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Datasheet for the decision
of 6 September 2007

Case Number: T 0808/05 - 3.3.03

Application Number: 97112106.6

Publication Number: 0892001

IPC: C08G 64/30

Language of the proceedings: EN

Title of invention:
Method for producing an aromatic polycarbonate having improved melt stability

Patentee:
Asahi Kasei Kabushiki Kaisha

Opponent:
Mitsubishi Chemical Corporation
Bayer MaterialScience AG

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56, 100(b)

Keyword:
"Novelty - (yes)"
"Inventive step - (yes)"
"Burden of proof"

Decisions cited:
T 0219/83, T 0197/86, T 0585/92, T 0989/93, T 0355/99

Catchword:
Burden of proof (Reasons, 4.22)

Case Number: T 0808/05 - 3.3.03

DECISION
of the Technical Board of Appeal 3.3.03
of 6 September 2007

Appellant I: (Opponent I)	Mitsubishi Chemical Corporation 14-1, Shiba 4-chome Minato-ku Tokyo 108-0014 (JP)
Representative:	HOFFMANN EITLE Patent- und Rechtsanwälte Arabellastrasse 4 D-81925 München (DE)
Appellant II: (Opponent II)	Bayer MaterialScience AG Patents and Licensing D-51368 Leverkusen (DE)
Representative:	-
Respondent: (Patent Proprietor)	Asahi Kasei Kabushiki Kaisha 2-6, Dojimahama 1-chome Kita-ku Osaka-shi Osaka 530-8205 (JP)
Representative:	Strehl Schübel-Hopf & Partner Maximilianstrasse 54 D-80538 München (DE)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office dated 5 April 2005 posted 2 May 2005 rejecting the opposition filed against European patent No. 0892001 pursuant to Article 102(2) EPC.**

Composition of the Board:

Chairman:	R. Young
Members:	C. Idez C. Heath

Summary of Facts and Submissions

I. The grant of the European patent No. 0 892 001 in the name of Asahi Kasei Kabushiki Kaisha in respect of European patent application No. 97 112 106.6 filed on 15 July 1997 was announced on 7 August 2002 (Bulletin 2002/32) on the basis of 6 claims.

Claim 1 read as follows:
"A method for producing an aromatic polycarbonate, which comprises:
feeding a feedstock dialkyl carbonate and a feedstock phenol mixture of phenol (a) and phenol (b) which is different in supply source from said phenol (a) to a reactor to effect a reaction between said feedstock dialkyl carbonate and said feedstock phenol mixture in the presence of a catalyst, thereby producing diphenyl carbonate, and
polymerizing said diphenyl carbonate with an aromatic dihydroxy compound in a polymerizer to produce an aromatic polycarbonate while producing phenol as a by-product,
wherein said by-product phenol is used as said phenol (b), and wherein the content of said phenol (b) in said feedstock phenol mixture is from 70 to 99 % by weight."

Claims 2 to 6 were dependent claims.

II. Two Notices of Opposition were filed against the patent, as follows:

(i) by Mitsubishi Chemical Corporation (Opponent I), on 29 April 2003, on the grounds of lack of novelty and lack of inventive step (Article 100(a) EPC), and

(ii) by Bayer AG (later Bayer MaterialScience AG) (Opponent II), on 7 May 2003, on the grounds of lack of novelty and lack of inventive step (Article 100(a) EPC), and of insufficiency of disclosure (Article 100(b) EPC).

The oppositions were based inter alia on the following documents:

Dl: EP-A-0 779 312,
D2: WO-A-93/03084,
D3: US-A-5 210 268, and
03: LU-A-88 569.

III. By a decision announced orally on 5 April 2005, and issued in writing on 2 May 2005, the Opposition Division rejected the opposition.
According to the decision, the requirements of Article 83 EPC were met, since the process of Claim 1 was extensively disclosed in Example 1 of the patent in suit and since the working examples covered the whole range of the percentage of phenol (b).
According to the decision, the subject-matter of Claim 1 was novel over document D1, since this document did not disclose a range of 70 to 99% by weight of recycled phenol (b) in the phenol feedstock mixture.
Concerning inventive step, document D1 was considered as the closest state of the art. According to the decision, the Parties agreed that the specific range of phenol (b) in the feedstock constituted the distinguishing feature between the claimed process and D1. Starting from D1, the technical problem was seen in the improvement of the melt stability of aromatic polycarbonates. According to the decision, there was no

indication in the prior art to specifically choose the range of phenol (b) in the feedstock in order to solve this problem.
Thus, the Opposition Division came to the conclusion that the requirements of Art. 56 EPC were fulfilled, and it decided to reject the opposition.

IV. Notices of Appeal were filed on 27 June 2005 by Appellant I (Opponent I) and on the 30 June 2005 by Appellant II (Opponent II), respectively. The prescribed fees were paid on the same day, respectively.

V. With its Statement of Grounds of Appeal filed on 2 September 2005, Appellant I submitted the following documents:

D5: JP-A-7-238156, and
D5A: Computer-based English translation of D5.

It also argued essentially as follows:

(i) Concerning novelty:

(i.1) D1 explicitly disclosed all the features of the claimed process, except that the feedstock phenol mixture should comprise 70 to 99% by weight of recycled phenol (b).

(i.2) These features were inherent to any continuous process since phenol (b) produced as a by-product in the polymerization reaction would be lost owing to two effects, namely:
(a) terminal phenyl groups in the polycarbonate produced and

(b) loss of phenol in the recovery/recycling procedure.

(i.3) It was hence necessary to replenish any phenol which had been lost.

(i.4) It was possible to calculate the theoretically maximum recovery rate of by-product phenol in the polymerization reaction with regard to the effect of item (a), as shown in item 8 of the submission of Opponent I (Appellant I) dated 3 June 2004.

(i.5) This demonstrated that at a conventional degree of polymerization (i.e. a molecular weight of 2000), only 89 % of the phenol initially used could be recycled as phenol (b), so that the remainder of 11 % must be replenished as phenol (a) (cf. first paragraph on page 7 of the letter dated 3 June 2004).

(i.6) The Opposition Division's reasoning for dismissing this argumentation was insufficient, since it was merely stated that it was theoretical.

(i.7) Consequently, D1 was novelty destroying for the subject-matter of Claim 1.

(ii) Concerning inventive step:

(ii.1) The Patent Proprietor had emphasised the "criticality" of the amount of recycled phenol (b) in the feedstock and had referred in that respect to Table A filed as Attachment 1 with its submission of 27 February 2004.

(ii.2) The phenols used in the feedstock phenol mixtures in the Examples and Comparative Examples were not, however, defined by means of their "supply source", but rather by their content of cresol, xylenol, and aromatic dihydroxy compound.

(ii.3) Thus, Table A presented by the Patent Proprietor could not support that it was the difference in supply source which governed the experimental results.

(ii.4) Furthermore, if the amount of recycled phenol should be low, this could be achieved by taking the appropriate amount of phenol (b), mixing phenols (a) and (b) in the required proportions and discarding any excess of phenol (b). Consequently, adjusting the composition of the feedstock phenol mixture would be independent of how the polymerization reaction would be conducted.

(ii.5) If the recycled by-product phenol (b) should represent a very high proportion of the feedstock phenol mixture, the polymerization reaction had to be conducted such that the necessary amounts of phenol (b) should be produced at all.

(ii.6) Consequently, examples showing a low proportion of phenol (b) in the feedstock mixture reflected a simple adjustment of the mixing proportions, whereas those examples showing a high proportion of phenol (b) reflected specific limitations imposed on the polymerization conditions.

(ii.7) Thus, Table A could not substantiate any technical effect associated with the amount of recycled phenol (b) in the feedstock.

(ii.8) Starting from D1, in view of the lack of technical effects associated with the proportion of phenol (b) of 70 to 90 % by weight in the feedstock phenol mixture, the objective technical problem could only be regarded as providing an appropriate recycling ratio of by-product phenol in the continuous process for producing an aromatic polycarbonate as known from Dl.

(ii.9) The theoretical upper limit of the recycling ratio is 100 % weight, which could not be accomplished in practice.

(ii.10) According to D2 a conventional proportion of the by-product phenol in the feedstock phenol mixture was at least 95 percent by weight (cf. page 3, lines 4 to 7).

(ii.11) The process of D2 was identical to the process according to the opposed patent and Dl except for the reaction used to produce fresh diaryl carbonate from the by-product phenol.

(ii.12) The way of producing the diaryl carbonate was independent of the recycling of by-product phenol, so that the value of 95 percent by weight of by-product phenol in the feedstock phenol mixture suggested in D2 rendered obvious the recycling ratio according to the patent in suit.

(ii.13) Document D5 was directed to polycarbonate having excellent hue (lack of discoloration), thermal resistance (melt stability) and water resistance (cf. paragraph [0005]).

(ii.14) According to D5, the proportion of hydroxyl terminal groups of the polycarbonate should be limited (cf. paragraph [0006]).

(ii.15) D5 further taught that a large proportion of terminal groups of the aromatic polycarbonate should be phenyl groups.

(ii.16) According to D5 the preferred molar ratio of diphenyl carbonate to aromatic dihydroxy compound indicated in D5 was 1.01:1 to 1.30:1. This allowed to estimate the maximum amount of by-product phenol that could be recycled (i.e. 1.54 to 1.98 moles per one mole diphenyl carbonate used).

(ii.17) Since however 2 moles of phenol were needed to obtain 1 mole of diphenyl carbonate, the amount phenol must be hence supplemented to 2 moles. Consequently, the amount of recycled phenol would become between 77 and 99% by weight.

(ii.18) Consequently, the combination of D1 with D5 rendered the claimed subject-matter obvious.

(ii.19) According to the Opposition Division D2 was not an appropriate starting point, since it related to a phosgene process.

(ii.20) The "phosgene process" according to D2 was acknowledged even in the opposed patent in paragraphs [0002] and [0003].

(ii.21) The process of D2 was carried out in a continuous manner, recycling the by-product phenol formed in the polymerization reaction. The "phosgene" feature was actually a mere partial feature of D2, namely the preparation of diphenyl carbonate by reacting phenol with phosgene (carbonic acid chloride).

(ii.22) The process claimed in the opposed patent differed from the process described in D2 only in the type of reactant used for converting phenol into diphenyl carbonate.

(ii.23) As acknowledged by the Patent Proprietor in paragraph [0003] of the opposed patent, the use of phosgene was associated with toxicity concerns.

(ii.24) Thus, the objective technical problem would be to forego the use of phosgene in the process according to D2 (cf. also paragraph [0004] of the patent in suit).

(ii.25) It was known, as reflected by document D3, that an aromatic carbonate could be produced by transesterifying a dialkyl carbonate with an aromatic hydroxy compound "without using poisonous phosgene" (column 45, lines 5 – 14).

(ii.26) Consequently, the claimed subject matter was obvious in view of the combination of D2 with D3.

VI. With its Statement of Grounds of Appeal filed on 8 September 2005, Appellant II submitted the following documents:

09: Y.Kim et al. "Kinetics of Melt Transesterification of Diphenyl Carbonate and Bisphenol-A to Polycarbonate with LIOH.H2O Catalyst"; Ind. Eng. Chem. Res.; Volume 31, 1992, pages 2118 to 2127; and

O10: Repetition of Example 5 of D1.

It also argued essentially as follows:

(i) Concerning novelty:

(i.1) Although D1 did not explicitly mention that an amount of 70 to 99% by weight of recycled phenol (b) was used in the feedstock, it was implicit that due to distillation and reactions some phenol (up to a few percent) would inevitably be lost, so that the remainder of phenol had to be replenished in the feedstock.

(i.2) Documents D2 and O3 also provided evidence that up to 5% by weight phenol must be replenished (cf. column 3, lines 4 to 7 of D2, page 5, lines 15 to 22 of O3).

(i.3) In Example 14 of D1, the maximum amount of recycled phenol could be 99.5% by weight. It was furthermore known to the skilled person that the recycled amount of phenol in a continuous process could not exceed about 98% by weight.

(i.4) Document 010 showed that the recycled amount of phenol in Example 14 would be in the range of 80% by weight. There was no need of a repeated distillation, contrary to the submissions made by Mr Fukuoka in his declaration annexed to the letter of 4 February 2005 of the Patent Proprietor, in order to obtain a level of trimethylamine in the phenol of less than 5 ppm.

(i.5) Thus D1 was a novelty destroying document for the subject-matter of Claim 1 of the patent in suit.

(ii) Concerning inventive step:

(ii.1) D1 could be regarded as the closest state of the art.

(ii.2) The alleged distinguishing feature of an amount of recycled phenol between 70 to 99% by weight did not provide any technical effect.

(ii.3) The technical problem must hence be seen as providing an alternative process for the manufacture of polycarbonate.

(ii.4) Thus the subject-matter of Claim 1 would be obvious in view of the combination of D1 with D2 or 03, which taught that up to 5% by weight phenol should be replenished.

(ii.5) The amount of 99% by weight of recycled phenol was not illustrated by an example. The skilled person would not expect that the melt stability of a polycarbonate would significantly improve when 99% by weight of recycled phenol is used instead of 99.1% by weight as in Comparative Example 4 (cf. Exhibit 2 annexed to the letter of 4 February 2005 of the Patent Proprietor).

VII. With its letter dated 23 March 2006, the Respondent submitted 6 auxiliary requests as well as the following documents:

Appendices 1 and 2 (drawings showing the process of Example 14 of D1);
Exhibit 3 (additional Examples 9 and 10);
Third declaration of Mr. Fukuoka, dated 19 March 2006; and
D7: Encyclopedia of Chemical Processing and Design, Vol. 39, 1992; pages 281 to 283.

It also argued essentially as follows:

(i) Concerning novelty:

(i.1) The decisive question was whether the amount of the recycled phenol (b) of 70 to 99 % by weight was disclosed by Dl.

(i.2) There was no doubt that Dl did not explicitly disclose this range.

(i.3) The Appellants had alleged that this range was implicitly disclosed by Dl. This was however not the case.

(i.4) According to the Appellants, the claimed invention of the present patent was anticipated by:

(A) Fig. 1 of Dl showing the process of Dl; and
(B) Example 14 of Dl which was the only Example of Dl where the recycling of the by—product phenol was performed.

(i.5) Appendix 1 and Appendix 2 showed that Example 14 of Dl only described the use of a phenol by-product as a phenol feedstock, and that there was a large discrepancy in Example 14 between the amount (0.94 kilomole/h) of the phenol feedstock and the amount (0.32 kilomole/h) of phenol by-product recovered from the polymerization reaction system.

(i.6) This large discrepancy would imply that a very large amount of a fresh phenol (i.e. at least 66 %) of a fresh phenol must be used, so that the phenol (b) content of the phenol feedstock would be far below the lower limit (70 % by weight) of phenol (b) content range recited in Claim 1 of the patent in suit.

(i.7) Furthermore, in Exhibit 1 annexed to Attachment 2 of letter of 4 February 2005, the by-product PhOH content of the feedstock mixture used in Example 14 of Dl had been estimated at about 59 % by weight without taking into consideration the above-mentioned discrepancy.

(i.8) The allegation of Appellant I that at conventional molecular weight, the "theoretically maximum recovery rate of by-product phenol" would be "only 89 % of the phenol initially used", and "the remainder of 11 % had to be replenished as phenol (a)" was groundless as shown in Attachment 1 to the letter of 4 February 2005 [see section 8 (pages 11 to 14) of Attachment 1].

(i.9) It should also be noted that the patent in suit had many Examples (Examples 1, 4, 6 and 7) in which the phenol (b) content was higher than 89 %.

(i.10) Furthermore, this allegation would be in contradiction with the further assertion of Appellant I that D2 described the phenol (b) content of 95 % by weight (page 11, paragraph 4 of the Grounds of Appeal of Appellant I).

(i.11) Appellant II had alleged that around 98 % of the total amount of the phenol could be recycled in Example 14 at the highest, since it was generally known to the skilled person that the amount of end–capped polycarbonate units was usually about 80–85 %.

(i.12) However, contrary to the assertion of Appellant II the "amount of end-capped polycarbonate units" might vary from 0 to 100 %. In that respect the Examples of D5 showed the "amount of end-capped polycarbonate units" varied from 19 to 100 %.

(ii) Concerning inventive step:

(ii.1) D1 would represent the closest state of the art.

(ii.2) Starting from D1, the objective technical problem was to provide a process for the production of a polycarbonate having improved melt stability at high temperatures.

(ii.3) New Examples 9 and 10 (cf. Exhibit 3) showed that the technical problem was solved over the whole range of phenol (b) content.

(ii.4) None of the cited prior art documents mentioned the particular problem of the present invention. Consequently, none of the cited prior art documents could provide the skilled person with hints or suggestions how to solve this particular problem.

(ii.5) Furthermore, documents D2 and 03 related to the phosgene process, and taught to use an amount of recycled phenol (b) of higher than 99% by weight.

(ii.6) Document D5 dealt with the problem of improvement of "thermal resistance", which was a different property than "melt stability at high temperatures".

(ii.7) Consequently the subject-matter of the main request was inventive over the cited prior art.

VIII. With its letter dated 6 August 2007, the Respondent submitted a further auxiliary request (auxiliary request 7).

IX. In its letter dated 29 August 2007, Appellant I argued essentially as follows:

(i) Concerning novelty:

(i.1) The apparent discrepancy in Example 14 of D1 between the feeding rate of 0.94 kilomole/h and the amount of phenol generated in the polycarbonate manufacture was to be explained by the fact that the rate of 0.94 kilomole/h represented the initial feeding rate.

(i.2) In view of the viscosity molecular weight of the polycarbonate obtained in Example 14 of D1, it could be calculated that the maximum recovery rate of phenol would be between 98.8 and 97.6% by weight.

(i.3) Even if phenol might be lost in the recycling process (20%), the amount of recycled phenol would be in the claimed range of the patent in suit.

(i.4) Thus, D1 was a novelty destroying document.

(ii) Concerning inventive step:

(ii.1) There was no pertinent difference between the property "thermal resistance" in D5 and the property "melt stability" in the patent in suit.

(ii.2) Both properties were evaluated by change in yellowness at high temperatures.

X. Oral proceedings were held before the Board on 6 September 2007.

At the beginning of the oral proceedings, following observations of the Board according to which no submissions concerning the ground of opposition under Article 100 (b) EPC had been made by the Appellants in the course of the appeal proceedings, Appellant II indicated that it relied, in that respect, on its written submissions made during the opposition proceedings. The discussion then moved to the questions of the assessment of novelty and inventive step of the subject-matter of the claims as granted. While essentially relying on the arguments presented in that respect during the written phase of the appeal proceedings, the Parties made additional submissions, which may be summarized as follows:

(i) Concerning novelty:

(i.1) By the Appellants:

(i.1.1) Processes for preparing a polycarbonate comprising the step of reacting a phenol with an dialkyl carbonate for making diphenyl carbonate, and the step of reacting the diphenyl carbonate with an aromatic dihydroxy compound to produce a polycarbonate was known in the art (cf. documents D3 and D1).

(i.1.2) The feature in Claim 1 of the patent in suit that phenol (a) and phenol (b) should differ in supply source did not exclude that they might be identical and could hence not represent a distinguishing feature and no technical effect could be associated therewith.

(i.1.3) Document D1 (cf. page 3, lines 10 to 20) further disclosed a step of recovering the phenol generated during the manufacture of the polycarbonate and recycling the recovered phenol to the manufacture of the diphenyl carbonate.

(i.1.4) Phenol would be lost during the manufacture of polycarbonate due to incorporation as end-groups in the polycarbonate. The calculation provided with the letter of 29 August 2007 showed that between 98.8 and 97.6% by weight of the phenol generated in the manufacture of the polycarbonate of Example 14 of D1 could be submitted to the further separation process.

(i.1.5) These values were also in line with the calculation made by the Patent Proprietor in view of the amount of diphenyl carbonate (0.163 kilomole/h) used in the continuous manufacture of polycarbonate in and the amount of phenol (0.320 kilomole/h) obtained at the exit of the polymerization vessel for carbonate in Example 14 of D1 (i.e. an amount of 98.2% of recovered phenol).

(i.1.6) Since, according to D1, the phenol recycled to the manufacture of diphenyl carbonate exhibited an anisole selectivity of 0.5% (page 15, line 14), it could be deduced that at most 97.5% by weight of phenol would be available for recycling in Example 14.

(i.1.7) There was no necessity to carry out multiple distillation steps, as argued by the Patent Proprietor, in order to lower the trimethyl amine amount in the phenol to be recycled to less than 5 ppm. Furthermore, there was no indication in the recycling process of Example 14 (cf. page 15, lines 5 to 10) that a multiple distillation steps had been carried out, since this passage only mentioned that the phenol produced in the polycarbonate process was treated with p-toluene sulphonic acid and sent to a simple distillation column to be continuously distilled.

(i.1.8) Document O10 showed that there was no need to carry out multiple distillation in order to reduce the level of trimethyl amine below 5 ppm even by discarding less than 20% of the distilled phenol as done in Example 5 of D1.

(i.1.9) Thus, the amount of recycled phenol in Example 4 would certainly be in the range claimed in the patent in suit.

(i.1.10) The apparent discrepancy between the amount of phenol sent to the diphenyl carbonate production (0.94 mol/hour) and the amount of phenol generated in the polycarbonate production (0.32 kilomole/h), was to be explained by the fact that phenol was already recycled coming from the manufacture of diphenyl carbonate (cf. also D1; page 7, line 57 to page 8, line 2).

(i.2) By the Respondent:

(i.2.1) Even if there would be some loss of phenol during the manufacture of polycarbonate in step (II) of the process of Example 14 of D1, D1 was totally silent on the amount of phenol recovered at step III.

(i.2.2) Example 5 of D1 showed that 20% by weight of the phenol had to be discarded in order to lower the amount of trimethylamine from 31 to 5 ppm in the phenol recovered after the polycarbonate manufacture.

(i.2.3) In Example 14, however, the amount of trimethyl amine recycled had however to be reduced from 71 to 10 ppm.

(i.2.4) It was very difficult to separate phenol from trimethylamine, since they might react together, and furthermore, the salt of trimethylamine with p-toluene sulphonic acid decomposed close to its melting point (92°C), while phenol had a boiling point of 180°C.

(i.2.5) Consequently, there would be important loss of phenol in Step III of Example 14 in order to obtain the required level of trimethylamine.

(ii) Concerning inventive step:

(ii.1) By the Appellants:

(ii.1.1) D1 or D2 could be used as starting points for the assessment of inventive step.

(ii.1.2) According to the patent in suit (cf. paragraph [0013]), the claimed invention was based on the following findings:
(α) better melt stability of the polycarbonate due to the use of specific ratio of recycled phenol in the phenol feedstock,

(β) stable production of polycarbonate (e.g. avoidance of clogging) due to a low content of aromatic dihydroxy compounds in the phenol feedstock, and

(γ) better melt stability of the polycarbonate due to a low content of cresol and/or xylenol in the recycled phenol.

(ii.1.3) The only distinguishing feature between the subject-matter of Claim 1 and D1 would reside in the fact that D1 did not disclose the amount of recycled phenol (b) in the feedstock for the preparation of the diphenyl carbonate, since features β and γ were not reflected in the claims.

(ii.1.4) If the phenols (a) and (b) could not be distinguished, there would be no technical effect.

(ii.1.5) Furthermore, it had not been shown that the distinguishing feature provided the claimed effect.

(ii.1.6) Although Examples 1 to 6 and Comparative Examples 1 to 3 had been carried out under the same process conditions, the amount of recycled phenol in the feedstock was not the only difference between the Examples 1 to 6 according to the claimed invention and the comparative Examples 1 to 3, since the amount of impurities in the fresh phenol and in the phenol feedstock were not the same.

(ii.1.7) Comparative Example 4 was even less pertinent, since the process conditions (e.g. ratio of diphenyl carbonate to bisphenol A) had been modified.

(ii.1.8) Thus, starting from D1, the technical problem must be seen as providing an alternative process for the manufacture of polycarbonates.

(ii.1.9) In view of document D2 and O3 it would have been obvious to use an amount of recycled phenol of at least 95% by weight.

(ii.1.10) In any case D5 taught to use an excess of diphenyl carbonate over bisphenol A in order to improve the heat stability of the polycarbonates. This would lead to a loss phenol due to the incorporation of phenyl groups instead of hydroxyl groups at the end of the polycarbonate chain. This loss of phenol must hence be compensated by replenishing of fresh phenol. As previously shown for Example 14 of D1, more than 1% by weight of fresh phenol must be added.

(ii.1.11) Stating from D2, the only distinguishing feature between the subject-matter of Claim 1 and D2 would be the fact that the diphenyl carbonate is prepared by reaction of phenol with a dialkyl carbonate, instead of a reaction of phenol with phosgene.

(ii.1.12) It would have been obvious to replace the phosgene process disclosed in D2 by the process disclosed in D3 for the manufacture of the diphenyl carbonate.

(ii.2) By the Respondent:

(ii.2.1) The aim of the patent in suit was to provide a process for the production of polycarbonate having a good melt stability.

(ii.2.2) Melt stability could not be compared with the thermal stability referred to in D5. It corresponded to the thermal stability of the polycarbonate in molten state at a very high temperature (350°C).

(ii.2.1) The thermal stability referred to in D5 corresponded to the thermal resistance of the polycarbonate in the solid state at much lower temperature (250°C).

(ii.2.2) The other documents relied by the Appellants were not concerned with the melt stability of polycarbonates.

(ii.2.3) Examples 1 to 6 and new Examples 9 to 10 showed that a good melt stability was obtained when operating with the specific amount of recycled phenol.

(ii.2.4) The ratio of diphenyl carbonate to bisphenol A had been modified in Comparative Example 4 in comparison to the ratio used in Examples 1 to 6 and 9 to 10 in order to obtain a sufficient quantity of phenol to be recycled (99.1%). This however did not destroy the validity of the comparison between Examples 1 to 6, 9 to 10 and Comparative Example 4 in terms of amounts of phenol to be recycled.

(ii.2.5) D2 and O3 disclosed phosgene processes for the manufacture of the diphenyl carbonate. It was hence evident that the diphenyl carbonate coming from this phosgene process would contain different impurities (e.g. chlorine) than diphenyl carbonate obtained by the process according to Claim 1. The presence of such impurities might also influence the melt stability of the polycarbonates.

(ii.2.6) Thus, although D2 and O3 mentioned a recycled amount of phenol of at least 95% by weight, there was no reason to combine this teaching with D1 in order to solve the technical problem.

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

The Respondent requested that the appeal be dismissed, or in the alternative that the decision under appeal be set aside and the patent be upheld on the basis of one of the auxiliary requests 1-6 filed with letter of 23 March 2006, or auxiliary request 7 as filed with letter of 6 August 2007.

Reasons for the Decision

1. The appeal is admissible.

Main request

2. *Article 100 (b) EPC:*

2.1 No arguments have been submitted by the Appellants either during the written phase of the appeal or at the oral proceedings of 6 September 2007 before the Board in order to challenge the conclusions of the Opposition Division concerning the ground of opposition under Article 100(b) EPC.

2.2 Under these circumstances, the Board, noting further that the description of the patent in suit provides detailed information in order to carry out the process according to Claim 1 (cf. page 6, line 36 to page 14, line 43; Example 1), does not see any reason to deviate from the findings of the Opposition Division as regards sufficiency of disclosure in the decision under appeal.

2.3 Consequently, the patent in suit meets the requirements of Article 83 EPC and the ground of opposition under Article 100(b) EPC cannot succeed.

3. *Novelty*

3.1 Lack of novelty of the subject-matter of Claim 1 of the patent in suit has been alleged by the Appellants in view of document D1.

3.2 Document D1 relates to a method for making polycarbonate comprising:

[I] a process for manufacturing diaryl carbonate by reacting dialkyl carbonate and an aromatic hydroxy compound in the presence of a catalyst and for removing alcoholic by-product and dialkyl carbonate by-product from the reaction system,

[II] a process for manufacturing polycarbonate by reacting the diaryl carbonate obtained in process [I] and an aromatic dihydroxy compound in the presence of a catalyst containing at least one nitrogen-containing basic compound and for removing aromatic hydroxy compound by-product from the reaction system, and

[III] a process for separating and removing the nitrogen-containing basic compound from the aromatic hydroxy compound by-product produced in process [II] and recycling the resultant aromatic hydroxy compound to process [I] (page 3, lines 10 to 20).

3.3 According to Example 14 of D1, 0.94 kilomole/h of phenol that had been through process [II] for manufacturing polycarbonate and process [III] for recycling phenol and is reacted and 0.01 kilomole per hour of titanium tetraphenoxide were fed to a first continuous reaction-type distillation apparatus and 3.3 kilomole/h of dimethyl carbonate was fed to the bottom of the column of the first continuous reaction-type distilling apparatus, as a continuous reaction was conducted at a temperature of 206 °C and residence time in the bottom of the column of 30 min. The high-boiling-point component containing catalyst components and phenyl methyl carbonate was continuously removed from the bottom of the column, and fed to a second continuous reaction-type distillation apparatus. The reaction was conducted continuously at a temperature of 200°C at the base of the column for a residence time of 1.5 h. The high-boiling-point component containing catalyst components and diphenyl carbonate was continuously removed from the bottom of the column and fed to a third packed distilling column where diphenyl carbonate and catalyst were continuously fractionated. The refined diphenyl carbonate was continuously fed to the subsequent polycarbonate manufacturing process at a rate of 0.16 kilomole/h (cf page 14, lines 5 to 22).

3.4 In the polycarbonate manufacturing process [II] according to Example 14, 0.44 kilomole of bisphenol A and 0.449 kilomole of diphenyl carbonate manufactured in the diphenyl carbonate manufacturing process were charged to a first 250 L tank and melted at 140°C. Meanwhile, 0.16 kilomole/h of bisphenol A and 0.163 kilomole/h of diphenyl carbonate were fed to the tank to maintain the original levels, as the resultant solution was sent to a second 50 L stirred tank at a rate of 0.16 kilomole/h, based on the bisphenol A content. The temperature of the stirred tank was maintained at 180°C. As catalyst, 0.04 mole/h of tetramethyl ammonium hydroxide and 0.00016 mole/h of sodium hydroxide were added. As the mixture was stirred, the component levels were maintained in such a way that the residence time would be 30 min. 0.16 kilomole/h of this reaction solution, based on the bisphenol A, was sent to a subsequent 50 L stirred tank with a temperature of 210 °C and pressure of 200 mm Hg. The component levels were adjusted so that the residence time was 30 min, and the reaction solution was stirred. Phenol, which was produced continuously, was distilled off from the distilling column, as bisphenol A, diphenyl carbonate, and polycarbonate oligomers were returned to the reaction system. This reaction solution was sent, at a rate of 0.16 kilomole/h of bisphenol, to a third 50 L stirred tank with a temperature of 240 °C and pressure of 15 mm Hg. The levels were adjusted to achieve a residence time of 30 min, and phenol was distilled off, as the solution was stirred in the manner described hereinabove. The intrinsic viscosity of the reaction product obtained when the reaction achieved a steady state was 0.15 dL/g.

The product was sent to a centrifugal thin-film evaporator at a rate of 0.16 kilomole/h of bisphenol A, and the reaction was continued. Using a gear pump, the reaction product was sent at a rate of 0.16 kilomole/h per hour of bisphenol A from the bottom of the evaporator to a twin-screw horizontal polymerization tank maintained at 290 °C and 0.2 mm Hg, where it was polymerized for a residence time of 30 min. Polycarbonate was manufactured continuously and the phenol produced was distilled off. The intrinsic viscosity [IV] of the polymer was 0.49 dL/g and the total amount of phenol produced in this polycarbonate manufacturing process was approximately 0.32 kilomole/h which was all sent to the subsequent recycling process [III]. This phenol contained 78 ppm of trimethylamine (page 14, line 26 to page 15, line 1)

3.5 According to Example 14, p-toluenesulfonic acid was added to the phenol that was continuously produced in the polycarbonate manufacturing process so that there were twice as many moles of the acid as trimethylamine in the phenol, and the phenol was continuously stirred in a static mixer and sent to a simple distillation column, where it was continuously distilled at ordinary pressure. There was no more than 5 ppm of trimethylamine in the distilled phenol and all this phenol was continuously sent to the diphenyl carbonate manufacturing process [I].
The selectivity for anisole in process [I] after 24 h of continuous operation was 0.5%, based on the phenol recovered (page 15, lines 4 to 13).

3.6 In this connection, the Board notes that, while the process according to Claim 1, as the one disclosed in D1, comprises the step of producing a diphenyl carbonate by reacting phenol with a dialkyl carbonate, the step of producing an aromatic polycarbonate by reacting the diphenyl carbonate with an aromatic dihydroxy compound and the step of recycling phenol generated as by-product in the manufacture of polycarbonate to the manufacture of diphenyl carbonate, Claim 1 of the patent in suit further requires, explicitly, that

(i) the feedstock phenol fed to the reactor to effect a reaction between said feedstock phenol and the feedstock dialkyl carbonate to produce the diphenyl carbonate is a phenol mixture of phenol (a) and phenol (b) which is different in supply source from said phenol (a), and

(ii) that the phenol produced as by-product in the manufacture of the aromatic polycarbonate is used as said phenol (b), and wherein the content of said phenol (b) in said feedstock phenol mixture is from 70 to 99 % by weight.

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

3.8 Thus, the question boils down as to whether in D1 there is a clear and unmistakable teaching of the combination of features mentioned above in paragraph 3.6.

3.9 In that respect, even if one would consider, as argued by the Appellants that Claim 1 of the patent in suit does not exclude that the phenol (a) and the phenol (b) might be the same, and that some fresh phenol must be inevitably replenished in step [I] of the process of D1, since the skilled person would not expect that 100% of the phenol used in the process step [I] of D1 could be effectively recycled, it is however primarily evident that there is no explicit disclosure in D1 of the amount of recycled phenol coming from the manufacture of polycarbonate in the phenol feedstock for the manufacture of the diphenyl carbonate in step [I].

3.10 In that respect, it had been however submitted by the Appellants that it could be inherently deduced from D1, in particular from Example 14 thereof, that the amount of recycled phenol in the phenol feedstock for the process step [I] of D1 would be in the range of 70 to 99% by weight.

3.10.1 In this connection, even if one would disregard the apparent discrepancy between the amount of recycled phenol fed in step (I) of the process of Example 14 (0.94 kilomole/h) the amount of phenol generated in the manufacture of the polycarbonate (0.32 kilomole/h) (cf. also paragraphs VII(i.5), VII(i.6), IX(i.1) and paragraphs 3.3 and 3.4 above), and even one would consider that there is some agreement between the recovery ratio of by-product phenol in the step [II] of the process of D1 phenol calculated by Appellant I in its letter dated 29 August 2007 (i.e. between 98.8% and 97.6%) on the basis of the intrinsic viscosity of the polycarbonate obtained in Example 14 (i.e. 0.49 dl/g) and of the amount of hydroxyl end-groups presumed to be in that polycarbonate and that calculated by the Patent Proprietor in Exhibit 1 (page 2; second paragraph) annexed to Attachment 2 of the letter of 4 February 2005 (i.e. 98.2%), this would, in the Board's view, not imply that the amount of recycled phenol after the recycling step [III] would inevitably be in the range 70 to 99% by weight in the phenol feedstock for the manufacture of the aromatic carbonate as required by Claim 1 of the patent in suit.

3.10.2 This is because it would still remain to be established, how much phenol is lost in the continuous distillation process of step [III] of Example 14 in order to reduce the level of trimethyl amine from 71 ppm to less than 5 ppm.

3.10.3 In that respect, while both Appellants have submitted that in view of the distillation process disclosed in Example 5 of D1 it could be deduced that at most 20% of the phenol generated in the polycarbonate manufacture (cf. letter of Appellant I of 29 August 2007, page 4, second paragraph; cf. also document 010 submitted by Appellant II with its Statement of Grounds of Appeal) would be lost in the distillation process, so that the amount of recycled phenol in the phenol feedstock of process [I] of D1 would be in the claimed range (i.e. 77.7 % by weight according to Appellant I or more than 70% by weight according to Appellant II), the Patent Proprietor had submitted calculations also based on the distillation process of Example 5 (cf. Exhibit 1 (page 5) annexed to Attachment 2 of the letter of 4 February 2005) according to which only 59 % of the phenol produced in step [II] would be recovered in step [III], i.e. leading to an amount of recycled phenol well below 70% by weight (i.e. 58% by weight).

3.10.4 In this connection, the Board however notes that neither the Appellants nor the Patent Proprietor have submitted a true reproduction of the recycling step of Example 14 of D1 and that therefore it is confronted with contrary assertions made by the Parties concerning the amount of phenol lost in the recycling process [III] of Example 14 of D1 based on the distillation process disclosed in Example 5 of D1.

3.10.5 Under these circumstances, since the Board is further unable to establish the facts of its own motion, according to the principles set out in the decision T 219/83 (OJ EPO 1986, 211) the benefit of the doubt must be given to the Patent Proprietor.

3.10.6 Consequently, it cannot be clearly and unambiguously derived from Example 14 of D1, that the amount of phenol recycled to the production of diphenyl carbonate would inevitably represent 70 to 99% by weight of the phenol feedstock for the manufacture of the aromatic carbonate in step [1] of the process of Example 14.

3.10.7 The same conclusion would apply in view of the theoretical calculation made by Appellant I (cf. paragraphs V(i.4) to V(i.5) above) concerning the amount of phenol which could be recovered at the end of the manufacture for a polycarbonate having an average molecular weight of 2000 (i.e. 89% by weight).

3.10.8 This is because, independently of the fact that the validity of such assertion had been challenged by the Patent Proprietor (cf. paragraphs VII(i.8) to VII(i.9) above), this calculation would not inevitably imply that only 11% by weight of phenol must be replenished, i.e. that there would be 89% by weight of recycled phenol in the phenol feedstock of process [I] of D1, since, as for Example 14 above, there is no indication in D1 as how much phenol would be lost in the recycling process [III] following the manufacture of such polycarbonate.

3.10.9 It thus follows that the subject-matter of Claim 1 must be regarded as novel over the disclosure of D1 (Article 54 EPC). The same conclusion applies to the subject-matter of dependent Claims 2 to 6.

4. *The patent in suit; the technical problem*

4.1.1 The patent in suit is concerned with a process for making an aromatic polycarbonate.

4.2 While document D1 has been considered as the closest state of the art in the decision under appeal, both Appellants have submitted that document D2 would also represent an appropriate starting point for the assessment of inventive step.

4.2.1 Document D2 deals with a process for making an aromatic polycarbonate comprising the steps of:

(A) reacting a diaryl carbonate with a bisphenol to produce a bisphenol polycarbonate and a phenol;
(B) separating the polycarbonate and phenol; and
(C) reacting a carbonyl halide with at least some of the phenol from step B to produce a diaryl carbonate, and recycling the diaryl carbonate to step A (page 1, line 25 to page 2, line 2).

4.3 According to D2, because of slight losses in the process, it might be necessary to provide make-up quantities of the phenol, so that the phenol recycled from step (B) supplies at least 95% more preferably 99 percent of the phenol reactant (page 3, lines 4 to 7). Furthermore, according to D2, the most preferred carbonyl halide is phosgene (page 3, line 8).

4.4 As can be understood from D2 its aim was to develop a more efficient means of generating polycarbonate resins (page 1, lines 13 to 14; page 5; lines 24 to 30).

4.5 According to the patent in suit its aim is to provide polycarbonate resins having good melt stability at high temperatures (cf. patent in suit paragraph [0012]).

4.6 Whilst both documents D1 and D2 disclose processes for making aromatic polycarbonate including the step of recycling the phenol generated in the polycarbonate manufacture to the manufacture of the diaryl carbonate, neither of them deals with the problem of the melt stability of the produced polycarbonate at high temperature.

4.7 The closest state of the art should normally be represented by a document which deals with the same problem. However, in the absence of such a document, the starting point for evaluating inventive step should be searched for in a document relating to a similar technical problem, or at least to the same or a closely related technical field as the patent in suit (cf. decision T 989/93 of 16 April 1997, not published in OJ EPO; Reasons, point 12).

4.8 In this connection the Board however observes that document D1 firstly refers to the heat stability of the polycarbonates (page 2, lines 14 to 15), and secondly that the process of D1 comes closer to the one according to the patent in suit than that disclosed in D2, since it discloses the steps of preparing the diphenyl carbonate by reaction of the phenol with a dialkyl carbonate instead of with phosgene as disclosed in D2. Consequently, document D1 represents, in the Board's view, a more appropriate starting point than document D2.

4.9 Starting from D1, the technical problem might hence be seen in the provision of a process enabling the production of aromatic polycarbonate having a good melt stability at high temperature.

4.10 The solution proposed according to Claim 1 of the patent in suit is to use a phenol feedstock in the manufacture of the diphenyl carbonate containing between 70 and 99% by weight of recycled phenol generated as by-product in the manufacture of the aromatic polycarbonate.

4.11 Consequently, it must be now be checked whether the technical problem is effectively solved by the claimed measures.

4.12 In that respect, it has been considered in the decision under appeal that the results of the melt stability presented in Table 1 of the patent in suit showed that a better melt stability of the polycarbonate was associated with the specific range of recycled phenol (i.e. 70 to 99% by weight) in the phenol feedstock (cf. decision under appeal passage bridging pages 9 and 10).

4.13 The Board however notes that the Appellants have contested the validity of the comparison made by the Patent Proprietor in the patent in suit. According to the Appellants, while it could be considered that the process conditions were similar in Examples 1 to 6, and

Comparative Examples 1 to 3, there were however differences in the impurity levels (cresol, xylenol, dihydroxy compounds) of the "fresh" phenol fed in conduit 9 as well in the feedstock phenol fed in conduit 2 (cf. patent in suit Table 1). Nor could, according to the Appellants, the comparative Example 4 provide a valid comparison, since the process conditions (e.g. mole ratio of diphenyl carbonate to bisphenol) have been also modified. In other words, since there was more than one difference between Examples 1 to 6 of the patent in suit and the comparative Examples 1 to 4, it had not been shown, according to the Appellants, that the relied distinguishing feature (amount of recycled phenol in the phenol feedstock) provided an effective solution to the technical problem.

4.14 As indicated in the decision T 197/86 (OJ EPO 1989, 371) where comparative tests are chosen to demonstrate an inventive step with an improved effect over a claimed area, the nature of the comparison with the closest state of the art must be such that the effect is convincingly shown to have its origin in the distinguishing feature of the invention (Reasons point 6.1.3).

4.15 In the present case, it firstly cannot be denied, in the Board's view, that the processes according to Examples 1 to 6 differ from the processes according to Comparative Examples 1 to 3 in that the amount of recycled phenol in the feedstock is in the claimed range. The same is further true for the additional Examples 9 and 10 (carried out according to Example 1) submitted with the Statement of Grounds of Appeal by the Patent Proprietor.

4.16 It cannot further be denied, in the Board's view, that the polycarbonates produced according to the claimed process exhibit a good melt stability (Δb^*_{60} between 1.2 and 2.9 for the Examples 1 to 6, and 9 to 10 to be compared with Δb^*_{60} between 4.1 and 9 for the Comparative Examples 1 to 3).

4.17 While it is true that the impurity levels (i.e. cresol, xylenol, dihydroxy compounds) in the phenol feedstocks (in conduits 9 and 2) are not the same in Examples 1 to 6, and 9 to 10 as in Comparative Examples 1 to 3, it should, however, be noted, that even if the level of impurities in the "fresh" phenol feedstock (conduit 9) would have been the same in all these examples, this would not change the fact that, except when the "fresh" phenol and recycled phenol are the same, i.e. have the same content of impurities (cresol, xylenol, dihydroxy compounds), the amount of impurities in the phenol feedstock (conduit 2) would be inevitably dependent on the amount of recycled phenol in that feedstock.

4.18 In other words, this implies that, apart from the exceptional case mentioned above, it is not possible to disconnect the amount of impurities (cresol, xylenol, dihydroxy compounds) in the phenol feedstock from the amount of recycled phenol in that phenol feedstock, i.e. to provide examples and comparative examples differing only by the amount of recycled phenol in that feedstock.

4.19 This however does not, in the Board's view, inevitably deprive *ab initio* the comparison between Examples 1 to 6, and 9 to 10 and Comparative Examples 1 to 3 of the possibility of convincingly showing that the claimed distinguishing feature (amount of recycled phenol in the phenol feedstock) might have indeed a predominant effect on the melt stability of the produced polycarbonate.

4.20 In this connection the Board observes that during the opposition proceedings the Opponents (now Appellants) have not submitted experimental data showing that even in the exceptional case referred above in paragraph 4.17, no effect in terms of melt stability of the produced polycarbonate can be attributed to the distinguishing feature on the whole claimed range of recycled phenol. The Board further notes during the opposition proceedings the Patent Proprietor had submitted in view of the comparison between Examples 4 and 6 of the patent in suit (cf. Exhibit 2 annexed to Attachment 2 to the letter of 4 February 2005) that the level of impurities (cresol, xylenol, dihydroxy compounds) in the phenol feedstock (conduit 2) was not the predominant factor for the melt stability of the produced polycarbonate.

4.21 Under these circumstances, it is conceivable, in the Board's view, that the Opposition Division could indeed have been convinced that the achievement of a good melt stability had been shown to have predominantly its origin in the distinguishing feature of the claimed invention.

4.22 Since the Opposition Division has considered in its decision that this distinguishing feature led to a good melt stability of the produced polycarbonate, this has for its consequence that the burden of proof is on the Appellants to demonstrate that the decision of the Opposition Division was wrong in that respect (cf. by analogy T 585/92 (OJ EPO 1996, 129; Reasons point 3.2)), i.e. to substantiate their allegation that the use of an amount of recycled phenol in the range of 70 to 99% in the phenol feedstock is no relevance for the melt stability of the obtained polycarbonate, in particular when no distinction in terms of the mentioned impurities could be made between the recycled phenol and the fresh phenol.

4.23 The Board can, however, only state that no evidence has been submitted by the Appellants in the course of the appeal proceedings in that respect.

4.24 Since as indicated above in paragraph 4.22, the burden of proof in the present case is upon the Appellants to establish that the amount of recycled phenol in the feedstock does not lead to a good melt stability, this inevitably implies that the Appellants have not discharged the burden of proof for their contention.

4.25 Under these circumstances, the Board can only consider that the proposed solution provides an effective solution to the technical problem.

5. *Inventive step*

5.1 It remains to be decided whether the proposed solution was obvious in view of the prior art relied on by the Appellants, i.e. documents D1, D2, D3, D5 and O3.

5.2 As indicated above, document D1 does not contain any indication on the amount of phenol to be recycled. Since it is furthermore not concerned by the achievement of a good melt stability at high temperature (e.g. 350°C) of the produced polycarbonate, it is evident that D1 alone cannot suggest the solution proposed by the patent in suit.

5.3 While it is true that document D2 indicates that the recycled phenol could represent 95% by weight of the phenol feed for the manufacture of the diphenyl carbonate, the Board is unable to find in D2 an indication that the use of such an amount of recycled phenol would lead to a good melt stability of the produced polycarbonate. Consequently, even if one would disregard the fact that D2 relates to a phosgene process for the manufacture of the diphenyl carbonate, the combination of D1 with D2 cannot render the subject-matter of Claim 1 obvious.

5.4 Document 03 relates to a process for making an aromatic polycarbonate comprising the steps of producing a polycarbonate by transesterification of diphenyl carbonate with bisphenol A thereby producing phenol as by-product, of separating phenol and polycarbonate, of producing diphenyl carbonate by reaction of phosgene with the phenol (cf. Claims 1 and 2). According to O3 the loss of phenol (i.e. below 5 weight%) occurring during the manufacture of the polycarbonate due to end groups formation and to residues of phenol in the polycarbonate must be compensated with the corresponding amount of fresh phenol (page 5, lines 17 to 22) for the manufacture of diphenyl carbonate.

5.5 There is however no indication in O3 that the use of such amount of recycled phenol (i.e. at least 95%) in the manufacture of the diphenyl carbonate would lead to a good melt stability of the polycarbonate produced therefrom. Consequently, the same consideration as for the combination of D1 with D2 applies to the combination of D1 with O3, and, hence, this combination could not render the subject-matter of Claim 1 obvious.

5.6 Document D5 (D5A) refers to polycarbonates having in particular a good thermal resistance (paragraph [0001]. These polycarbonates are obtained by melt-polycondensing an aromatic dihydroxy compound with a carbonic acid diester in the presence of specified catalyst and exhibit a hydroxyl end group content of less than 30 mol%, a sodium content of 1 ppm or below, and a chlorine content of 20 ppm or below (paragraphs [0002] and [0006]. This polycarbonate can be prepared by reacting a diaryl carbonate such as diphenyl carbonate with an aromatic dihydroxy compound in a mole ratio of 1.01 to 1.30 (paragraphs [0016] and [0018]).

5.7 The thermal resistance of the polycarbonate is tested by evaluating the change in yellowness of the polycarbonate change either after exposition in the solid state for 16 hours at 250 °C or for 1000 hours at 140 °C (paragraphs [0082] and [0083]).

5.8 In this connection, the Board however observes that, despite the fact that melt stability of the polycarbonate produced according to the process of Claim 1 of the patent in suit is also assessed by evaluating the change in yellowness after thermal ageing, the conditions of that thermal ageing totally differ from those applied in D5.

5.9 While the polycarbonates produced according to D5 are subjected in the solid state to temperatures of either 250°C or 140°C, those produced according to process of Claim 1 are tested at a very much higher temperature (i.e. 350 °C) in the molten state (cf. patent in suit paragraph [0069]).

5.10 It is hence more than questionable as to whether the thermal stability considered in D5 could validly be compared with the melt stability referred to in the patent in suit.

5.11 Even if it were, it is further observed by the Board that D5 does not disclose the manufacture of diphenyl carbonate and hence whether phenol generated in the manufacture of the polycarbonate is to be recycled in the manufacture of the diphenyl carbonate, let alone the influence of such recycled amount on the thermal stability of the polycarbonate, so that D5 even combined with D1 could not suggest the solution proposed in the patent in suit.

5.12 This conclusion could also not be altered by the argument of Appellant I that a good melt stability would be achieved by using a mole ratio of diphenyl carbonate to aromatic dihydroxy compound in the range of 1.01 to 1.30 as taught by D5 in order to obtain a low content in hydroxyl terminal groups, and hence, according to the calculations of Appellant I, by using a recycled amount of phenol of 99 to 70% by weight (cf. paragraphs V (ii.15) to V (ii.18) above).

5.12.1 This is because, although in Examples 1 to 6, 9 to 10 and in Comparative Examples 1 to 3 a mole ratio of diphenyl carbonate to aromatic dihydroxy compound of 1.06 (as calculated from the respective amounts of diphenyl carbonate and bisphenol A (each 40 kg in accumulation tank 68; cf. patent in suit page 17, lines 41 and 42), i.e. well in the range suggested in D5, a good melt stability is achieved only for the polycarbonates produced according to the claimed process.

5.12.2 This is also because this comparison further shows that the use of such a mole ratio does not inevitably imply, contrary to the calculations made by Appellant I, that the amount of recycled phenol in the phenol feedstock for the manufacture of the diphenyl carbonate would be in the range 70 to 99% by weight when using such a mole ratio of diphenyl carbonate to bisphenol, since it is 0 % in Comparative Example 1, 40% in Comparative Example 2 and 60 % in Comparative Example 3.

5.13 Document D3 is even less relevant than documents D1, D2, O3 and D5, since it predominantly refers to the manufacture of diaryl carbonate by reacting a dialkyl carbonate with an aromatic compound, and only refers in passing to the use of such aromatic carbonates in the manufacture of polycarbonates (column 45, lines 5 to 11) and evidently cannot provide any hint to the solution proposed by the patent in suit.

5.14 Consequently, the subject-matter of Claim 1, and by the same token that of dependent Claims 2 to 6 involves an inventive step (Article 56 EPC).

5.15 Since the main request of the Respondent is allowable, there is no need for the Board to deal with the auxiliary requests 1 to 7 presented by the Respondent.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:	The Chairman:
E. Görgmaier	R. Young