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Datasheet for the decision of 14 January 2026

Case Number: T 0135/24 - 3.3.03

Application Number: 13789295.6

Publication Number: 2917266

IPC: C08G75/23

Language of the proceedings: EN

Title of invention:
POLYARYLENE ETHER SULFONES

Patent Proprietor:
Syensqo Specialty Polymers USA, LLC

Opponent:
BASF SE

Relevant legal provisions:
RPBA 2020 Art. 12(4), 11
EPC Art. 56, 111(1)

Keyword:

Statut of a document admitted before the opposition division and forming the basis for the decision - in the appeal proceedings (yes)
New document submitted with the statement of grounds of appeal - admitted (yes)
Submission concerning an additional distinguishing feature over the closest prior art - admitted in the appeal proceedings (yes) - no need for a remittal
Inventive step - obvious further process and its optimization (all requests)

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Chambres de recours

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Case Number: T 0135/24 - 3.3.03

D E C I S I O N
of Technical Board of Appeal 3.3.03
of 14 January 2026

Appellant: (Opponent)	BASF SE Carl-Bosch-Str. 38 67056 Ludwigshafen am Rhein (DE)
Representative:	Baier, Martin Ellwanger & Baier Patentanwälte Partnerschaftsgesellschaft Friedrichsplatz 9 68165 Mannheim (DE)
Respondent: (Patent Proprietor)	Syensqo Specialty Polymers USA, LLC 4500 McGinnis Ferry Road Alpharetta GA 30005-3914 (US)
Representative:	Benvenuti, Federica SyensQo S.A. Intellectual Assets Management 98, rue de la Fusée 1130 Bruxelles (BE)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 15 December 2023 concerning maintenance of the European Patent No. 2917266 in amended form.**

Composition of the Board:

Chairman	D. Semino
Members:	F. Rousseau
	L. Basterreix

Summary of Facts and Submissions

I. The appeal lies from the interlocutory decision of the opposition division according to which European patent No. 2 917 266 as amended according to the claims of Auxiliary Request 1 submitted during the oral proceedings on 8 November 2023 and a description adapted thereto met the requirements of the EPC.

II. The following items of evidence were submitted during the opposition proceedings:

D1: Saber Chatti et al, Poly(ether sulfone) of Isosorbide, Isomannide and Isoidide, High Performance Polymers, 21: pages 105-118, 2009
D2: H. R. Kricheldorf and M. Al Masri, New polymer syntheses. LXXXII. Syntheses of poly(ether-sulfone)s from silylated aliphatic dials including chiral monomers, Journal of Polymer Science Part A: Polymer Chemistry, Vol. 33, pages 2667-2671 (1995)
D4: WO 2014/095794 A2
D10: M.J. El-Hibri et al, Poly(aryl ether sulfone)s, Handbook of Thermoplastics, 1997, Chapter 36, pages 893-900,
D19: J. Bicerano, Glass transition, Encyclopedia of Polymer Science and Technology, 2001, pages 655-677
D21: Y.R. Ting and L.F. Hancock, Preparation of polysulfone/poly(ethylene oxide) block copolymers, Macromolecules, 1996, 29, pages 7619-7621

III. According to the conclusions for the contested decision which are pertinent for the appeal proceedings, D21 was admitted into the proceedings and an inventive step was acknowledged for the process defined in claim 1 of

Auxiliary Request 1, D1 representing the closest prior art.

IV. An appeal against that decision was lodged by the opponent (appellant). With the statement setting out the grounds of appeal, the following documents were submitted:

D25: Haibo Li et al., Poly(arylene ether sulfone) multi-block copolymers bearing perfluoroalkylsulfonic acid groups, Polymer 52 (2011), pages 3550-3559
D26: Christen, Grundlagen der organischen Chemie, 6. Auflage, 1985, pages 720 and 721

V. With its reply to the statement of grounds of appeal, the patent proprietor (respondent) submitted six sets of claim requests as Auxiliary Requests 1 to 6.

VI. In preparation of the oral proceedings, a communication pursuant to Article 15(1) RPBA conveying the Board's provisional opinion was issued.

VII. Oral proceedings before the Board were held on 14 January 2026.

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

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

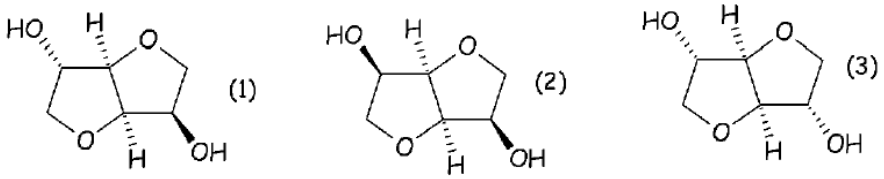
The respondent requested that the appeal be dismissed or, alternatively, that the decision under appeal be set aside and that the patent be maintained in amended form on the basis of any of Auxiliary Requests 1 to 6 submitted with the reply to the statement of grounds of appeal.

IX. The claims relevant to the present decision are as follows:

Main request (Auxiliary Request 1 submitted on 8 November 2023)

Claim 1 which reads:

"1. A process for the manufacturing of a poly(arylether sulfone) polymer [polymer (b-PAES), herein after] comprising reacting in a solvent mixture comprising a polar aprotic solvent and in the presence of an alkali metal carbonate, a monomer mixture which contains :
- at least one 1,4:3,6-dianhydrohexitol [diol (AA), herein after] selected from the group consisting of isosorbide (1), isomannide (2) and isoidide (3) :



- at least one dihaloaryl compound [dihalo(BB), herein after] of formula (S) :

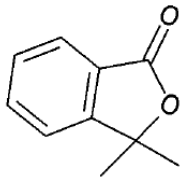
$X\text{-}Ar^1\text{-}SO_2\text{-}[Ar^2\text{-}(T\text{-}Ar^3)n\text{-}SO_2]m\text{-}Ar^4\text{-}X'$ formula (S)

wherein

- n and m, equal to or different from each other, are independently zero or an integer of 1 to 5 ; X and X', equal to or different from each other, are Cl or F,

- each of Ar^1, Ar^2, Ar^3 and Ar^4 equal to or different from each other and at each occurrence, is an aromatic moiety,

- T is a bond or a divalent group optionally comprising one or more than one heteroatom ; preferably T is selected from the group consisting of a bond, $-CH_2-$, $-C(O)-$, $-C(CH_3)_2-$, $-C(CF3)_2-$, $-C(=CCl_2)-$, $-C(CH_3)(CH_2CH_2COOH)-$, and a group of formula :



- optionally, at least one dihydroxyl compound [diol (A'A')] different from the diol (AA) ;

- optionally, at least one dihaloaryl compound [dihalo (B'B')] different from the dihalo (BB) ;

- optionally, at least one hydroxyl-halo compound [hydro-halo (A'B')] ;

being understood that the overall amount of halo-groups and hydroxyl-groups of the monomers of the monomer mixture is substantially equimolecular, so as to obtain a polymer (b-PAES),

wherein the reaction is carried out at a total % monomer mixture concentration [total % monomers, herein after] equal to or more 15 % and less than 70 % with respect to the combined weight of monomer mixture and solvent mixture,

wherein the amount of the alkali metal carbonate used, when expressed by the ratio of the equivalents of alkali metal (M) per equivalent of hydroxyl group (OH) [eq. (M)/eq. (OH)] ranges from 1.3 to 4.0;

and wherein the dihaloaryl compound dihalo(BB) is a compound of formula (S) wherein X,X' is Cl [dihalo ($B_{Cl}B_{Cl}$)]."

Auxiliary Request 1

Claim 1 which corresponds to claim 1 of the Main Request in which the use of at least one dihydroxyl compound [diol (A'A')] different from the diol (AA) is not any more optional, but mandatory.

Auxiliary Request 2

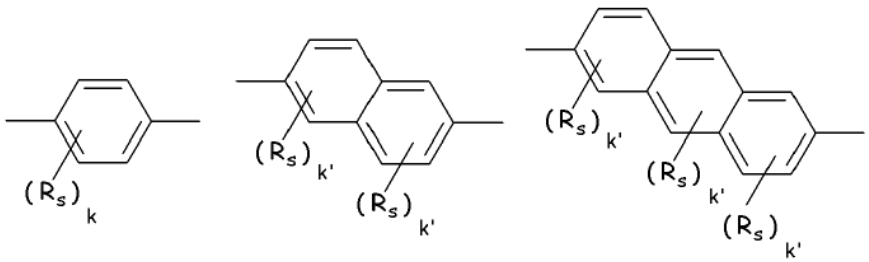
Claim 1 which corresponds to claim 1 of Auxiliary Request 1 in which the at least one dihydroxyl compound [diol (A'A')] different from the diol (AA) is

"selected from the group consisting of compounds of formula (O): $HO-Ar^5-(T'-Ar^6)_n-O-H$ formula (O),

wherein :

- n is zero or an integer of 1 to 5 ;

- each of Ar^5 and Ar^6, equal to or different from each other and at each occurrence, is an aromatic moiety of the formula :

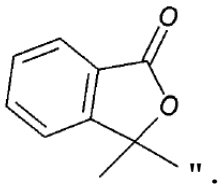


wherein

- each R_S is independently selected from the group consisting of halogen, alkyl, alkenyl, alkynyl, aryl, ether, thioether, carboxylic acid, ester, amide, imide, alkali or alkaline earth metal sulfonate, alkyl sulfonate, alkali or alkaline earth metal phosphonate, alkyl phosphonate, amine and quaternary ammonium ;

and

- k is zero or an integer of 1 to 4 ; k' is zero or an integer of 1 to 3 ; - T' is a bond or a divalent group optionally comprising one or more than one heteroatom ; preferably T is selected from the group consisting of a bond, $-SO_2-$, $-CH_2-$, $-C(O)-$, $-C(CH_3)_2-$, $-C(CF_3)_2-$, $-C(=CCl_2)-$, $-C(CH_3)(CH_2CH_2COOH)-$, and a group of formula :



".

Auxiliary Request 3

Claim 1 which corresponds to claim 1 of the Main Request in which the feature "a solvent mixture comprising a polar aprotic solvent" is replaced by "a solvent mixture comprising sulfolane as a polar aprotic solvent".

Auxiliary Request 4

Claim 1 which corresponds to claim 1 of the Main Request.

Auxiliary Request 5

Claim 1 which corresponds to claim 1 of Auxiliary Request 1.

Auxiliary Request 6

Claim 1 which corresponds to claim 1 of Auxiliary Request 3.

X. The parties' submissions, in so far as they are pertinent to the present decision, may be derived from the reasons for the decision below. They essentially concerned admittance of documents D21, D25 and D26 into the proceedings and inventive step of the process for the manufacturing of the poly(arylether sulfone) polymer (hereafter PAES) of claim 1 of all requests over the disclosure of document D1.

Reasons for the Decision

Status of document D21

1. The respondent submits that document D21 was not *prima facie* relevant and for this reason should not have been admitted into the proceedings by the opposition division (rejoinder, sections 4.2).

Although the admittance of D21 is not explicitly addressed in the minutes, this point was nevertheless discussed and considered at the same time as the issue of inventive step over D1 (minutes, point 4.4, second and third paragraphs). Reasons for the admittance of D21 are given in Reasons 2 of the contested decision.

In addition, the appellant's arguments concerning obviousness of the solution in view of D21 when D1 is taken as the starting point for assessing inventive step are dealt with in the impugned decision (Reasons 4.6.5, last paragraph).

It is generally accepted in the case law that the EPC does not provide any legal basis for excluding on appeal documents correctly admitted by the department of first instance, particularly if the contested decision was based on those (Case Law of the Boards of Appeal of the EPO, 11th edition 2025, hereafter "Case Law", V.A.3.4.3). This is, as shown above, the case for document D21.

For the above reasons, the Board decided that document D21 is in the appeal proceedings and consequently it is to be taken into account.

Admittance of documents D25 and D26

2. It is uncontested that the filing of documents D25 and D26 filed with the statement of grounds of appeal is to be regarded as an amendment to the appellant's appeal case within the meaning of Article 12(4) RPBA, whose admittance, disputed by the respondent, is at the discretion of the Board. The respondent submits that documents D25 and D26 should not be admitted into the proceedings, because they would provide no clear evidence clarifying the inventive step analysis (rejoinder, page 8, last full paragraph).

2.1 According to the appellant, D25 was filed in order to demonstrate that it was customary at the filing date of the patent in suit to use potassium carbonate in excess, relative to the dihydroxy component used, when

preparing poly(arylether sulfone) by polycondensation of 4,4'-difluorodiphenylsulfone (hereafter DFDPS) and 4,4' bisphenol (statement of grounds of appeal, page 13, 5th and 6th full paragraphs). The relevant teaching of D25 in that respect is to be found in section 2.5 of that document concerning the synthesis of the hydrophobic prepolymer by reacting DFDPS and 4,4' bisphenol using a 2:1 molar ratio of K_2CO_3/bisphenol. A similar reaction is to be found in section 2.6, lines 8-11. Although that document concerns the reaction of a difluoro compound, but not that of a dichloro compound, the filing of this document is deemed a reasonable and timely response to the argument in the appealed decision that the skilled person would not have been motivated to use an excess of K_2CO_3 because it would complicate the reaction procedure and its working-up (Reasons, 4.5 and 4.6.3), which argument, however, does not emerge from the written submissions preceding the oral proceedings before the opposition division.

2.2 Regarding D26, the appellant brings forward that this document was submitted as a direct response to the decision of the opposition division in order to demonstrate that it was known to the skilled person that fluoroaryl compounds in a nucleophilic aromatic substitution reaction, such as hydrolysis, react much faster than the corresponding chloroaryl compounds (statement of grounds, page 4, first and second full paragraphs). This is indeed the case, as the opposition division considered in point 4.6.4 of the Reasons that the appellant had failed to provide supporting evidence in this respect.

2.3 Consequently, the filing of D25 and D26 at the outset of the appeal proceedings is considered a justified and timely reaction to the Reasons for the contested

decision. Under these circumstances, the Board exercised its discretion under Article 12(4) RPBA by admitting D25 and D26 into the proceedings.

Main request - inventive step

Closest prior art

3. While the parties agree in their written submissions that the closest prior art disclosure was to be found in D1, however without explicitly setting out the disclosure within D1 considered, their written submissions regarding the distinguishing feature(s) over the closest prior art suggested that they did not use the same starting point within D1 for their assessment of inventive step.

The opposition division also did not specify the starting point within D1 and considered that "*the difference of claim 1 over D1 was that claim 1 of the patent requires that the amount of the alkali metal carbonate used, when expressed by the ratio of the equivalents of alkali metal (M) per equivalent of hydroxyl group (OH) [eq. (M)/eq. (OH)] ranges from 1.3 to 4.0*" (Reasons, page 20, 4.2). This implies that D1 would disclose the preparation of poly(ether sulfone)s by polycondensation of 4,4'-dichlorodiphenylsulfone (hereafter DCDPS).

This, however, is not the case. According to the last paragraph of the introduction of D1, "*it was the purpose of the present work to study syntheses of poly(ether sulfone)s directly from isosorbide, isomannide and isoidide. In the present work 4,4'-difluorodiphenylsulfone was used as electrophilic monomer to obtain sufficiently high molecular weight.*

However, in the ongoing research, polycondensations of sugar diol with bis (4-chlorophenyl) sulfones are also under investigation." Hence, D1 does not report on polycondensation reactions of DCDPS with a sugar diol, for example isorbide, contrary the appellant's written submissions (letter of 23 September 2024, page 7, last full paragraph). In fact, no information at all is disclosed in D1 about the polycondensations of sugar diol with DCDPS reported to be under investigation, as pointed out by the respondent (rejoinder, page 13, last paragraph).

This is in line with the indication on page 3, lines 14-16 of the application as filed, that no examples were described in D1 where the polymerisation reaction with isosorbide was conducted with the less reactive DCDPS, which indication is also to be found in paragraph [0009] of the specification.

Moreover, according to paragraph [0010] of the patent in suit, there was still a need in the art for an efficient process for the manufacturing of poly(arylether sulfone)s (PAES) polymers comprising recurring units derived from bio-compatible and bio-based raw materials and a variety of dihaloaryl compounds comprising at least one SO_2 group, whereby said PAES are characterized by having among others high molecular weights. This subjective problem is formulated immediately following the description in paragraph [0009] of the disclosure of D1, i.e. the preparation of PAES polymers containing isosorbide by reaction of pure isosorbide and DFDPS, the highest apparent molecular weight polymer obtained being indicated to have an inherent viscosity (IV) of 0.65 dL/g and a Tg of 245°C. It is undisputed that this PAES polymer is the product obtained both in Experiment 3 in

Table 2 of D1 and (comparative) Example C1 of the patent in suit.

On that basis, faced with the above problem that there was still a need in the art for an efficient process for the manufacturing of PAES polymers comprising recurring units derived from bio-compatible and bio-based raw materials and a variety of dihaloaryl compounds comprising at least one SO_2 group, a realistic starting point for the present invention is the actual polymerisation reaction described in D1 on which the skilled person would then build upon, i.e. the PAES of Experiment 3 in Table 2 of D1, corresponding to comparative Example C1 of the patent in suit. This was agreed by the parties at the oral proceedings.

Distinguishing features

4. In view of the foregoing, the parties were in agreement that the subject-matter of claim 1 differs from that above mentioned starting point in that

- (i) a dichloro compound (dihalo(BB) of formula (S) wherein X, X' is Cl) is used instead of DFDPS,
- (ii) a ratio [eq.(M)/eq. (OH)] of from 1.3 to 4 is employed in place of a ratio of 1.05 (rejoinder, page 13, line 11) and
- (iii) the total % mononer is within the 15-70% range instead of 11.8%.

The amount of 11.8% is computed based on the indication in Table 2 of D1 of a concentration of 0.30 mol/L of isosorbide. This is the double amount of that used in experiment 1 of D1 in the same table, the latter being indicated by the respondent to correspond to a total %

monomer of 5.9% (rejoinder, page 13, lines 12-13 and footnote).

4.1 The appellant requested in writing, which request was reiterated at the oral proceedings, that the submissions of the respondent based on distinguishing feature (iii) not be admitted to the appeal proceedings (letter of 23 September 2024, page 7, third paragraph).

It is undisputed that the respondent's submissions based on that distinguishing feature (iii) constitute an amendment to the respondent's case under Article 12 (4) RPBA, whose admittance is at the discretion of the Board.

According to Article 12 (4) RPBA, the Board shall exercise its discretion in view of, *inter alia*, the complexity of the amendment, the suitability of the amendment to address the issues which led to the decision under appeal, and the need for procedural economy.

While distinguishing feature (iii) was not mentioned before the first instance, its existence was not relevant for the analysis of inventive step, since the use of a ratio [eq.(M)/eq. (OH)] of from 1.3 to 4 representing distinguishing feature (ii) was considered by the opposition division to involve inventive ingenuity.

It is also relevant that claim 1 of Auxiliary Request 1 underlying the contested decision filed during the oral proceedings was a new independent claim, identical to claim 1 of Auxiliary Request 1 filed only two months before the oral proceedings, whereby the previous claim requests were found by the opposition division in their

preliminary opinion sent in preparation for oral proceedings to lack novelty over D4.

Moreover, the respondent did not concede before the opposition division that the sole distinguishing feature between the subject-matter of claim 1 of the new Auxiliary Request 1 and the closest prior art was feature (ii). It is furthermore apparent from Table 1 of the specification that the molecular weight of the polymer or properties relating to it, i.e. its inherent viscosity and Tg, as a function of the total % monomers, corresponding to said feature (iii), are addressed in the patent in suit, while this process condition is also indicated in D1 to influence the molecular weight of the polymer obtained (D1, page 112, last paragraph, page 107, table 2).

In view of the above, none of the criteria mentioned in Article 12 (4) RPBA speaks against admitting the respondent's submissions relating to distinguishing feature (iii). Not admitting these submissions which were brought forward at the outset of the appeal proceedings, would moreover have amounted to deliberately making a decision that is not based on the disclosure of D1, which would be contrary to an objective assessment of the inventive step.

On that basis, the Board had no ground to use its discretion conferred by Article 12 (4) RPBA and not to admit the submissions of the respondent relating to distinguishing feature (iii).

4.2 The appellant also requested a remittal of the case to the opposition division, should the submissions of the respondent relating to distinguishing feature (iii) be admitted into the proceedings. This would be needed in

order to preserve the appellant's right to be heard (letter of 23 September 2024, page 7, fourth paragraph).

The right to be heard under Article 113(1) EPC is a fundamental principle for ensuring a fair procedure between the EPO and a party to proceedings before it. It is intended in particular to ensure that a party is given an adequate opportunity to comment on the issues which are relevant to the decision, which is procedurally independent from the possibility for the Board to remit the case to the opposition division.

Under Article 11 RPBA, a case is not to be remitted to the department whose decision was appealed, unless special reasons present themselves for doing so. Whether "special reasons" present themselves is to be decided on a case-by-case basis. If all issues can be decided without undue burden, a board should normally not remit the case (see explanatory remarks on Article 11 RPBA in Supplementary publication 2, OJ 2020). In the present case, additional considerations relating to distinguishing feature (iii) could be decided without any undue effort. In this respect, the respondent did not submit during the whole proceedings, including the oral proceedings, which aspect of the assessment of inventive step in respect of distinguishing feature (iii) would require a postponement of the oral proceedings, let alone explained why these issues would have necessitated a remittal to the opposition division.

Under these circumstances, the Board decided to exercise its discretion under Article 111(1) EPC together with Article 11 RPBA not to remit the case,

and instead to discuss the additional submissions relating to distinguishing feature (iii).

Problem successfully solved

5. The appellant brought forward that none of the processes in the specification identified as example of the invention would be in accordance with operative claim 1, since those exemplified compositions would be carried out with sulfolane as the sole solvent, contrary to the process defined in claim 1 requiring "*a solvent mixture comprising a polar aprotic solvent*". In the absence of any experimental evidence showing a process according to operative claim 1, evidence for a technical effect arising from the distinguishing features would be missing and the problem successfully solved over the closest prior art would merely reside in the provision of a further process for the manufacturing of PAES polymers.

The respondent countered those submissions refuting the reading of the expression "*a solvent mixture comprising a polar aprotic solvent*" made by the appellant. It would be clear to the person skilled in the art when reading the text of the specification, including the examples using sulfolane as the sole solvent and identified as inventive, that the solvent mixture in the process claims does not require more than at least one polar aprotic solvent.

In the following, it is for the sake of argumentation considered to the benefit of the respondent that the wording of claim 1 also encompasses the use of a single aprotic solvent as the sole solvent of the process. Under these circumstances, the processes identified in the specification as examples, which all uses as the

sole solvent sulfolane, in particular Examples 4-7 and 11-13, are deemed in accordance with operative claim 1. Since the Board comes to the conclusion that an inventive step is lacking even under this assumption favourable to the respondent, there is no need to deal with the issue in any further detail.

5.1 The respondent addressed in section 8.5.2.2 of the rejoinder (pages 14 and 15) the technical effect achieved by each of the above mentioned distinguishing features. For feature (i) the respondent stated that the selection of the dichloro compound (dihalo(BB)) presented a significant challenge due to its much lower reactivity (rejoinder, page 14). In the respondent's opinion the technical problem solved by distinguishing feature (i) was therefore "*to find an effective way to obtain polymers containing the diol (AA) when starting from the low reactivity dichloroaryl compound dihalo ($B_{Cl}B_{Cl}$)*".

While the Board notes that such a problem would rather concern distinguishing features (ii) and (iii), it is nevertheless established case law that an analysis of inventive step based on the definition of partial problems, i.e. on the technical effect achieved by each of the distinguishing feature, is appropriate when the distinguishing features over the closest prior art are not functionally interdependent, i.e. when they do not mutually influence each other (Case Law, I.D.9.3.2).

In the present case, however, the parameters for which values are defined for distinguishing features (ii) and (iii) are not only influenced by each other, but also by the selection of the dichloro (BB) compound instead of the difluroro (BB) compound, i.e. distinguishing feature (i).

5.2 This is demonstrated in the experimental part of the specification in which the efficiency of the polymerisation is shown to depend not only on the type of halogen substituent on the aryl group, but also on the polymerisation conditions, in particular those represented by features (ii) and (iii), in agreement with the disclosure of D1 (see below).

It can be referred in this respect to the respondent's submissions concerning:

(a) a comparison of Example C10 and Examples 7, 11, 12 and 13 in Table 2 of the patent in suit, which differ only by the amount of K_2CO_3 employed and shows that the ratio of K_2CO_3/isosorbide defined in operative claim 1 allows for a variation of the molecular weight, when the polymerisation is carried out in sulfolane with a concentration of monomers of about 40 wt.% and

(b) a comparison of Examples 4-7 in Table 1 of the patent in suit (all carried out under same conditions, including a [eq. (M)/eq. (OH)] ratio of 2.0, except varying total % monomers from 17.7% to 40.2%) which demonstrates that the molecular weight of the resulting PAES varies with said ratio.

While the first mentioned comparison shows that a continuous increase of the ratio of K_2CO_3/isorbide (as the diol component) results in a progressive increase of the molecular weight expressed as Mw value of the PAES, the second comparison shows that the % monomers defined in operative claim 1 allows for an optimization of the molecular weight of the PAES polymer for the conditions used in said examples.

5.3 As to the combined effect of distinguishing features (ii) and (iii) with distinguishing feature (i) the results shown in Tables 1 and 2 of the specification are relevant. Having regard to a comparison of

(a) the examples in accordance with operative claim 1, all of which exhibit a molecular weight of at most 58 kDa for Example 8, corresponding to a maximum inherent viscosity of 0.38 dL/g, with

(b) comparative example C1 which reproduces the closest prior art for which an inherent viscosity of 0.65 dL/g is obtained,

it cannot be held that using a dichloro (BB) compound as monomer in combination with features (ii) and (iii) results in a more efficient polymerisation reaction or higher molecular weight despite the use of a much higher polymerisation temperature.

In this respect, a comparison of Comparative Example C3 with Example 5 or 6 in Table 1 for which the same polymerisation temperature and approximatively the same monomer concentration is used, shows that the use of the dichloro (BB) compound results in a lower molecular weight, despite the use of a higher K_2CO_3/isosorbide ratio held by the respondent to lead to an increase of the polymer molecular weight.

This is in agreement with the indication in paragraph [0009] of the specification that DCDPS is less reactive than DFDPS, which is common general knowledge, as shown in D10 (page 896, last paragraph) and D26 (page 720, 8th to 4th lines from the bottom of the last full paragraph).

This is also understood by the skilled reader to be reason for the indication at the end of the introduction of D1 (page 106) that "*In the present work 4,4'- difluorodiphenylsulfone was used as electrophilic monomer to obtain sufficiently high molecular weight. However, in the ongoing research, polycondensations of sugar diol with bis (4-chlorophenyl) sulfones are also under investigation*", i.e the polycondensations with DCDPS were under investigation since they lead to a lower molecular weight.

Even under the assumption made in point 5 above that Examples 4-7 and 11-13 are deemed in accordance with operative claim 1, the appellant contested during the oral proceedings that the experimental tests comprised in the patent in suit would demonstrate that distinguishing features (ii) and (iii) allow for an optimization of the PAES polymer molecular weight. The appellant, however, did not explain why the experimental evidence addressed above would be inadequate or insufficient in this regard so that their unsubstantiated opinion cannot be persuasive.

5.4 In view of the above the Board concludes that the problem successfully solved over the closest prior art by the subject-matter of claim 1 resides in the provision of a further process for producing PAES polymers comprising recurring units derived from bio-compatible and bio-based raw materials, whereby the parameters of said process have been optimized in respect of the molecular weight obtained.

Obviousness of the solution

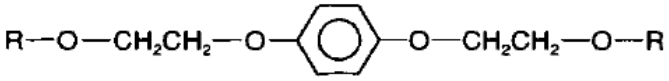
6. It remains to be decided whether, in view of the disclosure of D1, possibly in combination with other

prior art documents or common general knowledge, the skilled person desiring to solve said problem would have arrived in an obvious manner at a method in accordance with operative claim 1.

Feature (i)

6.1 The respondent brought forward at the oral proceedings that the skilled person would be taught away to replace DFDPS by DCDPS, as D2 (page 2669, left-hand column, lines 7-10) would indicate that DCDPS is not satisfactory as an electrophilic monomer and D1 did not provide any result relating to it.

This is not convincing. First of all, the teaching addressed in D2 does not concern the polymerisation of DCDPS with the diol monomers of the closest prior art, i.e. isosorbide, or the similar diols isomannide and isoidide, which are all diols in accordance with operative claim 1, but either the free diol 2a or its bistrimethylsilyl ether 2b as reaction partner, whereby said reaction partner has the following formula



with R being H and $SiMe_3$ for compounds 2a and 2b, respectively (D2, page 2669, left-hand column, lines 4-6, compounds 2a and 2b being defined on page 2668, right column, second formula).

More importantly, as already outlined in point 3 above, D1 teaches that in the ongoing research polycondensations of sugar diol with DCDPS are also under investigation (page 106, last sentence of the introduction), with the awareness that it yields a lower molecular weight in comparison to DFDPS used for

the work reported in D1 (page 106, second full paragraph, last two sentences).

D1 therefore does not teach away from the use of DCDPS, but on the contrary, just as there is an economic need for technical synthesis to replace the silylated diols by isosorbide, isomannide and isoidide, in particular isosorbide (D1, page 106, first and second paragraphs), there is also for the same reason an obvious need to replace DFDPS by DCDPS. In this respect, it is common general knowledge reflected in D10 (page 896, last paragraph) that DCDPS is economically more attractive, making it by far the preferred choice, although the difluoro monomer offers faster reaction kinetics.

Moreover, as indicated above the skilled person is made aware in D1 of the necessity to provide at the same time a polymerisation process which is satisfactory in terms of the molecular weight of the PAES obtained.

The respondent's argument at the oral proceedings that the absence of publication for the polymerisation of DCDPS with sugar diols which was under investigation would have discouraged the skilled person to polymerise DCDPS with diol sugars is also not convincing. The mere absence of published results, even if it had been proven by the respondent, would constitute no indication that investigations relating to DCPS which are mentioned in D1 were pursued, but remained unsuccessful.

Accordingly, when faced with the task of providing a further process for producing PAES polymers comprising recurring units derived from bio-compatible and bio-based raw materials, the skilled person, in view of D1, would not only find it obvious to use DPCS, but would

also seek to optimise the process parameters with respect to the molecular weight obtained.

Features (ii) and (iii)

6.2 The implicit argument by the appellant that the polymerisation route used in D1 is an aromatic nucleophilic substitution polycondensation reaction is undisputed. In this respect, D1 teaches that K_2CO_3 serves the deprotonation of the diol (isosorbide) (page 108, first paragraph of the section "Result and discussion" and page 112, first full paragraph) and that 4,4'-DFDPS was used as electrophilic monomer (page 106, last paragraph of the introduction). It can be also referred to D10 in which similar reactions using K_2CO_3 as deprotonating agent for the polymerisation of 4,4'-dihydroxydiphenyl or bisphenol S with DCDPS are described (D10, page 897).

On that basis, the skilled person would find it likely that the mechanisms governing the polymerisation of isosorbide with DCDPS are analogous to those taking place when polymerising isosorbide and DFDPS. For these reasons, the skilled person would find it natural to explore the parameters of the polymerisation which are reported in D1 to be relevant for a satisfactory polymerisation.

6.2.1 In this respect, it is evident for the skilled person based on the common general knowledge reflected in D10 (D10, page 897, second full paragraph) that the use of DCDPS having a lower reactivity than DFDPS would require a higher polymerisation temperature, dictating the use of a polar aprotic solvent having a higher boiling point, such as sulfolane, as was done in the patent in suit.

6.2.2 Considering that K_2CO_3 serves the deprotonation of the diol (isosorbide) (see point 6.2 above), whereby the deprotonation of the diol is required in a first step of the nucleophilic reaction, the Board, in line with the appellant's submissions, is of the view that a person skilled in the art would expect that a variation of the amount of deprotonating agent has an influence on the amount of deprotonated diols available at a given time for the polymerisation reaction and therefore the success of said reaction.

Moreover, D1 teaches that K_2CO_3, whose amount (21.0 mmol) is slightly above the amount necessary to deprotonate all hydroxyl groups provided by the amount of sugar diol (20.0 mmol), is not completely converted (page 106, section 2.2 and page 116, last paragraph). This is indicated to be likely due to a rapid precipitation of KF, meaning that the whole amount of K_2CO_3 used cannot take part in the polymerisation reaction (page 116, last paragraph).

The importance of the K_2CO_3 conversion, i.e. of the amount of K_2CO_3 effectively available is also outlined in D2 describing a similar reaction between DFDPS and a sylilated dihydroxy compound (D2, paragraph bridging pages 2669 and 2670), KF being indicated to crystallize on the surface of the K_2CO_3 particles which reduces the activity of said particles. In D2, milling of the commercial K_2CO_3 before its use was found to give higher molecular weights in a shorter time (D2, paragraph bridging pages 2669 and 2670), which means that an increase of the surface of the K_2CO_3 particles renders the amount of K_2CO_3 effectively available higher.

Moreover, both D21 concerning the polymerisation of bisphenol A with DCDPS (pages 7620, Scheme 1 and paragraph bridging pages 7620 and 7621) and D25 reporting on the polymerisation of biphenol and DFDPS (pages 3552 and 3353, section 2.5, Scheme 2 for the hydrophobic prepolymer) show that the skilled person is well aware of the possibility to use a large excess of K_2CO_3 as deprotonating agent for a dihydroxyl monomer in a nucleophilic substitution polycondensation reaction involving DCDPS or its analogue compound DFDPS. Expressed as a [eq.(M)/eq. (OH)] ratio in accordance with the definition in operative claim 1, that ratio is of 2.9 and 2.0 in D21 and D25, respectively.

Accordingly, having regard to the existence of phenomena reported in D1 and D2 hindering the full conversion of K_2CO_3 and thereby impacting the success of the polymerisation reaction, the skilled person was fully aware that the amount of the deprotonating agent K_2CO_3 required in the first step of the nucleophilic reaction was a critical parameter to be taken into account for the polymerisation of isosorbide with DCDPS.

6.2.3 Furthermore, a relevant parameter of the polymerisation reaction described in D1 is the monomer concentration which is taught to have an enormous influence on the molecular weight of the polymer (page 112, last paragraph, page 107, table 2). In this respect, higher concentrations are indicated to significantly lower the reaction rates and result in low conversions, a rapid precipitation of KF hindering a complete conversion of K_2CO_3 being the more likely explanation (sentence bridging pages 115 and 116 and last paragraph of page 116).

6.2.4 In view of the foregoing, a person skilled in the art faced with the problem of providing a further process for producing PAES polymers would have been guided by the teaching of D1 to focus their attention on the polymerisation parameters which can be understood from D1 to play a role in advancing the polymerisation reaction, namely the amount of K_2CO_3 and the monomer concentration.

6.2.5 Since there is no reason that optimum parametric values should be identical for DFDPS and DCDPS, as those monomers do not have the same reactivity, the skilled person would have found natural to empirically vary these two parameters so as to find appropriate values allowing for an optimisation of the molecular weight of the polymer obtained, which activity in the Board's view does not go beyond mere routine experimentation. This is line with established case law, according to which enhanced effects cannot be adduced as evidence of inventive step if they emerged from obvious tests (Case Law, I.D.9.21.7).

6.2.6 It was also undisputed that the skilled person in order to facilitate the polymerisation reaction would keep using halo-groups and hydroxyl-groups of the monomers of the monomer mixture in a substantial equimolecular amount when replacing DFDPS by DCDPS. This was agreed by the respondent during the oral proceedings in view of the reaction equations shown on pages 896 and 897 of D10 representing the common general knowledge.

6.2.7 It follows from the above considerations that facing the problem set out in point 5.4 the skilled person would have arrived in an obvious manner at a polymerisation method falling within the ambit of granted claim 1, i.e. a method of polymerising

isosorbide with DCDPS in a substantially equimolecular amount, using an amount of K_2CO_3 and a total % monomer mixture concentration as set out therein.

Respondent's arguments for non-obviousness

6.3 The respondent brought forward that the rate of a reaction does not predicate the extent of the reaction, meaning that there would be no evidence that the increase of the alkali metal carbonate ratio [eq. (M)/ eq. (OH)] would necessarily result in an expectation of increasing the Mw and Tg (rejoinder, page 19, three last paragraphs before the section dealing with the auxiliary requests).

The respondent also submitted (rejoinder, page 15, second paragraph) that D1 teaches on page 112 that the skilled person would be taught away from increasing the amount of K_2CO_3 as this would favour the occurrence of side reactions, resulting in cyclic oligomers and thus reduce the molecular weight. Similarly, D1 would teach an optimum isosorbide content of 0.3 mol/L, corresponding to a total % monomers of about 12%, beyond which the viscosity (hence the molecular weight) would decrease (rejoinder, page 15, third to fifth paragraphs). This also would teach away from the present invention for which a total % monomer mixture concentration equal to or more than 15 % and less than 70 % is used.

These arguments are not convincing for the reasons indicated in above point 6.2.4. There is no reason for the skilled person to adhere to the process conditions recommanded in D1, since DFDPS and DCDPS exhibit different reactivity. Rather, as shown above, guided by the teaching of D1 and a reasonable amount of

experimental work, the skilled person would have arrived at the process conditions defined in operative claim 1.

As regard the Tg, it is common general knowledge that the Tg value of a polymer tends to increase with an increase of the molecular weight (D19, page 664, last paragraph, page 665, last paragraph and page 666), which is also observed in D1 (page 117, lines 9-10 and page 107, table 2). In other words, an optimization of the Tg value is the mere consequence of the obvious optimization of the molecular weight, which is also observed for the experimental data of the patent in suit (page 19, table 1 and page 20, table 2). This was indicated in the Board's communication and not contested.

6.4 The respondent also submitted during the oral proceedings that the reaction of diol with K_2CO_3 would be governed by the saturation concentration of K_2CO_3 in the solvent. K_2CO_3 would be hardly soluble in solvents and at the K_2CO_3 concentration used in D1, K_2CO_3 would not be any more soluble. Accordingly, increasing the amount of K_2CO_3 beyond the concentration used in D1 would not be considered by the skilled person as a means to increase the amount of deprotonated diols and the molecular weight of the polymer. This would be all more the case, since an increase of the amount of monomer, as done for the claimed invention, would result in a decrease of the amount of solvent and would be therefore contra productive, as resulting in a higher amount of precipitated K_2CO_3. All these changes would make the reaction mixture more viscous by the presence of more solids in the reaction medium. In other words, only a change of solvent and an increase of the temperature would be the means to shift the

equilibrium of the reaction between the diol and the deprotonating agent in order to increase the molecular weight.

The respondent's arguments is based on the assumption that D1 or other prior art, including common general knowledge, would indicate that the success of the reaction between DFDPS or DCDPS and the sugar diol is strictly governed by the saturation concentration of K_2CO_3 in the solvent. The respondent, however, did not refer to any passage of D1 or other prior art indicating that this would be the case. On the contrary, D1 and D2 indicate that other factors have an impact on the amount of the amount of K_2CO_3 effectively available (see point 6.2.2 above), so that it was obvious for the skilled person to test higher amounts of K_2CO_3.

6.5 In view of the foregoing, the Board concludes that the subject-matter of present claim 1 which encompasses obvious embodiments does not meet the requirements of Article 56 EPC, prejudicing maintenance of the patent in the form defined in the present Main Request.

Auxiliary requests

7. Auxiliary request 1 differs from the main request in that the process for the manufacture of the polyarylsulfone includes the polymerisation of an additional dihydroxyl compound [diol (A'A')] different from the diol (AA). Auxiliary request 2 differs from auxiliary request 1 in that the nature of the second diol has been specified. At the oral proceedings, however, the respondent declared that had no further arguments concerning the inventive step of auxiliary requests 1 and 2 in addition to those submitted for the

main request, and neither did the appellant. On that basis, the Board concludes that the assessment of inventive step provided above in respect of claim 1 of the Main Request and the conclusion arrived at equally apply to claim 1 of Auxiliary Requests 1 and 2. Auxiliary Requests 1 and 2 are therefore not allowable either.

Auxiliary request 3 differs from the Main Request in that the polar aprotic solvent is defined to be sulfolane. The respondent did not submit that the selection of sulfolane as solvent would result in a different formulation of the problem solved over the closest prior art, but that this solvent would be advantageous as allowing the use of higher temperatures. These submissions, however, have no impact on the reasoning and conclusion given for the Main Request, since the use of sulfolane in view of this advantage reported in D10 is already part of the obvious measures leading to the process in accordance with claim 1 of the Main Request (point 6.2.1 above). Accordingly, this amendment does not lead to a assessment of inventive step which is different from that given in relation to the Main Request. Auxiliary Request 3 is therefore not allowable, as its subject-matter is devoid of an inventive step.

Auxiliary requests 4 to 6 comprise claim 1 of the Main Request, Auxiliary Request 1 and Auxiliary Request 3, respectively, which claims do not meet the requirements of Article 56 EPC. For this reason, Auxiliary Requests 4 to 6 are not allowable either.

Order

For these reasons it is decided that:

The decision under appeal is set aside.

The patent is revoked.

The Registrar: The Chairman:

D. Hampe D. Semino

Decision electronically authenticated