out of specific functional groups.
- 1.5.5 It is standard case law that such a shrinking of the generic group of chemical compounds is not objectionable under Article 123(2) EPC, since these deletions do not lead to a particular combination of specific meanings of the respective residues which was not disclosed originally or, in other words, did not generate another invention (Case Law of the Boards of Appeal, 10th Edition, 2022, II.E.1.6.3).
- 1.5.6 In keeping with the standard case law, the Board does not recognize in the present situation, in the combination of limitations of groups X and Y, a combination of specific meanings generating another invention than that disclosed in the application as filed. The Board concludes therefore that the combination of definitions of groups X and Y in the polymer chains  $P^2$  and  $P^1$  of claim 1 of the main request meets the requirements of Article 123(2) EPC.

1.6 Objection (ii)

1.6.1 The amendment of the upper value of the range defining Mn in claim 1 of the main request is disclosed in claim 106 and also on page 59 of the application as filed. It does not constitute a new combination of features as such because the combination of a broader definition of Mn (between about 400 and about 20,000) with the other features of operative claim 1 was already present in claim 100 as filed. The Board sees the amendment of the range defining Mn to the range of between 400 and 4,000 in claim 1 of the main request as a limitation of the range defining the claimed subject-matter to a range limited by a lower preferred upper value. The appellant argued that the limitation of the upper value defining the range of Mn was in contradiction with the length of the polymer chains  $P^1$  as defined by the parameter  $p$  ranging up to 10,000. In particular, for a parameter  $p$  of 10,000 the molecular weight of the copolymer would be at least 1,760,000, much higher than the limit of 4,000 now claimed (letter of 25 April 2022, section 5.1). It is however apparent that that alleged contradiction already existed in claim 114 depending on claim 100 as filed which defines a molecular weight Mn of between about 400 and about 20,000. In that regard, the Board does not see how the limitation, in claim 1 of the main request, of the upper value of the molecular weight to 4,000, could as such extend the scope of protection of the claims as filed.

1.6.2 The Board concludes that the amendment of the upper value defining the range of Mn does thus not constitute an unallowable extension under Article 123(2) EPC.

1.7 Objection (iii)

1.7.1 The disclaimer present in operative claim 1 is an undisclosed disclaimer introduced in view of example 2 of D3, a document according to Article 54(3) EPC. It was not contested that the undisclosed disclaimer was one that fulfilled the criteria set out in the Enlarged Board of Appeal decision G1/03 (OJ EPO 2004, 413) and confirmed in G1/16 (OJ EPO 2018, A70) (Case Law, *supra*, II.E.1.7.2a and c).

1.7.2 It is clear that the combination of that disclaimer with the other features of claim 1 of the main request, including the definitions of polymer chains P<sup>1</sup> and P<sup>2</sup> and the amended range for Mn, per definition of an undisclosed disclaimer, is not to be found in the application as originally filed but that as such is not a situation leading to an infringement of the requirements set out in Article 123(2) EPC (in particular it is obviously not an additional requirement of G1/03).

1.8 Objection (iv)

1.8.1 Claim 1 of the main request discloses that the Mn of the polycarbonate polyol composition, as determined by gel permeation chromatography (GPC), is between 400 and 4,000. The appellant argued that the application as filed did not indicate that the Mn of the polycarbonate polyol compositions was determined by GPC.

1.8.2 The application as filed does in fact not disclose explicitly that GPC was used to measure Mn of the polycarbonate polyol compositions of claim 1 of the main request. GPC however is the only method disclosed in the application to be used for the determination of

molecular weights (claim 98 and examples 1 and 2) and it is common general knowledge that GPC is a standard method to measure molecular weights such as Mn. Example 1 (page 96, line 19) and example 2 (page 98, line 7) also indicate that GPC analysis was used to determine the Mn of the polycarbonate polyol compositions produced therein. It cannot be derived from the application as filed as a whole nor from the examples in particular that the use of GPC is limited to the process or to the details of examples 1 and 2. In view of that, the Board does not find that the mention in claim 1 of the main request that the Mn of the polycarbonate polyol composition were determined by GPC infringes the requirements of Article 123(2) EPC.

1.8.3 Basis for claims 5 and 6

1.9 The opposition division considered that claims 5 and 6 of the main request found a basis on page 95, lines 21-24 of the application as originally filed (section 4.1.2 of the decision). The appellant considered in appeal that the article of claim 5 and the method of claim 6 referring back to claim 1 of the main request did not find a basis in the application as filed.

1.10 Claim 5 pertains to an article of manufacture comprising the polycarbonate polyol composition of claim 1. Claim 6 pertains to a method of forming a polyurethane composition by reacting one or more isocyanates with one or more aliphatic polycarbonate polyol compositions of claim 1. Both claims 5 and 6, in their generality, find a basis in the general passage on page 95, lines 22-24 which broadly refers to articles and methods of preparation of polycarbonate polyol compositions of the application as filed. It is apparent from that passage that the general reference

to the articles and methods on page 95 applies to all embodiments of the application as filed, including therefore those of operative claim 1, which find a basis in the original application for the reasons set out above. The reference to the polycarbonate polyol compositions according to claim 1 of the main request in claims 5 and 6 of the main request therefore does not constitute an extension of subject matter and the requirements of Article 123(2) EPC are found to be met.

## 2. Clarity

2.1 The appellant argued that claim 1 of the main request lacked clarity because (a) there was an inconsistency between the range of Mn of the polycarbonate polyol composition and the value of the parameter  $p$  defining the length of the polymer chains  $P^1$  in claim 1 of the main request, (b) it was unclear whether the term "predominantly" in claim 1 of the main request referred to wt.-% or mol.-% and (c) claim 1 of the main request referred to groups E being "optionally substituted" but it did not define those substituents.

2.2 (a) Alleged inconsistency between the range of Mn in claim 1 and the range of parameter  $p$

2.2.1 The definition of the polycarbonate polyol composition by a combination of limitations concerning Mn (between 400 and 20,000) and  $p$  (from 5 to 10,000) was already present in claim 1 as granted. The definition of the chains of the copolymer already encompassed in view of the higher limit for  $p$  segments of the polymer chains  $P^1$  and  $P^2$  of relatively high molecular weight possibly incompatible with the higher limit for Mn.

2.2.2 In that regard, the amendment of the maximum value of the Mn range from 20,000 to 4,000 does not introduce a "new feature" and it does not appear to create a contradiction that was not possibly already present in claim 1 as granted. In view of G 3/14 (OJ EPO 2015, A102) the objection of clarity raised by the opponent here is therefore not one that can be raised and dealt with in opposition proceedings.

2.3 (b) "predominantly"

2.3.1 The wording in claim 1 of the main request "wherein -E- comprises predominantly -CH<sub>2</sub>CH<sub>2</sub>- units derived from ethylene oxide or comprises -CH<sub>2</sub>CH(CH<sub>3</sub>)- groups derived from propylene oxide" that is objected to by the opponent was already present in claim 1 as granted.

2.3.2 The limitation of the unit E added in claim 1 of the main request does not change the substance of the definition of that unit and in particular the alleged issue with the wording "predominantly" in that definition. In view of G 3/14 the objection against the definition of segment E is also not one that can be validly raised and dealt with in opposition proceedings.

2.4 (c) "optionally substituted"

2.4.1 The polycarbonate polyol compositions of claim 1 of the main request contain polymer chains P<sup>1</sup> and P<sup>2</sup> each defined by a formula involving a group E. That group E is in turn defined as being an optionally substituted C<sub>2</sub> unit derived from an epoxide.

2.4.2 Claim 1 of the main request does not define the substituent that could be present on the group E but

the term "substituted" is in itself clear. In that regard, the definition of E is broad but that broadness however does not imply that the definition of the group E in claim 1 of the main request lacks clarity.

2.5 Claim 1 of the main request therefore fulfills the requirements of Article 84 EPC.

### 3. Sufficiency

3.1 Claim 1 of the main request concerns a polycarbonate polyol composition comprising an epoxide CO<sub>2</sub> copolymer and characterized, among others, in that the copolymer has greater than 90% carbonate linkages. The appellant argued that claim 1 of the main request was not sufficiently disclosed because it did not disclose how the amount of carbonate linkages could be determined when the starter compound included a group A that was polymeric. In particular the use of the <sup>1</sup>H-NMR technique when the group A was a polyether could not yield the amount of carbonate linkages of the polycarbonate polyol composition due to other linkages having <sup>1</sup>H-NMR signals in the same region as shown in an analysis of two examples from the prior art D1 and D3 provided with the statement of grounds of appeal.

3.2 The question of sufficiency of disclosure in the present case is whether the skilled person would find the necessary guidance for the preparation of that copolymer in the patent in suit and in their common general knowledge. The objection of the appellant in appeal is however not that a skilled person would not be able to obtain a copolymer having greater than 90% carbonate linkages as defined in operative claim 1. The preparation of these copolymers is in fact not contested by the appellant.

3.3 The objection raised by the appellant is about the definition of a measurement method for the carbonate linkages. The patent in suit indicates in paragraph 163 that both  $^1\text{H}$ - and  $^{13}\text{C}$ -NMR were typical methods used to detect carbonate linkages. The patent in suit therefore taught that  $^{13}\text{C}$ -NMR could also be used, in particular when the  $^1\text{H}$ -NMR method alone could not yield the amount of carbonate linkages. The analysis of two examples from the prior art D1 and D3 provided with the statement of grounds of appeal only addresses alleged shortcomings of using  $^1\text{H}$ -NMR alone. That analysis however does not address the possible use of  $^{13}\text{C}$ -NMR and the appellant did not produce reliable facts showing that a skilled person was not in the position to measure the amount of carbonate linkages according to claim 1 of the main request using  $^{13}\text{C}$ -NMR as suggested by the patent in suit or a combination of  $^1\text{H}$ - and  $^{13}\text{C}$ -NMR as argued by the respondent. In that regard, the Board cannot come to the conclusion that claim 1 of the main request lacks sufficiency of disclosure because no reliable method of measurement exists.

3.4 The appellant also argued that claim 1 of the main request lacked sufficiency of disclosure on the grounds that the polymer chain  $P^1$  in claim 1 of the main request could contain up to 10,000 (parameter  $p$ ) of a repeating unit that would result in the molecular weight of the polycarbonate polyol composition being at least 1,760,000. Since claim 1 of the main request limited the upper value of  $M_n$  of the polycarbonate polyol composition to 4,000, the claim was not operable over its whole scope. Claim 1 of the main request was thus not sufficiently disclosed.

- 3.5 Sufficiency of disclosure presupposes that the skilled person is able to obtain substantially all embodiments **falling within the ambit of the claims**. The ambit of claim 1 of the main request relates to a polycarbonate polyol composition that must simultaneously fulfill all the requirements set out in that claim, namely, polycarbonate polyol compositions that both (i) comprise polymer chains  $P^1$  and  $P^2$  having a number  $p$  of repeating units based on group E of from 5 to 10,000 and (ii) have an  $M_n$ , as determined by gel permeation chromatography, of between 400 and 4,000.
- 3.6 It is apparent from the argument of the appellant that in the present situation they construed the polycarbonate polyol compositions according to claim 1 of the main request as all compositions fulfilling the requirements (i) and (ii) independently. It follows that the appellant applies the requirements of sufficiency of disclosure to compositions that are in fact not part of the ambit of claim 1 of the main request, such as those compositions having polymer chains with a number of repeating units of  $p=10,000$  and an  $M_n$  much larger than 4,000. Claim 1 of the main request however concerns compositions for which the requirements (i) and (ii) are concomitantly fulfilled. In that regard, the objection of the appellant must fail.
4. The appellant had mentioned novelty objections based on examples 1, 3 and comparative example 7 of D3 in their statement of grounds of appeal (top of page 5). These objections were not pursued at the oral proceedings before the Board.

5. Inventive step

5.1 D1 was the closest prior art in the contested decision, which is not disputed by the parties in appeal. It was also not in dispute that operative claim 1 differed from D1 (examples 6-8) in the ratio of P<sup>1</sup> polymer chains to P<sup>2</sup> polymer chains (noted ratio P<sup>1</sup> to P<sup>2</sup> hereafter), that ratio being greater than 40:1 in claim 1 and the ratio being 20:1 in the examples 6-8 of D1 (Section 4.6.6 of the contested decision, page 17 of the rejoinder of the patent proprietor and page 6, section 4.1.3 of the rejoinder of the opponent). It was also not in dispute that the compositions in examples 6-8 of D1 otherwise correspond to operative claim 1. The Board does not see a reason to depart from examples 6-8 of D1 as the closest prior art for claim 1 of the main request.

5.2 The patent in suit does not contain evidence of an effect by comparison with the compositions of examples 6-8 of D1, nor was any evidence of an effect made available by the respondent. The absence of evidence showing an improvement of the polycarbonate polyol compositions according to claim 1 of the main request over those of D1 was also acknowledged by the respondent during the oral proceedings before the Board. In that regard, the problem over D1 can only be defined as providing further polycarbonate polyol compositions.

5.3 The opposition division considered based on paragraphs 84 and 144 of D1 that the skilled person would not have been able to prepare compositions with a ratio P<sup>1</sup> to P<sup>2</sup> of greater than 40 in combination with an upper limit of Mn of 4,000 and an amount of carbonate linkages greater than 90% (Section 4.6.6 of the contested

decision). In particular, the opposition division considered that an increase of the amount of multifunctional chain transfer agent (CTA) was taught to lead to an increase of molecular weight and a decrease of the carbonate linkages in the composition, that also paragraph 141 contained no incentive to raise the amount of multifunctional CTA in the process and that D11 and D15 lacked relevance.

- 5.4 The process of preparing polycarbonate polyol compositions in examples 6-8 of D1 uses water as a difunctional chain transfer agent which is a multifunctional chain transfer agent according to claim 1 of the main request. The appellant argued in appeal that D1 taught the need to reduce the levels of halogen in the final product (paragraphs 7, 8 and 145) and the need to provide a control of the molecular weight of the produced polycarbonate (paragraphs 84-86). To that effect, D1 taught a higher ratio of chain transfer agent to catalyst which also corresponded to a higher ratio  $P^1/P^2$  (statement of grounds of appeal, page 15). Examples 6-8 of D1 also showed a ratio of  $P^1/P^2$  of 20 (disclosed as the molar amount B in Tables 1 and 3). Since D1 did not limit the value of  $P^1/P^2$ , any value of that ratio above 20 could have been considered by the skilled person. Paragraphs 84, 144 of D1 also taught that there was no reason for the skilled person to expect that the molecular weight of the composition or the amount of carbonate linkages would be compromised as a result of raising the ratio  $P^1/P^2$ . Example 5 in Tables 1 and 2 of D1 disclosed a ratio of  $P^1/P^2$  of 40 resulting in a polycarbonate polyol composition having a high amount of carbonate linkages (95%) as well as a molecular weight (1,600) that was well within the range of 400 to 4,000 disclosed in claim 1 of the main request. Although example 5 of D1 used a monofunctional

chain transfer agent (ethanol), the teaching of that example could be applied to examples 6-8 since swapping a monofunctional chain transfer agent for a multifunctional chain transfer agent did not significantly affect the molecular weight of the produced polycarbonate polyol composition (statement of grounds of appeal, pages 12-15). Since the skilled person knew that low levels of halogen were advantageous, they would want to raise the ratio  $P^1/P^2$  in order to achieve lower levels of halogen and complex as taught by D1 thereby arriving at values of  $P^1/P^2$  above 40. Claim 1 of the main request therefore lacked an inventive step.

5.5 The question of obviousness in the present case is the question of whether the skilled person starting from examples 6-8 of D1 would have considered raising the amount of multifunctional CTA and by doing so would have arrived at a composition according to claim 1 of the main request.

5.5.1 Examples 6-8 of D1 disclose the preparation of polycarbonate polyol compositions and use a catalyst containing halogen as apparent from its structural formula (Formula 1 disclosed in paragraph 149 to be tetraphenyl porphinato cobalt chloride [(TPP) CoCl]). The teaching of paragraph 145 is that the amount of halogen present at the end groups of the prepared copolymer should be lowered and a means of doing that in D1 is to raise the amount of chain transfer agent having active hydrogens in the preparation. The chain transfer agents used in examples 6-8 have active hydrogens (water, ethylene glycol, polypropylene glycol) so that it can be accepted that raising their amounts in examples 6-8 would result in an increase of

the ratio  $P^1/P^2$ .

- 5.5.2 While the skilled person could derive from D1 that increasing the amount in multifunctional chain transfer agent in the preparation of examples 6-8 would result in higher ratios  $P^1/P^2$ , the Board finds no indication in D1 that the amount of the chain transfer agent could be raised to such an extent that the ratio  $P^1/P^2$  could be doubled (from 20 in examples 6-8 to greater than 40 according to claim 1 of the main request) while obtaining polycarbonate polyol compositions still having more than 90% carbonate linkages and an Mn between 400 and 4,000.
- 5.5.3 The Board does not find that the skilled person would have considered example 5 as providing a teaching directly applicable to the preparations of examples 6-8 in particular because the process of example 5 concerns the polymerization of a different monomer (cyclohexene in example 5 and propylene oxide in examples 6-8) with a different type of chain transfer agent (monofunctional in example 5 and difunctional in examples 6-8). Furthermore, the chain transfer agent in example 5 is monofunctional so that there can be in that polymerization process no formation of polymer chains  $P^1$  according to claim 1 of the main request, as shown by the respondent (letter of 20 May 2020, passage bridging pages 13 and 14). The molar amount in B of 40 derivable from the molar ratio A/B/C disclosed in Table 1 (corrected from 4 to 40 as shown in the original Japanese document D2 corresponding to its translation in D1) does therefore not represent the ratio  $P^1/P^2$  since a different set of polymers is produced in example 5 by comparison with examples 6-8. In that regard, it is doubtful whether the skilled person would have found in example 5 a teaching regarding the ratio

$P^1/P^2$ .

5.5.4 Considering examples 6-8, the polycarbonate polyol obtained has a molecular weight of between 2,500 and 3,000 (Tables 2 and 4) and an amount of carbonate linkages of 96% or more. It is known from the common general knowledge and it was not in dispute between the parties in appeal that raising the amount of chain transfer agent in polymerization reactions leads to a decrease of molecular weight of the polymer obtained. In that regard, it can be expected from the common general knowledge that raising the amount of difunctional chain transfer agent in the process of examples 6-8 would lower the molecular weight of the polycarbonate polyol obtained. It has however not been shown by the appellant that an at least doubling of the ratio  $P^1/P^2$  obtained by raising the amount of chain transfer agent in these examples would keep the molecular weight of these polymers in the range of between 400 to 4,000 as set out in claim 1 of the main request. With regard to the carbonate linkages also the appellant did not show that a doubling of the ratio  $P^1/P^2$  in the process of examples 6-8 would keep the amount of carbonate linkages of the resulting polymer above 90%. The Board concludes therefore that it has not been shown, starting from examples 6-8 of D1, that a skilled person would have raised the ratio  $P^1/P^2$  from 20 to above 40 and still be able to obtain polycarbonate polyol compositions according to claim 1 of the main request.

5.6 D4/D5, D6, D10, D11, D14 and D15 were cited by the appellant in their statement of grounds of appeal as combination documents with D1. None of these documents is found by the Board to lead to the polycarbonate polyol compositions of claim 1 for the following

reasons:

- 5.6.1 D4/D5 concerns the production of biodegradable polycarbonates from carbon dioxide and alkylene oxide (paragraph 2). The appellant considered that D4/D5 had a content that was similar to D1 and that example 6 of D4/D5 disclosed a polymerization process in the presence of 49 equivalent chain transfer agent (statement of grounds of appeal, page 17). The appellant concluded that D4/D5 made clear that there was no upper limit to the ratio of chain transfer agent to catalyst in D1. The appellant however did not show with D4/D5 that by raising the ratio  $P^1/P^2$  in the examples 6-8 of D1, a polycarbonate polyol composition having an Mn of 400-4,000 and carbonate linkages in an amount of greater than 90% can be obtained. In view of that the combination of D1 with D4/D5 does not lead to the subject matter of claim 1 of the main request.
- 5.6.2 D6 in an academic publication that describes aluminium porphyrin catalysts in the context of immortal polymerisation reactions, including CO<sub>2</sub>/epoxide copolymerisation (Abstract and Table I) and discloses the use of multifunctional chain transfer agents for this type of copolymerizations (page 2869). D6 was cited by the appellant to support the view that the requirement for multiple OH end groups in polyurethane production and multifunctional chain transfer agents to achieve double ended (telechelic) or star polymers was well known in the art. There is however in D6 no teaching that would prompt the skilled person to use a ratio  $P^1/P^2$  greater than 40 with the expectation of obtaining polycarbonate polyol compositions with an Mn of 400-4,000 and carbonate linkages in an amount of greater than 90%. In view of that the combination of D1 with D6 does not lead to the subject matter of claim 1

of the main request.

5.6.3 D10 concerns the production of polycarbonate polyols and polyurethane foams from these polyols (page 2, lines 1/2). D10 was cited by the appellant to show that there was an interest in using multifunctional hydroxyl chain transfer agent (statement of grounds of appeal, pages 18/19). D10 however does not explicitly address raising the ratio  $P^1/P^2$  above the value of 40 so that D10 cannot lead to claim 1 of the main request.

5.6.4 D11, D14 and D15 were also cited to support the argument of the appellant that multihydroxyl chain transfer agents would be more advantageous than monohydroxyl chain transfer agents in the process of D1 (statement of grounds of appeal, pages 19/20). These documents however do not specifically address raising the ratio  $P^1/P^2$  that could be applied to the process of examples 6-8 of D1 in the expectation of obtaining polycarbonate polyol compositions with an Mn of 400-4,000 and carbonate linkages in an amount of greater than 90%. In view of that also the combination of D1 with D11, D14 and D15 does not lead to the subject matter of claim 1 of the main request.

5.7 The appellant also argued in their statement of grounds of appeal that it was not plausible that the range of compounds claimed was inventive over all the versions of E as defined in claim 1 of the main request (Plausibility of E, page 20). It was even argued in that passage that it was not plausible that all versions of E, such as substituted  $C_{30}$  aliphatic or  $C_{14}$  aryl epoxides could even be produced. The appellant did however not provide any evidence in support of these arguments. In the absence of any reliable facts underlying the position of the appellant, the Board

cannot reach the conclusion that some versions of E would not lead to polycarbonate polyol compositions according to claim 1 of the main request as further polycarbonate compositions to those of examples 6-8 of D1.

5.8 The Board concludes therefore that claim 1 of the main request involves an inventive step starting from D1 as the closest prior art.

### Order

#### **For these reasons it is decided that:**

The appeal is dismissed.

The Registrar:

The Chairman:



B. ter Heijden

D. Semino

Decision electronically authenticated