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Datasheet for the decision of 29 May 2009

Case Number: T 0095/07 - 3.3.03

Application Number: 00953908.1

Publication Number: 1261658

IPC: C08G 63/183

Language of the proceedings: EN

Title of invention:
Continuous process for producing poly(trimethylene terephthalate)

Patentee:
E.I. DU PONT DE NEMOURS AND COMPANY

Opponent:
Solotex Corporation
Zimmer Aktiengesellschaft

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56, 113(1), 116, 117, 123(2)

Relevant legal provisions (EPC 1973):
-

Keyword:
"Main request - added subject matter - yes"
"First auxiliary request - maintenance in amended form - yes"
"Novelty - repetition of prior art not beyond all reasonable doubt"
"Request to withdraw experimental report - refused - no legal basis

Decisions cited:
G 0010/91, G 0004/95, T 0793/93, T 0270/94, T 0644/97, T 0910/06

Catchword:
See reasons 4.2.12

Case Number: T 0095/07 - 3.3.03

DECISION
of the Technical Board of Appeal 3.3.03
of 29 May 2009

(Opponent)	Solotex Corporation Shin-Daibiru Bldg., 2-6 Dojimahama, 1-chome, Kita-ku, Osaka 530-8205 (JP)
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(Opponent)	Zimmer Aktiengesellschaft Borsigallee 1 D-60388 Frankfurt/Main (DE)
Representative:	Meyer-Dulheuer, Karl-Hermann Dr. Meyer-Dulheuer & Partner Patentanwaltskanzlei Barckhausstraße 12-16 D-60325 Frankfurt am Main (DE)
Respondent: (Patent Proprietor)	E.I. DU PONT DE NEMOURS AND COMPANY 1007 Market Street Wilmington, DE 19898 (US)
Representative:	Hirsch & Associés 58, avenue Marceau F-75008 Paris (FR)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office, dated 24 October 2006 and posted 5 December 2006 concerning maintenance of the European patent No. 1261658 in amended form.**

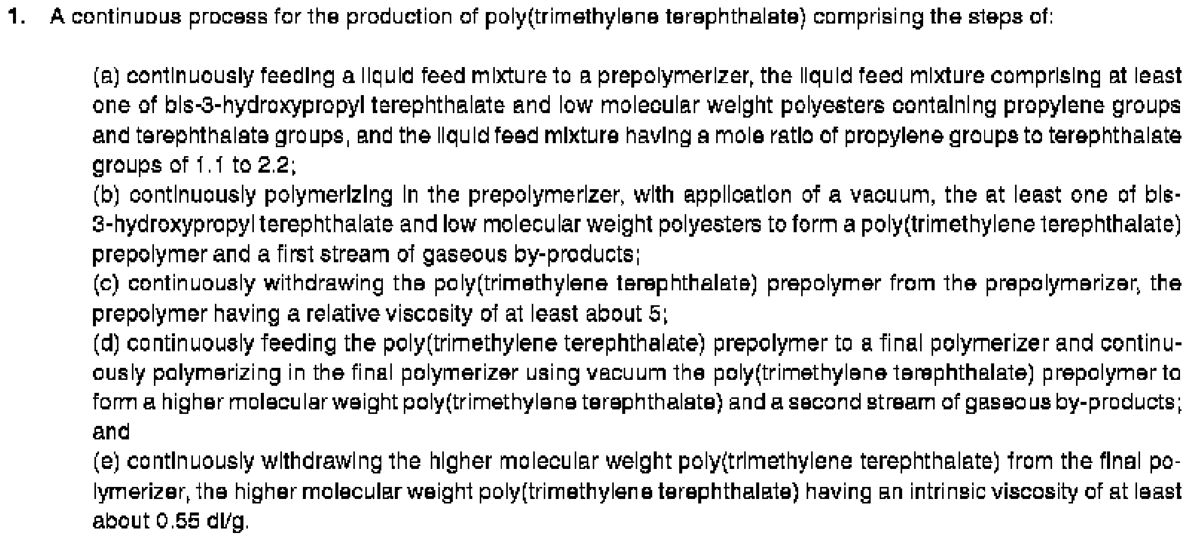
Composition of the Board:

Chairman:	R. Young
Members:	M. C. Gordon
	C.-P. Brandt

Summary of Facts and Submissions

I. Mention of the grant of European Patent No. 1 261 658 with the title "Continuous Process for Producing Poly(trimethylene terephthalate)" in the name of E.I. du Pont de Nemours and Company in respect of European patent application No. 00953908.1, filed on 10 August 2000 as international application No. PCT/US00/21778, published as WO 01/58980 A1 on 16 August 2001, and claiming a priority date of 11 February 2000 from US 09/501 700 was announced on 15 October 2003 (Bulletin 2003/42) on the basis of 15 claims.

Claim 1 read as follows:



1. A continuous process for the production of poly(trimethylene terephthalate) comprising the steps of:

(a) continuously feeding a liquid feed mixture to a prepolymerizer, the liquid feed mixture comprising at least one of bis-3-hydroxypropyl terephthalate and low molecular weight polyesters containing propylene groups and terephthalate groups, and the liquid feed mixture having a mole ratio of propylene groups to terephthalate groups of 1.1 to 2.2;
(b) continuously polymerizing in the prepolymerizer, with application of a vacuum, the at least one of bis-3-hydroxypropyl terephthalate and low molecular weight polyesters to form a poly(trimethylene terephthalate) prepolymer and a first stream of gaseous by-products;
(c) continuously withdrawing the poly(trimethylene terephthalate) prepolymer from the prepolymerizer, the prepolymer having a relative viscosity of at least about 5;
(d) continuously feeding the poly(trimethylene terephthalate) prepolymer to a final polymerizer and continuously polymerizing in the final polymerizer using vacuum the poly(trimethylene terephthalate) prepolymer to form a higher molecular weight poly(trimethylene terephthalate) and a second stream of gaseous by-products; and
(e) continuously withdrawing the higher molecular weight poly(trimethylene terephthalate) from the final polymerizer, the higher molecular weight poly(trimethylene terephthalate) having an intrinsic viscosity of at least about 0.55 dl/g.

Claims 2 to 15 were dependent claims.

II. Notices of opposition to the patent were filed on:

- 13 July 2004 by Solotex Corporation (hereinafter "OI") and
- 15 July 2004 by Zimmer AG (hereinafter "OII").

Both opponents invoked the grounds of opposition pursuant to Art 100(a) EPC (lack of novelty, lack of

inventive step). OI also invoked the ground of opposition pursuant to Art. 100(c) EPC (extension of the subject-matter of the patent beyond the content of the application as filed).
Neither party invoked the grounds of opposition pursuant to Art 100(b) EPC (lack of sufficient disclosure).

Inter alia the following documents were cited in support of the oppositions:

D1: EP-A-1 046 662 (a document comprised in the state of the art pursuant to Art. 54(3) EPC and cited by both opponents)
D2: US-A-4 110 316 (cited by OI)
D3: US-A-2 727 882 (cited by both opponents)
D4: US-A-5 798 433 (cited by OI) and the corresponding DE 197 05 249 A1 (cited by OII)
D6: Certified Experimental Results (cited by OI)
D9: US-A-5 340 909 (cited by OI)
D11: Value table of the correlation between relative viscosity and intrinsic viscosity of poly(trimethylene terephthalate) (cited by OII).

III. By an interlocutory decision announced at the conclusion of oral proceedings held on 24 October 2006 and issued in writing on 5 December 2006 the opposition division held that the patent could be maintained in amended form on the basis of a set of 15 claims filed during the oral proceedings as the first auxiliary request.
This set of claims differed from claims 1-15 of the patent as granted in that part (a) of claim 1 read as follows, the additions compared to claim 1 as granted being indicated in **bold** and deletions by ~~strikethrough~~ :

"(a) continuously feeding a liquid feed mixture to a prepolymerizer, the liquid feed mixture comprising at least one of bis-3-hydroxypropyl terephthalate and low molecular weight polyesters **of 1,3-propane diol** ~~containing propylene groups~~ and terephthalate groups, and the liquid feed mixture having a mole ratio of propylene groups to terephthalate groups of 1.1 to 2.2;".

(a) *Art. 123(2) EPC*

According to the decision the term "propylene groups" in part (a) of claim 1 of the patent as granted included groups derived from 1,3-propanediol but also groups derived from 1,2-propanediol. Since the application documents as originally filed did not support the presence of propylene groups other than those derived from 1,3-propanediol the amendments made during the examination procedure offended against Art. 123(2) EPC.

Consequently the main request was refused.

With respect to the first auxiliary request, the opposition division held that the terms "polyesters of 1,3-propanediol" reinstalled the originally filed wording. This amendment was held to meet the requirements of Art. 123(2) (and (3)) EPC.

(b) *Art. 54 EPC*

According to the decision, example 4 of D1 (which was a comparative example) disclosed a multi-step process for the production of poly(trimethylene terephthalate) - hereinafter "PTT". The prepolymer obtained in this process was disclosed as having

an intrinsic viscosity of 0.26 dl/g.
The opponents had submitted documents D6 and D11 in order to demonstrate the relative viscosity corresponding to this intrinsic viscosity. The decision held that D6 and D11 only supported significantly different values of the corresponding relative viscosity and hence could not be taken as support for the submission of the opponents that comparative example 4 of D1 inherently disclosed prepolymers having a relative viscosity of at least about 5.

(c) *Art. 56 EPC*
According to the decision, the closest prior art was D4 since this document pertained to the production of PTT.
Starting from D4 the distinguishing features were the processing conditions specified in claim 1 of the patent in suit, which had the effect that PTT with a low level of by-products such as acrolein and allyl alcohol could be produced.
Consequently, the objective technical problem solved by the patent in suit was the provision of a continuous process for the production of PTT having low amounts of acrolein and allyl alcohol as by-products.
This was not suggested by the prior art in the opposition procedure. D4 also described a process leading to PTT with low acrolein and ally alcohol contents, however with the help of a catalyst blocker.

(d) Accordingly it was held that the patent could be maintained in amended form on the basis of the first auxiliary request.

IV. Notices of appeal against the decision were filed by all parties:

- OII on 17 January 2007.
- OI on 31 January 2007 and
- the patent proprietor on 13 February 2007,

the prescribed fees being paid by the respective parties on the above indicated dates.

V. The statements of grounds of appeal were received as follows:

- the patent proprietor on 21 March 2007
- OII on 24 March 2007 and
- OI on 31 March 2007.

(a) The appellant/patent proprietor requested in its statement of grounds of appeal as the main request that the patent be maintained as granted. Submissions were made only with respect to the objection pursuant to Art. 123(2) EPC (see section III.(a) above). It was argued that the invention was directed to poly(<u>trimethylene</u> terephthalate) (emphasis of the appellant/patent proprietor), which implied that the propylene groups contained in the PTT necessarily derived from 1,3-propanediol. PTT contained only linear propylene groups, which could only be obtained by using 1,3-propanediol as a starting diol, which was a linear diol. In contrast thereto, 1,2-propanediol was a branched diol and could not be used to prepare the stated polymer since it would lead to a polymer containing branched polypropylene groups.

(b) Appellant/OI submitted in its statement of grounds of appeal with respect to Art. 54 EPC *inter alia* that D1 disclosed that in the process of comparative example 4 a PTT prepolymer having an intrinsic viscosity of 0.26 dl/g was obtained. The value of the intrinsic viscosity was measured by the method disclosed in D1. This intrinsic viscosity corresponded to a relative viscosity of 6.6 measured by a measurement method disclosed in the specification of the opposed patent, as proven by D6. This value was within the range of "a relative viscosity of at least about 5" as specified in claim 1(c) of the patent in suit
With regard to the findings of the opposition division with respect to the evidence provided by the two opponents (i.e. D6 and D11), and in particular that the evidence of appellant/OII, i.e. D11, showed that the intrinsic viscosity disclosed in comparative example 4 of D1 corresponded to a relative viscosity of less than 5 it was submitted that the data of appellant/OII was based on a theoretical conversion obtained by calculation using a relational equation between intrinsic and relative viscosity, based on values disclosed at paragraph [0033] of the patent in suit. The underlying equation was however not disclosed in D11.
Further, the correlation presented in D11 was not based on experimental data, but had been established based on extrapolation of values of 0.55 dl/g or more, the value of interest i.e. 0.26

dl/g not being included in said range. It was submitted that this approach was not reliable.
In contrast the values of D6, submitted by appellant/OI represented data on the basis of a relational equation derived from an experiment repeating comparative example 4 of D1. In this repetition of comparative example 4 the experimental results of the intrinsic viscosity and the relative viscosity had been obtained by using PTT samples having an intrinsic viscosity of approximately 0.26 dl/g, i.e. by interpolation. Interpolation was much more accurate than an extrapolation starting from a value extremely far from the experimental value. According the discrepancy between D6 and D11 was due to inaccurate extrapolation.
The viscosity value of 6.6 dl/g evidenced by D6 was correct whereas that based on D11 could not be correct. It was therefore requested that D11 not be taken into account.
Since the other features of claim 1 were also anticipated by the process of comparative example 4 of D1 the consequence was that the subject- matter of claim 1 of the patent in suit lacked novelty.

With respect to Art 56 EPC OI submitted that D4 represented the closest prior art. The object of the invention of the patent in suit was to provide a continuous three vessel process for the production of PTT. In this process the production of by-products (acrolein, allyl alcohol) was minimised whilst the molecular weight of the PTT was maximised (reference being made to paragraph

[0005] of the patent in suit). The object of D4 was in particular to provide a process for producing PTT with a lower acrolein and allyl alcohol content.
According to the disclosure of D4 (col. 2 lines 23-32) a crucial factor in achieving this aim was the inactivation or blocking of the esterification catalyst by addition of a phosphorous compound which, it was submitted, suppressed the formation of by-products due to thermal decomposition.
Thus the objects of D4 and of the patent in suit were substantially the same.
D4 did not clearly disclose a continuous PTT polymerisation process, which thus represented the feature distinguishing the subject-matter of claim 1 from this disclosure. However D4 implicitly included the above continuous PTT polymerisation process comprising a 3-stage process with the steps of esterification, prepolymerisation and final polymerisation since D4 did not explicitly exclude a continuous PTT polymerisation process. It would however have been evident that the process of D4 could be converted to a continuous process, reference being made *inter alia* to D2, a document relating to a continuous polymerisation process for poly (ethylene terephthalate) (hereinafter "PET").

(c) Appellant/OII submitted in its statement of grounds of appeal with respect to Art. 54 EPC and the disclosure of comparative example 4 of D1 that the data of D6, i.e. the experimental data of OI were more reliable than D11, i.e. the theoretical calculation provided by OII and stated that it withdrew D11.

It was concluded, in the light of the evidence provided by D6, that the disclosure of comparative example 4 of D1 anticipated the subject-matter of operative claim 1.

With respect to Art. 56 EPC it was disputed that the objective technical problem solved by the patent in suit was the provision of a continuous process for the preparation of PTT.

Such a process was already known, reference being made to a document cited in the description of the patent in suit, namely US-A-5 599 900 (hereinafter designated "D17").

It was the process of D17 which was the starting point of the process of the patent in suit. Thus the decision of the opposition division was *prima facie* incorrect since the alleged objective technical problem of providing a continuous process with a low content of by-products had already been solved. D17 made explicit reference to the removal of volatile by-products (thus also allyl alcohol and acrolein) by means of the introduction of a stream of heated inert gas. Thus the further problem of the patent in suit, namely the reduction as far as possible of the content of allyl alcohol and acrolein had also been solved.

The relevance of D17 was further increased by the disclosure in col. 2 lines 63-67 thereof that the teaching of D17 encompassed both continuous and batch processes. Thus the patent proprietor had itself acknowledged that batch and continuous processes were process variants which corresponded to each other, with the result that it was not possible to recognise an inventive step for providing a continuous process under the circumstances that a batch process was already known.

The relevance of the state of the art referred to in the patent in suit was further emphasised by the fact that "other volatile reaction by-products" were removed by a heated stream of inert gas (D17, claim 1). It did not need to be stressed that this step would result in removal of allyl alcohol and acrolein. Thus it was not even necessary to add the catalyst inactivating or blocking additives referred to in D4 in order to reduce the content of these by-products - normal processing conditions were sufficient. The position taken in the decision under appeal, namely that the state of the art required the addition of such additives to reduce the content of acrolein and allyl alcohol and that the fact that the process of the patent in suit could dispense with this step could support an inventive step was manifestly incorrect.

These submissions however did not change the fact that D4 remained a highly relevant state of the art. Although D4 related to a batch process, it was known from D17 that the process parameters developed for such a batch process could be employed in a continuous process without any problems. The conversion of a batch process to a continuous process - and *vice versa* - formed part of the daily, routine activities of the process engineer and did not require any inventive step.

VI. In a letter dated 2 July 2007 appellant/OI disputed the submissions made by the appellant/patent proprietor with respect to Art 100(c)/123(2) EPC.

In particular the term "propylene group" encompassed the 1,2-propylene group and the 1,3-propylene group, with the 1,2-propylene group not being directly and unambiguously disclosed in the application as filed. Thus the amendment to "low molecular weight polyesters containing propylene groups and terephthalate groups" represented a generalisation of the original disclosure, contrary to the requirements of Art. 123(2) EPC.

This was aggravated by the fact that part (a) of claim 1 stated that the liquid feed mixture "comprises" said "low molecular weight polyesters…". This wording did not exclude the presence of isomers of propane diol other than specifically 1,3-propane diol.

Independently a further broadening was seen in the amendment of the originally disclosed phrase "low molecular weight [polyesters] of 1,3-propane diol.." to "low molecular weight polyesters containing propylene groups" (emphasis in each case of appellant/OI) which did not exclude - in combination with the term "comprising" - that the feed mixture contained low molecular weight polyesters containing groups other than the originally specifically disclosed 1,3-propane diol groups.

VII. In a letter dated 17 October 2007 the appellant/patent proprietor maintained the previously submitted requests and submitted an amended version of claim 1 as a second auxiliary request. The wording of this claim is however not of relevance for the present decision.

With respect to Art. 100(c)/123(2) EPC the patent proprietor emphasised the arguments presented in its statement of grounds of appeal (See section V.(a) above).

With respect to Art. 54 EPC and in particular the question of the viscosity of the prepolymer in step (c) of claim 1 it was observed that D6 indicated that an intrinsic viscosity of 0.26 dl/g - disclosed in comparative example 4 of D1 - corresponded to a relative viscosity of 6.64992, which value had been obtained by interpolation. Specifically, D6 reported the measurement of the relative viscosity of three samples having intrinsic viscosities of 0.20, 0.3 and 0.34 dl/g. The evidence of OII (D11) indicated that an intrinsic viscosity of 0.26 dl/g corresponded to a relative viscosity of 4.6, i.e. outside the range specified in step (c) of claim 1.

It was observed that the value provided by OI was 50% higher than that provided by OII.

Although OI had asserted that the certified experimental results of D6 were "more reliable" than the conversion table D11, reference was made to a statement by OII during the oral proceedings before the opposition division that the determinations of viscosity reported in D11 were absolutely correct and accepted by different experts (emphasis of the appellant/patent proprietor) and further that D11 was used in everyday work by OII (reference being made to section 4.5 of the minutes). Thus it could not be understood how this table could not be reliable.

Further the appellant/patent proprietor submitted that the disclosure of comparative example 4 of D1 did not allow for the preparation of a prepolymer having an IV of 0.26 dl/g. If the skilled person had been able to reproduce the prepolymer of comparative example 4, he would certainly have prepared a prepolymer sample having an IV of exactly 0.26 dl/g. However the samples of D6 (the appellant/patent proprietor erroneously referred to D11) had IVs of around this value (see above). This was an indication that comparative example 4 of D1 did not contain all the necessary parameters which allowed for the preparation of a prepolymer having an IV of 0.26 dl/g.

With regard to inventive step D17 was considered to be the closest prior art as it was the only document which described a continuous process for the preparation of PTT. The process of D17 included the removal of propylene glycol and other volatile reaction by-products by the use of an inert gas that flowed counter-currently. In contrast to the patent in suit D17 disclosed a closed loop system operated at atmospheric pressure. Further D17 did not provide a process for reducing emissions of organic by-products, but a process for converting organic by-products to non-toxic products. There was no mention of allyl alcohol or acrolein in D17.
Thus the subject-matter of claim 1 differed from the disclosure of D17 by the following features:

- the molar ratio of propylene groups to terephthalate groups was 1.1 to 2.2;
- prepolymerisation and polymerisation were carried out under vacuum;
- the prepolymer had a relative viscosity of at least 5;
- the intrinsic viscosity of the PTT polymer was at least about 0.55 dl/g.

The technical effect achieved by these differences was a low amount of allyl alcohol and acrolein.

The objective problem of the invention was, with reference to paragraph [0005] of the patent in suit, to provide a continuous process for the production of PTT in which the production of the stated by-products was reduced and in which the molecular weight of the PTT was maximised. This problem was solved, as shown by Tables I and II of the patent in suit.

D17 taught away from using a vacuum in the polymerisation process. On the contrary according to the invention prepolymerisation and polymerisation were necessarily carried out under vacuum. D17 did not give any indication of the viscosity that could be obtained by its process and did not suggest either the relative viscosity of the prepolymer of at least 5 or the intrinsic viscosity of the polymer of at least 0.55 dl/g.

Regarding the combination of D17 and D4, it was noted that D4 related to a batch process. D4 however did not identify any process parameters as a means to reduce the content of acrolein and allyl alcohol - D4 pointed to a solution based on the addition of a phosphorous compound.

Thus the skilled person searching for a means to reduce the stated by-products would follow the teaching of D4 which consisted in blocking the esterification catalyst after the esterification. Further D4 did not disclose the viscosity of the prepolymer at the exit of the prepolymeriser.

With respect to the combination of D17 with D2 it was submitted that the skilled person would not consider D2 since D2 was directed to a continuous process for the preparation of PET, not PTT, which polymers have different physical and chemical properties.

Similarly with respect to the combination of D17 and D3 it was noted that D3 was directed to glycols in general and PET in particular. There was no mention of PTT in D3. Further D3 relied on the production of large amounts of vaporous by-products to effect agitation - this was the opposite of the technical effect achieved in the invention of the patent in suit.

VIII. In a letter dated 19 September 2008 appellant/OI raised an objection of lack of novelty in respect of examples 5-8 of D1, emphasising that these were inventive examples.
Reference was made again to D6 and D11, and it was reemphasised that the - interpolated - values given in D6 were more reliable than the extrapolated values of D11.
Inter alia it was submitted that in the process of example 5 of D1 the precondensate, i.e. the product exiting the prepolymerisation stage had an intrinsic viscosity of 0.26 dl/g.

With regard to Art. 56 EPC it was submitted that of D4 and D17, only D4 had the same aim as the patent in suit, i.e. to minimise the acrolein and allyl alcohol content. In contrast thereto the object of D17 was not to minimize the reaction by-products but to facilitate the removal thereof.
Hence D4 was considered to represent the closest state of the art. Reference was made to the submissions in the statement of grounds of appeal (see section V.(b) above). It was also noted that D4 disclosed to employ three stages, namely monomer/oligomer production; prepolymerisation; and final polymerisation in order to

produce a high molecular weight PTT.
In particular it was emphasised that the basic principle underlying the process of D4 was to remove by-products thus driving the equilibrium reaction towards the desired products - which principle underlay the process according to the patent in suit.
With respect to D17, whilst D4 and the patent in suit employed vacuum means to remove by-products, D17 employed the atmospheric pressure, inert gas circulation method. These methods were however the same in chemical action and mechanism in continuous polymerisation and were interchangeable. Further D4 and D17 employed the same principle of employing low temperatures to suppress the decomposition of PTT to allyl alcohol and acrolein. Although the processes of D4 and D17 differed in the means for removal of by-products, D17 was a highly relevant teaching for the skilled person in converting the process of D4 to continuous operation. Hence there would have been sufficient motivation to combine the teachings of D4 and D17.
Further D2 and D3 provided information relating to a three stage continuous polymerisation process in the vacuum method not disclosed in either of D4 or D17. Specifically, it was submitted that combining the disclosures of D3 and D2 provided technical information highly relevant to the solution of the objective technical problem underlying the patent in suit aimed at the vacuum continuous polymerisation of polyester. Hence there would have been sufficient motivation to combine D2 and D3 with D17.

Alternatively, considering the atmospheric pressure process of D17 as the closest prior art, the distinguishing feature of operative claim 1 was a vacuum continuous polymerisation. Hence the technical problem underlying the patent in suit was solved by "the use of vacuum continuous polymerisation to produce high molecular weight PTT while suppressing the generation of allyl alcohol and acrolein". D17 taught that in the continuous polymerisation of PTT heat-decomposition occurred and the heat-decomposition products had to be treated. The removal of the by-products, including the monomer propanediol by inert gas stream had the effect of driving the equilibrium to the right, i.e. favouring the polymerisation reaction, i.e. this was precisely the same mechanism as employed in the patent in suit and in D4. This showed that the vacuum method and the atmospheric pressure method had the same chemical action and mechanism and hence were interchangeable. Thus the technical means disclosed in D17, other than the methods/conditions of circulation of inert gas were applicable to vacuum continuous polymerisation.

Further D17 disclosed technical requirements applicable to continuous polymerisation.

It was also argued that starting from D17, disclosing the continuous polymerisation of high molecular weight PTT, D4 would provide the relevant information relating to a vacuum process. Additional information relevant to the vacuum continuous process not disclosed in either of D4 or D17 would be provided by D2 and D3. Hence the combination of D17, D4, D2 and D3 provided sufficient technical information to solve the objective technical problem underlying the patent in suit meaning that an inventive step had to be denied.

An objection pursuant to Art. 100(b)/Art 83 EPC (lack of sufficient disclosure) - which had not been one of the grounds of opposition invoked in the notices of opposition (see section II above) was also raised for the first time.

IX. On 18 March 2009 the Board issued a summons to attend oral proceedings.
In a communication dated 26 March 2009 the Board observed with respect to the objection pursuant to Art. 83 EPC raised by OI (see section VIII above) that Art. 100(b) EPC had not been one of the grounds of opposition invoked by either of the opponents, and that the appellant/patent proprietor had not indicated its agreement to having this ground admitted to the proceedings. Accordingly pursuant to G 10/91 (OJ EPO 1993, 420), the Board had no power to consider this ground.

X. In a letter dated 30 March 2009 the appellant/OII submitted with respect to the arguments of the appellant/patent proprietor in view of D17 that the production of PTT under vacuum conditions was known in the art and hence that this feature could not support an inventive step. In this respect reference was made to D9.

XI. In a letter dated 21 April 2009 appellant/OI announced the attendance of two technical experts, *inter alia* Ms. Nami Saeki, identified as "Manager of the Intellectual Property Department of Asahi Kasei Corporation".
It was requested that the experts be allowed to speak "with regard to technical matter in support of the submissions made by the [professional representative]".

XII. In a letter dated 22 April 2009 the appellant/patent proprietor clarified the scope of the second auxiliary request.

XIII. Oral proceedings were held before the Board on 29 May 2009.
The appellant/patent proprietor stated that it did not agree to the admission of the ground of opposition pursuant to Art. 100(b)/83 EPC raised by OI in its submission of 19 September 2008.
The Board, with reference to G 10/91 (see section IX above) thus announced that this ground would not be admitted to the procedure.

(a) *Main request- claims of the patent as granted.*
The appellants/opponents maintained their objections pursuant to Art. 100(c)/123(2) EPC, reference being made to the written submissions (see section VI above).
The appellant/patent proprietor emphasised the position that the term "propylene" within the context and framework of a process for the production of PTT had necessarily to be and could only be understood as referring to 1,3-propanediol.

After deliberation the Board announced the decision that the main request was refused (Art 123(2) EPC).

(b) *First auxiliary request - Art 84 and 123(2) EPC*
The appellants/opponents raised no formal objections (Art 84, 123 EPC) in respect of this request.

(c) *First auxiliary request- Art. 54 EPC*

With respect to comparative example 4 of D1 the appellants/opponents referred to the written submissions (see sections V.(b), V.(c), and VIII above).

The appellant/patent proprietor observed that none of the examples of the report D6 achieved a viscosity of 0.26 dl/g, i.e. the viscosity disclosed in comparative example 4 of D1. This indicated that the experiments reported in D6 had been done under different conditions from those of comparative example 4 of D1. It was submitted that this failure to achieve the viscosity reported in comparative example 4 of D1 might be because the disclosure of D1 was not sufficiently detailed to allow the comparative example to be completely and accurately repeated. The conclusion was that D6 did not relate to a correct reproduction of comparative example 4 of D1.

It was further submitted that the three data points reported in D6 showed a poor correlation which meant that the interpolation based on these values was not reliable. It would, on the contrary, have been necessary to perform several repetitions of comparative example 4 of D1, each yielding a value of ca 0.26 dl/g and interpolate from these results.

Regarding the table of values obtained by calculation (D11) the appellant/patent proprietor referred to the statement of OI reported in the section 4.5 of the minutes of the oral proceedings before the opposition division that the calculations of D11 were "absolutely correct and accepted by different experts" and the submission that "these lists of viscosity values were used in the company of opponent II every day" (see section VII above). It was noted that there was good concordance between the values in D11 and those given in paragraph [0033] of the patent in suit. It was then noted that according to D11 an intrinsic viscosity of 0.26 dl/g, i.e. the value reported in comparative example 4 of D1 corresponded to a relative viscosity of approximately 4.3 which was less than the value specified in operative claim 1.

The appellant/OI submitted that D6 was a correct repetition of comparative example 4 of D1, which example provided a complete description of the conditions. It was observed in this respect that the disclosure of the process in the patent in suit was no more precise than that in D1. The data in D6 were reliable since these referred to the prepolymerisation stage. In contrast thereto, the data in paragraph [0033] of the patent related to the finished polymer. With respect to D11 it was reiterated that these figures had been obtained by extrapolation which was less reliable than the interpolation method applied with respect to the experimental results obtained in D6. It was further submitted that it had not proved possible to obtain precisely a value of 0.26 dl/g for the intrinsic viscosity when repeating comparative example 4 of D1, hence a number of representative data points had been obtained and interpolation applied.

It was explained that the reason why the repetition of comparative example 4 of D1 had been carried out as it had been, rather than providing a single value was that an experiment, repeating comparative example 4 of D1 exactly and measuring the IV, would have yielded a single value which would have been very imprecise. The approach adopted of repeating the example with variations of the reaction time to obtain a set of values was more scientific and precise. In response to an observation by the Board that D6 failed to specify how the intrinsic viscosity had been measured the appellant/OI submitted that this had been carried out according to the disclosure of paragraph [0031] of D1.

In the course of the discussion on novelty, the appellant/OI requested that the technical expert Ms Saeki (see section XI above) be permitted to make oral submissions on the question of the viscosity and in particular the experimental report D6.
The appellant/patent proprietor resisted this request, referring to G 4/95 (OJ EPO 1996, 412). It was emphasised that no indication of the topic on which Ms Saeki was to speak had been notified in advance of the oral proceedings.
The appellant/OI submitted that it had been announced both that Ms Saeki would attend the oral proceedings and what her qualifications were. The appellant/opponent OI had however not been in a position to state on what subject she would speak as, at the time of making the announcement, it was not known which matters would be relevant.

Following a break for deliberation the Board announced that Ms Saeki would not be permitted to speak.

The appellant/patent proprietor maintained its objection that D6 did not represent a correct repetition of comparative example 4 of D1 stating in particular that the reaction time disclosed in D1 had not been employed.

The appellant/OII emphasised that the disclosure of D1 was not limited to the examples but the entire disclosure thereof should be taken into account. This would result in the conclusion that the subject-matter of the operative claims lacked novelty. It was further submitted that the relative viscosity of the prepolymer was merely a value of an intermediate product which underwent further processing to yield the final product. This intermediate value was without relevance either to the properties of the final product or to the technical teaching of the invention. Thus this intermediate value could not support the novelty of the subject-matter claimed.
After deliberation the Board announced that the claims of the first auxiliary request met the requirements of Art. 54 EPC.

(d) *First auxiliary request- Art. 56 EPC*
With regard to Art. 56 appellant/OI submitted that D17 had the same aims as the invention of the patent in suit. D17 related to a continuous process in which volatile by-products were removed which drove the equilibrium towards the end product. D17 however did not disclose that the

process was carried out under vacuum or that gaseous by-products were withdrawn.

The aim of D17 was to provide a continuous process for the production of PTT while avoiding the expense of employing vacuum conditions.

The problem underlying the patent in suit was to provide an alternative process which still effected removal of by-products thus driving the reaction to completion. The solution of using a vacuum was obvious in view of the disclosure of D17 col. 1 lines 21-24 that it was known to employ vacuum processes. Similarly it was undisputed that doing this would drive the reaction to favour the products as taught in D17.

Alternatively, D4 concerned the same problem, whereby in contrast to D17 the removal of allyl alcohol and acrolein was explicitly mentioned. Thus it was implicit that in D17 these by-products were also removed. D4 carried out the process under vacuum which established that the skilled person was aware of how to accomplish this. Although D4 did not relate to a continuous process the conditions described therein could be applied to continuous processes.

Further the claimed process was inferior technically and economically to that of D17 and also inferior to that of D4 in terms of the outcome. According to examples 5 and 6 of D4 acrolein contents of 5 or 4 ppm and allyl alcohol contents of 1.7 or 2 ppm were obtained. The data in Table 2 of the patent in suit reported significantly higher contents of these impurities. Thus the claimed process related to a predictable disadvantageous outcome with no evidence of any

improvement arising with respect to the state of the art. Reference was made to the Guidelines for Examination Part C, Chapter IV, item II according to which accepting a predictable disadvantage could not substantiate an inventive step.
The appellant/OII further submitted that according to its claim 6 D17 related to PTT having a degree of polymerisation suitable for fibres and films which led to the conclusion that the intrinsic viscosity was in the range of from 0.75 to 1.15 dl/g i.e. above the minimum specified in operative claim 1.

The appellant/patent proprietor submitted that according to example 2 of D17 the product became so viscous that the polymerisation apparatus had to be shut down. This indicated that high viscosity polymers could not in fact be obtained by the process of D17. Further D17 did not employ a prepolymerisation step.
It was disputed that the objective problem was to provide an alternative process. The process of D17 did not minimise production of allyl alcohol or acrolein but simply transferred these to a separate step to strip/scrub them out. Nor did D17 solve the problem of maximising the molecular weight of the PTT. Further in the process of D17 the inert gas flowed in counter-current to the direction to the reaction, i.e. in the sequence finisher→prepolymeriser, thus starting in the finisher which was where the highest concentration of acrolein and allyl alcohol would be found. These by-products were then swept back through the whole system to the earlier stages, i.e.

prepolymerisation. Hence in contrast to the process of the operative claims, by-products were not removed from the prepolymerisation stage but, on the contrary were introduced thereto. A further effect of this would be to depress the molecular weight of the product of the prepolymerisation stage with the consequence that the minimum viscosity value required by operative claim 1 would not be attainable.

Accordingly, starting from D17 the objective problem was to minimise the production of acrolein and allyl alcohol and maximise the molecular weight.

The data in the patent in suit demonstrated low contents of acrolein and allyl alcohol in the prepolymeriser and in the finisher.

With regard to D4 it was noted that the data relating to the by-product concentration reported therein related to the polymer whereas the data in the patent in suit related to the concentration of by-products in the gaseous streams i.e. the "exhaust" streams. These streams contained ca 90 wt% of the total by-products produced in the reaction, the remaining 10% being in the PTT. Hence the amount of the by-products in the PTT, i.e. corresponding to the figure reported in D4, would be ca 10% (one tenth) that reported, i.e. the amount detected in the "exhaust" streams. This calculation revealed that the process of the operative claims was at least as good as that of D4.

It was disputed that the skilled person would be inclined to modify the atmospheric pressure process of D17 to work under vacuum. Even if this were done, it would not lead to all the features of the operative claim due to the feature of removing the by-products at the various stages. Further there was no recognition in D17 that simply employing a vacuum would minimise the production of acrolein and allyl alcohol since in the process of D17 acrolein and allyl alcohol were simply transported back through the system (see above).

It was further emphasised that the viscosity of the prepolymer was an essential feature which was not obtained in either of the processes of D4 or D17.

The appellants/opponents submitted with regard to D2 and D3 that these provided the necessary teaching in combination with D4 and/or D17 to provide a continuous process. In particular it was maintained that D2 and D3 showed that a process for esterification inevitably included variants carried out continuously and was not limited to batch processes. The appellant/patent proprietor submitted that D2 and D3 related to PET, not to PTT an it was neither simple nor obvious how a continuous process for producing PET could be converted to the production of PTT.

XIV. The appellant (patent proprietor) requested that the decision under appeal be set aside and that the oppositions be rejected.

As a first auxiliary request it was requested that the patent be maintained in the form as upheld by the opposition division.

As a second auxiliary request maintenance of the patent in amended form on the basis of claim 1 as submitted with the letter dated 17 October 2007 and claims 2-15 as in the patent as granted was requested.

The appellants opponent I and opponent II requested that the decision under appeal be set aside and the European Patent No. 1 261 658 be revoked.

Reasons for the Decision

1. The appeal is admissible.

2. *Scope of the proceedings*

In its letter of 19 September 2008 (see section VIII above) the appellant/OI invoked the ground of opposition of insufficiency of disclosure (Art. 100(b)/83 EPC).
This ground had not however been invoked in either of the notices of opposition (see section II above).

As held in G 10/91, paragraph 3 of the Opinion, fresh grounds for opposition may be considered in appeal proceedings only with the approval of the patent proprietor.
In this case the patent proprietor stated that it did not give its approval (See section XIII above).
Accordingly the Board has no power to consider this ground.
The ground of opposition pursuant to Art. 100(b)/83 EPC is therefore not admitted to the procedure.

3. *Main request - Art. 123(2) EPC*

3.1 The objection raised relates to part (a) of claim 1 (see sections III.(a), V.(a), VI, VII, and XIII.(a) above).

Part (a) of claim 1 of the application as filed reads as follows:

"continuously feeding a liquid feed mixture to a prepolymerizer, the liquid feed mixture comprising at least one of bis-3-hydroxypropyl terephthalate and low molecular weight polyesters **of 1,3-propanediol** and terephthalic acid, and the liquid feed mixture having a mole ratio of propylene groups to terephthalate groups of 1.1 to 2.2;"

Claim 1 of the patent as granted however reads as follows:

"continuously feeding a liquid feed mixture to a prepolymerizer, the liquid feed mixture comprising at least one of bis-3-hydroxypropyl terephthalate and low molecular weight polyesters **containing propylene groups** and terephthalate groups, and the liquid feed mixture having a mole ratio of propylene groups to terephthalate groups of 1.1 to 2.2;" (emphasis in both cases by the Board).

3.2 Thus according to claim 1 of the application as filed a low molecular weight polyester of a specific isomer of propanediol was employed, namely 1,3-propanediol. In contrast thereto according to claim 1 of the granted patent low molecular weight polyesters were employed which were defined more generally.

Firstly, the wording of the application as filed, i.e. "low molecular weight polyesters of…" restricted the monomers forming the polyesters to those explicitly

named. In contrast, the term "containing" in claim 1 as granted is broader, requiring only that the stated groups be present in the polyester but does not, in contrast to the wording of the application as filed restrict the polyesters to these monomers.
Further the definition of one of the groups present in the polymer according to the granted claim, i.e. "propylene" is more general than that that in claim 1 of the application as filed i.e. "1,3-propanediol" since it does not restrict this group to a specific isomeric form but encompasses both the 1,2 and 1,3 isomers.

3.3 The appellant/patent proprietor submitted that since the claim was directed to a process for the production of poly(trimethylene terephthalate) the term "propylene groups" would inevitably and necessarily be understood as relating only to 1,3-propylene groups (see sections V.(a), VII, and XIII.(a) above). However, as explained in the foregoing section, the Board takes the view that this limitation can not in fact be derived from the wording of claim 1.
Whilst the preamble the claim does indeed refer to a process for preparing poly(trimethylene terephthalate) the effect of the wording and further features of the claim is to extend the scope thereof in some undefined manner to other polymers. Specifically, as explained above, in contrast to claim 1 as originally filed, the terms of claim 1 as granted encompasses monomers other than those which would result necessarily and exclusively in the formation of poly(trimethylene terephthalate).

3.4 Accordingly claim 1 of the main request contains subject-matter extending beyond the content of the application as filed, contrary to the requirements of Art. 123(2) EPC.

3.5 The main request is therefore refused.

4. *First auxiliary request*

4.1 *Art 123(2) EPC*

Part (a) of claim 1 of the first auxiliary request, the wording of which is cited in section III above, employs the wording of part (a) claim 1 as originally filed (see section 3.1 above). No objections to this set of claims pursuant to Art. 123(2) EPC have been raised by the opponents. Nor does the Board see any reason to raise objections of its own.
Accordingly it is concluded that this request meets the requirements of Art. 123(2) EPC.

4.2 *Art. 54 EPC*

4.2.1 An objection of lack of novelty was raised in respect of the disclosure of comparative example 4 of D1 (see sections III.(b), V.(b) and (c), VII and XIII.(c) above). This discloses a multi-step continuous process for the production of PTT:

- trimethylene glycol (i.e. 1,3-propanediol) and terephthalic acid in a molar ratio of 1.16 were continuously fed to a paste mixer, and the resulting paste subjected to esterification. The esterification was carried out in two stages, i.e.

an "initial esterification" and a "subsequent stirred esterification stage";

- the esterification product was transferred to a third reaction stage for precondensation, i.e. prepolymerisation at a pressure of 100 mbar, a temperature of 255°C and a time specified as "within 30 minutes". The precondensation was completed in a further stage at a pressure of 7 mbar a temperature of 257°C and a time specified as "within 35 minutes"; the precondensate had an intrinsic viscosity of 0.26 dl/g;
- the precondensate was then subjected to final polycondensation.

4.2.2 Claim 1 of the first auxiliary request is directed to a continuous process for the production of PTT.

The first three steps are:

- continuously feeding a liquid feed mixture to a prepolymeriser, the liquid feed mixture comprising at least one of bis-3-hydroxypropyl terephthalate and low molecular weight polyesters of 1,3-propanediol and terephthalate groups, having a mole ratio of propylene to terephthalate groups of 1.1 to 2.2;
- continuously polymerising said feed mixture in the prepolymeriser with application of a vacuum to form a PTT prepolymer and a first stream of gaseous by-products;
- continuously withdrawing the PTT prepolymer from the prepolymeriser, the PTT having a relative viscosity of at least about 5.

4.2.3 Accordingly the process of comparative example 4 of D1 and that of the operative claims both involve the

preparation of a prepolymer. In each case the viscosity of the prepolymer is disclosed, however D1 and the patent in suit specify the viscosity differently, i.e. in terms of the intrinsic viscosity and relative viscosity respectively.
The appellants/opponents each submitted documents in order to show the correspondence of the two viscosity measurements of D1 and the patent in suit.

4.2.4 D6, submitted by appellant/OI relates to a series of experiments in which, it was submitted, the esterification and prepolymerisation reactions were carried under the same conditions as in comparative example 4 of D1 except that the prepolymerisation reaction time in the latter stage was varied to give PTT prepolymers of different intrinsic viscosities (see sections V.(b) and XIII.(c) above). Thus prepolymers having intrinsic viscosities of 0.2, 0.3 and 0.34 dl/g were produced. The relative viscosities of these samples, determined under the conditions disclosed in paragraph [0028] of the patent in suit (see section XIII.(c) above), were reported as 5.38, 7,15 and 8.77 respectively.

4.2.5 In the case of arguing a lack of novelty based on a replication of an example of a prior art citation, the case being made is that the subject-matter claimed, even if not anticipated by the explicit literal disclosure of the citation is nevertheless implicitly anticipated to the extent that in carrying out the express literal disclosure and instructions of a prior art document (e.g. an example) subject-matter falling within the terms of the claims of the patent in suit is the inevitable outcome. In deciding what is or is not the inevitable outcome of an express literal disclosure, there can be no space for doubt and hence a much stricter standard of proof than the "balance of probability", namely "beyond all reasonable doubt" needs to be applied. This means that if there is any reasonable doubt as to what may or may not be the result of carrying out the literal disclosure and instructions of a prior art document, i.e. if there remains a "grey area" then the case of anticipation based on that document must fail (see T 793/93 of 27 September 1995, not published in the OJ EPO, Catchword and section 2.1 of the reasons).

4.2.6 In the present case none of the three experiments reported in D6 resulted in an intrinsic viscosity of 0.26 dl/g. The consequence of this is that it has not been shown to any extent, let alone to the standard of "beyond all reasonable doubt" that comparative example 4 of D1 had in fact been replicated.

4.2.7 It is not even possible to understand the basis or source of the deviation between the data obtained in D6 and that reported in comparative example 4 of D1 since D6 does not specify the nature of the variation, i.e. the time allowed for the first and second prepolymerisation stages (according to D1 "within 30 minutes" and "within 35 minutes" respectively - see section 4.2.1 above). Further, due to the absence of information concerning the duration of the prepolymerisation stages it is impossible to understand precisely how the data of D6 were obtained, which consequently makes it impossible evaluate the validity and reliability of the interpolation on which the correlation of the viscosity measurements was carried

out (see section XIII.(c) above).
Accordingly not only does the evidence of D6 not correspond to a repetition of the teaching of comparative example 4 of D1 but it also fails to provide a complete disclosure of what was in fact done. Hence the evidence of D6 is not suitable to show to the required standard of proof (cf T 793/93 cited above) the inevitable outcome of carrying out the teaching of D1. As a result this evidence does not support the contention of the appellant/opponents that the viscosity of the prepolymer obtained in comparative example 4 of D1 is in the range specified in operative claim 1.

4.2.8 In connection with D6 a request was made that an accompanying person be allowed to speak at the oral proceedings (see section XIII.(c) above).

(a) According to G 4/95, it is required that the request for permission for oral submissions to be made by an accompanying person should state the name and qualifications of the accompanying person and should specify the subject-matter of the proposed oral submissions (G 4/95 Order 3.(b).(i)). It is also required that the request be made sufficiently in advance of the oral proceedings so that all opposing parties are able properly to prepare themselves in relation to the proposed oral submissions (Order 3.(b).(ii)).

(b) In the present case the attendance of the accompanying person, Ms Saeki was announced in a letter dated 21 April 2009, i.e. more than a month before the oral proceedings. In this letter it was stated that Ms Saeki was "Manager of the Intellectual Property Department of Asahi Kasei Corporation". No further details of the qualifications of Ms. Saeki were provided. As regards the subject-matter of the proposed submissions, it was requested that the accompanying persons be permitted "to speak with regard to technical matter in support of submissions made by the undersigned representative".

(c) Whilst in some cases, for example where the accompanying person is identified as being the inventor, this information might be considered sufficient to establish both the qualifications and - at least in general terms - the subject-matter of the proposed submissions (cf T 910/06 of 10 December 2008, not published in the OJ EPO, reasons 5.9.5), this does not apply when the accompanying person is, as in this case, identified solely as an employee of an opponent or an affiliated company of the opponent which employee further is not identified as performing a technical function associated with the subject-matter of the patent in suit, nor as having had any involvement, even peripherally, in the preparation of the disputed experimental data (D6). As a consequence of this, it would not have been possible in advance of the oral proceedings to understand - even in general terms - with respect to which technical aspects the requested submissions were to be made.

(d) Under these circumstances the Board could only come to the conclusion that the preconditions set out in G 4/95 were not met and as a consequence refuse to authorise Ms Saeki to make oral submissions.

4.2.9 The conclusion is therefore that the experimental data provided according to D6 has not been shown to any extent, let alone to the high standard of proof required by the Case Law (cf T 793/93 cited above) to be a correct replication of the disclosure of the prior art in question and hence D6 cannot lead to the conclusion that the inevitable result of carrying out the teaching of comparative example 4 of D1 is subject-matter lying within the scope of operative claim 1.

4.2.10 D11, which was stated to be based on a mathematical calculation to be routinely used by appellant/OII (see sections VII and XIII.(c) above) consists of a table of values giving relative viscosity (left hand column) and intrinsic viscosity.
A similar set of data is provided in paragraph [0033] of the patent in suit with respect to the finished polymer i.e. the product of the polycondensation. According to this disclosure relative viscosities of about 17, about 35 and about 40 correspond, respectively to intrinsic viscosities of about 0.55 dl/g, 0.85 dl/g and 0.91 dl/g. The data points given in the patent are in agreement with those given in the table D11.
Notwithstanding the question of whether the data of the table D11, which as noted appear to relate to the final polymer would even be applicable to the prepolymer, it is noted that an intrinsic viscosity of 0.26 dl/g, i.e.

the value disclosed in comparative example 4 of D1 is not disclosed in D11. The closest value given is 0.261271 which is stated to correspond to a relative viscosity of 4.36242. The adjacent values for intrinsic viscosity, i.e. 0.252725 and 0.269771 are stated to correspond to relative viscosities of 4.02685 and 4.69799.

Thus according to the data of D11 an intrinsic viscosity of 0.26 dl/g can be estimated to correspond to a relative viscosity of approximately 4.36. This is however below the minimum of 5 specified in operative claim 1.

Accordingly based on the data of D11 it must be concluded that comparative example 4 of D1 does not disclose a process within the scope of operative claim 1 since the required viscosity of the prepolymer is not attained.

4.2.11 In summary two approaches have been advanced by the opponents in support of the objection of lack of novelty. Of these one, namely D6, has not been shown to be a correct and faithful replication of the disclosure of the prior art of interest, and therefore fails to establish the properties of the product resulting from the disclosed example of the prior art. The consequence is that D6 cannot establish that the prepolymer of comparative example 4 of D1 exhibits the viscosity required for the prepolymer according to operative claim 1. The second set of data, i.e. D11 has been submitted to be reliable, which submission is supported by comparison thereof with the data in paragraph [0033] of the patent. D11 however demonstrates that the intrinsic viscosity disclosed in comparative example 4 of D1 corresponds to a relative viscosity lying below 5

and hence outside the scope of claim 1.
The conclusions is that neither D6 nor D11 establish that the subject-matter of operative claim 1 is anticipated by the disclosure of comparative example 4 of D1.

4.2.12 This conclusion cannot be altered by the request of the appellant/OII to withdraw D11 (see section V.(c) above). The fact of the matter is that D11 formed part of the proceedings from the outset and forms part of the public file. Whilst a party may choose not to rely on a particular piece of evidence in the file the Board is not aware of any legal mechanism for removing arbitrarily or by simple preference of that party elements of evidence already cited and forming part of the proceedings. On the contrary by analogy with the finding of T 270/94 of 22 January 1998 (not published in the OJ EPO), reasons 2.1, D11 formed part of the legal and factual framework within which the examination of the opposition was to be conducted. Pursuant to Art 113(1) EPC each party must be allowed to comment on any evidence legitimately submitted in the proceedings. Allowing one party, even the party having originally submitted that evidence unilaterally and arbitrarily to require such evidence to be excluded from consideration would infringe this right.
In the present case, moreover, for the reasons given the remaining piece of evidence relied upon (D6) leads to the conclusion that the subject-matter of comparative example 4 of D1 does not anticipate the subject-matter of operative claim 1. D11 contains no information which would result in a modification of this conclusion. Hence insofar as the consideration of

novelty is concerned, neglecting the evidence provided by D11 would not change the conclusion reached.

4.2.13 Objections were also raised with respect to examples 5-8 of D1 (see section VIII above). In this respect the Board notes that these examples do not disclose the intrinsic viscosity of the prepolymer obtained. Further, since these examples employed different proportions of starting materials to comparative example 4 it was not possible to assume, as canvassed by the appellant/opponents that the viscosity of the prepolymer would be identical to that reported in comparative example 4.

4.2.14 With regard to the submissions of appellant/OII that the viscosity of the prepolymer was merely an intermediate value, without import for the final product and hence should be disregarded in the consideration of novelty, (see section XIII.(c) above), it is recalled that operative claim 1 is directed not to the final product, but to a process. One of the characterising features of this process is the viscosity of the prepolymer (feature (c) of claim 1). If the prepolymer does not have the required viscosity then the consequence would be that the process was not according to claim 1 and hence not according to the invention. Accordingly the feature of claim 1 defining the viscosity of the prepolymer is a technical feature defining the claimed invention and consequently cannot be disregarded in the assessment of novelty.

4.2.15 It was also submitted by appellant/OII at the oral proceedings that it was not correct to restrict consideration of novelty to the disclosure of the examples of D1 but that instead the entire disclosure thereof should be considered (see section XIII.(c) above). However, D1 is not limited to continuous processes but, according to paragraph [0020] can be carried out either as a batch or as a continuous process. However the general part of the disclosure of D1 does not refer to the intrinsic viscosity of the product of the prepolymerisation which, insofar as it is disclosed in the (comparative) examples of D1 has not been shown to correspond to the relative viscosity required by operative claim 1.

4.2.16 It is therefore concluded that the subject-matter of operative claim 1, and consequently also of the dependent claims 2-15 is novel with respect to the disclosure of D1.
No other documents have been cited as anticipating the subject-matter of the operative claims.

4.2.17 Accordingly the claims of the first auxiliary request meet the requirements of Art. 54 EPC.

4.3 *Art. 56 EPC*

4.3.1 *The patent in suit, the technical problem*

The patent in suit relates, according to paragraph [0001], to a continuous process for the production of PTT. The process can be used as part of a three vessel process, the first vessel being either an ester exchanger or a vessel for direct esterification, the second vessel being a prepolymeriser and the third vessel being a final polymeriser or finisher.
According to the survey of the prior art presented in

the patent in suit there was known a continuous process for the production of PET (i.e. poly(ethylene terephthalate)), reference being made to the document designated D3 in the present procedure. A batch process for the production of PTT was known, reference being made to the document identified above as D9. Further reference is made to the above mentioned D17 as disclosing an atmospheric pressure process for the production of PTT.

According to paragraph [0005] the aim of the patent is to provide a continuous three-vessel process for the production of PTT, and in particular one in which the production of by-products, acrolein and allyl alcohol being specifically mentioned, is minimized and the molecular weight of the final PTT is maximised.

This problem is stated to be solved by the process according to claim 1.

The prepolymerisation stage is discussed commencing at paragraph [0016] of the patent in suit. According to paragraph [0022] 1,3-propanediol vapour is a by-product of the reaction and is the driving force for the operation of the prepolymeriser. This is driven off from the prepolymeriser by the combination of heat and vacuum. In paragraph [0026] it is explained that the 1,3-propanediol vapours exiting the prepolymeriser contain other reaction by-products, acrolein and allyl alcohol being specifically mentioned. It is further stated that it is desirable that the production of these by-products be minimised such that the amount of acrolein contained in the condensed 1,3-propanediol stream exiting the prepolymeriser is no greater than 20ppm and the amount of allyl alcohol is no greater than 170 ppm.

Similarly, with respect to the polycondensation, which is discussed in the passage commencing at paragraph [0030] of the patent in suit, it is explained in paragraph in paragraph [0034] that 1,3-propanediol and other by-products are removed from the finisher by vacuum. In paragraph [0035] it is taught that the amount of acrolein contained in the condensed 1,3-propanediol stream exiting the finisher, i.e. the polycondenser, is no greater than 80 ppm and that the amount of allyl alcohol in said stream is no greater than 1000 ppm. These requirements are not specified in operative claim 1, i.e. are not mandatory features of the claimed invention.

In all except two examples (examples 10 and 22) the amounts of by-products in the vapour stream exiting the precondenser are within the desirable ranges indicated in the description, and that in these cases the amounts thereof in the vapour stream exiting the polycondenser is nevertheless within the desirable ranges indicated. Similarly with respect to the polycondenser all except two examples (14 and 15) report contents of by-products within the range indicated as desirable in the description.
It can thus be concluded that the technical problem as set out in the patent in suit is solved by the process according to claim 1.

4.3.2 *The prior art*

(a) D4, which was held in the decision under appeal to represent the closest state of the art (see section III.(c) above) relates to a batch process for preparing PTT. This process employs the step of carrying out a direct esterification of 1,3-

propanediol and terephthalic acid with a titanium catalyst; blocking the catalyst by addition of a phosphorus-oxygen compound and carrying out the pre- and polycondensation steps. According to the examples the condensation steps are carried out under reduced pressure, with the vacuum being increased to transition from the pre- to the polycondensation phases) (col. 4 lines 15, 16).
According to the teaching of D4 the inactivation of the esterification catalyst results in a reduction in the amount of allyl alcohol and acrolein formed (col. 1 lines 28-43, col. 2 lines 23-33, and col. 5 lines 1-13).
According to the examples of D4 the content of by-products in the resulting polymers is 3-5 ppm acrolein and 1.7-2.4 ppm allyl alcohol.
In the patent in suit the content of these by-products is given in the by-product streams, not in the polymers. According to the information given by the patent proprietor at the oral proceedings before the Board - which was not contested by the appellants/opponents (see section XIII.(d) above) - the proportion of by-product in the polymer is ca. 10% of that detected in the vaporous by-product streams. Based on this it can be calculated that the lowest content of the by-products acrolein and allyl alcohol present in the polymers produced according to the examples of the patent in suit is 0 ppm (example 4)) and 0.911 (example 12) respectively, i.e. below that exemplified in D4. Therefore, contrary to the submission of the appellants/opponents at the oral proceedings (see section XIII.(d) above) the

process of the patent does not represent a worsening compared to the teaching of D4.

(b) D17, which was referred to for the first time in the appeal proceedings (see section V.(c) above) discloses according to claim 1 a process for preparing PTT by polymerising bis(3-hydroxy propyl) terephthalate or low molecular weight oligomers thereof, with the production of propylene glycol (i.e. 1,3-propanediol as explained at col. 3 line 18 of D17) and other - non-specified - volatile reaction by-products. The process is conducted at atmospheric pressure or above by contacting the indicated starting materials in melt form with a stream of inert gas, the condensation by-products being removed by the inert gas (D17, column 4 lines 28-49).
According to the section entitled "Technical Background" known processes for the production of polyesters from terephthalic acid or its esters and glycols required the use of vacuum conditions to remove the condensation by-products especially glycols, which was technically complicated and costly. Hence the aim of D17 was to provide a less costly polymerisation process that could be carried out at atmospheric pressure, in a closed loop configuration and eliminated volatile organic emissions (D17 col. 1 lines 15-34).
In column 7 a continuous process for preparing PTT is discussed, with reference to figure 1. This process involves the steps of preparing an oligomer, subjecting this to prepolymerisation and then to final polymerisation. A stream of inert gas is injected into the final polymeriser

("finisher"). The inert gas flows through the finisher to remove volatile reaction by-products, stated to be mainly propylene glycol. This inert gas stream then flows to the prepolymerisation column removing volatile reaction by-products - again stated to be mainly propylene glycol. Upon exiting the prepolymerisation column the gas steam enters the glycol recovery system where it is scrubbed and glycol recovered.

According to the embodiment depicted in figure 2 of D17 the inert gas flows counter-currently to the flow of reactants. This is explained in the passage commencing at col. 8 line 59 of the description of D17.

D17 has two examples, both of which relate to a batch process. Example 1 discloses a process carried out in a test-tube whilst example 2 employs the laboratory apparatus depicted in figure 2.

In both examples the monomers are placed in the reaction vessel and reacted to form the polymer. The prepolymerisation and final polycondensation steps are, in contrast to the process according to the operative claims, carried out in the same vessel, the transition between the stages being effected by modification of the conditions, primarily the temperature. In both examples the reaction is stopped once the viscosity increases to such an extent as to prevent effective mixing (D17 col. 10 lines 44-46 and col. 11 lines 38-39). Further, insofar as the general exposé of D17 relates to a continuous process, there is no disclosure of the removal of streams of gaseous by-products from the pre- and polycondensation stages. Instead, as explained above with reference to figures 1 and 2, and to an extent example 2, the inert gas serves to sweep the by-products from the final polymerisation stage back through the system to the prepolymerisation stage, i.e. as submitted by the appellant/patent proprietor at the oral proceedings before the Board (see section XIII.(d) above) in the process in D17 by-products were in fact introduced to the reaction zones. This is in contrast to the process according to the patent in suit which emphasises the need to remove by-products from the precondensation stage in order to drive the reaction to completion (see patent in suit, paragraph [0022]).

Further the starting point of D17 is processes which are operated under vacuum conditions and the express aim of D17 is correspondingly to avoid the need for vacuum conditions, as explained in the paragraph entitled "Technical Background" in col. 1 of D17.

Thus, D17 does not employ a vacuum, and insofar as it divides the reaction into stages of prepolymerisation and polycondensation, does not remove gaseous streams of by-products from the reaction system at each stage of the reaction but passes the by-product stream back through the system by means of the inert gas stream. Further, D17 does not exemplify a continuous mode of operation. Finally D17 refers generally to by-products which are only specified as being mainly propylene glycol but contains no disclosure relating specifically to acrolein and allyl alcohol.

4.3.3 *The closest state of the art*

As follows from the foregoing sections 4.3.1 and 4.3.2, the patent in suit is directed to a continuous process, operated under vacuum conditions, for the preparation of PTT in which the production of by-products, acrolein and allyl alcohol being specifically identified, is reduced by means of removal thereof from the reaction system.

During the appeal proceedings the opposing parties relied on different documents as a starting point for the assessment of inventive step. Whereas appellant/OI initially regarded D4 as the closest state of the art (see section V.(b) above) in common with the decision under appeal (see section III.(c) above), appellant/OII (see section V.(c) above) and the appellant/patent proprietor (see section VII above) preferred to start from the teaching of D17.
In view of this situation and although the Board tends to the view of the opposition division that D4 is the closer state of the art, the Board sees no alternative than to address the matter from each point of view.

4.3.4 *The objective technical problem compared to D4, its solution*

As noted above the results of the process of D4 and that of the patent in suit as regards by-product concentration are comparable (see section 4.3.2(a) above). Thus compared to D4 the objective technical problem to be solved can be formulated as the provision of a further such process for the production of PTT.

This problem was solved by employing a continuous process as specified in operative claim 1.

4.3.5 *Obviousness of the claimed solution with respect to the disclosure of D4*

D4 does not relate - even in general terms - to a continuous process. On the contrary, the process of D4 is carried out solely on a batch basis, relying, as noted in section 4.3.2(a) above on the step of inactivating the esterification catalyst prior to commencing the condensation steps.

This inactivation of the catalyst is the only means suggested in D4 of reducing the amount of acrolein and allyl alcohol produced. In fact the inactivation of the catalyst which according to D4 is achieved by the addition of a phosphorous/oxygen compound, such as phosphoric acid, itself implies an interruption of the polymerisation reaction, which is incompatible with continuous operation. Further D4, unlike the patent in suit (or indeed D17), does not explicitly refer to removal of by-products from the reaction system despite the fact that the process is carried out under vacuum. Finally, D4 does not contain any recognition that the feature that the process is carried out under vacuum with removal of by-product streams contributes to reducing the formation of allyl alcohol and acrolein by-products in the polymer. Quite to the contrary, the reduction of the amount of acrolein and allyl alcohol formed is achieved in D4 exclusively by chemical means (the blocking of the catalyst) and not by adjustment of the processing conditions. Consequently there is nothing in the disclosure of D4 which would suggest that the same result could be achieved by any other means, let alone specifically with the measures forming the solution to the technical problem according to the claim 1 of the patent in suit. In summary, and in contrast to the submission of the Appellant OII (see section V.(c) last paragraph, above) there is no recognition in D4 that inactivation of the catalyst - an essential feature of D4 - could be dispensed with and the same effect achieved with "normal process conditions" of any kind, let alone specifically those defined according to the operative claims. Accordingly the teachings of D4 taken on their own cannot render the claimed subject-matter obvious.

4.3.6 Although Appellant OI canvassed a combination of the teachings of D4 and D17 as leading to the claimed subject-matter, there are several obstacles to such a combination for the following reasons.

(a) Whereas the process exemplified in D4 is carried out under vacuum, that of D17 is mandatorily carried out at atmospheric pressure.

(b) Whereas the solution to the technical problem requires removal of the gaseous by-products under vacuum, which removal drives the reaction equilibrium forwards i.e. toward the formation of polymer whilst removing the acrolein and allyl alcohol formed, the continuous process discussed in D17 by contrast feeds the by-products of polymerisation, specifically propanediol, back through the system to the prepolymeriser where it might be expected to drive the equilibrium backwards i.e. away from the formation of polymer. This is diametrically opposed to the disclosure of

D4 and of the patent in suit and in any case evidently militates against the achievement of the technical solution, namely maximising the molecular weight whilst minimising the formation of by-products.

(c) Quite apart from the above, D17 makes no mention of the specific undesirable by-products acrolein and allyl alcohol mentioned in D4 and the patent in suit. Nor is there any indication in D17 of an attempt to reduce the quantity of by-product produced in its process. Quite to the contrary, the by-products are simply led in countercurrent to the reactants and removed physically from the system.

(d) Consequently, the skilled person would have no reason apart from hindsight of the subject-matter claimed in the patent in suit for supposing that the process of D17 would offer any benefit in a conceptual modification of the process of D4.

(e) Even if the skilled person were nevertheless to consider a combination of D4 (vacuum process) and D17 (atmospheric pressure process) there is no teaching or guidance in D17 as to how the process of D4, which it is emphasised requires the step of deactivation of the catalyst, could be converted to continuous operation. There is in particular no teaching in D17 which would lead the skilled person to adapt the process of D4 to develop a process having the essential features of the process as claimed, namely operation under reduced pressure with removal of gaseous streams of by-products at two points and the requirement that the product of the prepolymerisation should attain a certain minimum relative viscosity.

(f) Consequently even a combined consideration of the disclosures of D4 and D17 cannot lead in an obvious way to the claimed solution of the technical problem.

4.3.7 During the course of the proceedings it was argued that it would have been evident to the skilled person that the process of D4 could be converted from a batch process to a continuous process, reference being made to the combination of D4 with D2 and/or D3 (see sections V.(b) and XIII.(d), final section above). However D2 and D3 relate to continuous processes for the preparation of a different polymer, namely PET and do not contain any teachings specifically with respect to PTT. The appellant/patent proprietor submitted in this connection that the skilled person would not consider teachings relating to PET since this polyester had different properties from PTT (see section VII above).

Nor has it been shown by the appellants/opponents that the process requirements of PET and PTT were comparable to the extent that teachings relating to process conditions for one type of polyester would be applicable, without modification, to the other. Hence the appellants/opponents have failed to establish that it would be obvious *prima facie* even to consult D2 or D3 in order to seek teachings with respect to modifying the process of D4, in particular with regard to conversion thereof to continuous operation.

Further it has not been shown that even if D2 or D3 were to be consulted these would provide the teaching necessary to arrive at the process now claimed, in particular the features of removal of by-products from the reaction system at the indicated stages and the required minimum viscosity of the prepolymer.

4.3.8 It therefore has to be concluded that the subject-matter of the operative claims does not result in an obvious way from the disclosure of D4, either taken alone or in combination with other documents, specifically D17, D2 or D3.

4.3.9 As noted in section 4.3.3, above, D17 has also been canvassed as representing the closest state of the art.

(a) D17 however does not refer to the technical problem solved according to the patent in suit, i.e. that of minimizing the production of the by-products acrolein and allyl alcohol and maximising the molecular weight and contains no examples which provide any data with respect to these properties whatsoever, let alone in the context of a continuous process.
In this connection, the argument of appellant/OI that it was implicit in D17 that acrolein and allyl alcohol by-products would be removed together with propanediol (section XIII.(d) above) begs the question because the propanediol is **not** removed from the process but fed in countercurrent back into it (see section 4.3.2(b) above).

(b) Due to the absence of a disclosure of such relevant data in D17 it is not possible, on the basis of relevant performance comparisons, to formulate an objective technical problem to be solved with respect to the disclosure thereof in terms even remotely similar to those applicable to D4 (See sections 4.3.1, 4.3.2(a) and 4.3.4 above).

(c) On the contrary, although the process of D17 has some apparatus features in common with that of the patent in suit, the crucial character of its operation is, for the reasons given in sections 4.3.6(a)-(e) above, so different from that of the patent in suit that it can be said not to relate to the solution of the same technical problem.
According to the principles developed in T 644/97 of 22 April 1999 (not published in the OJ EPO), the technical problem arising from a "closest state of the art" disclosure which is irrelevant to the claimed subject-matter in the sense that it does not mention a problem that is at least related to that derivable from the patent specification has a form such that its solution can practically never be obvious, because any attempt by the skilled person to establish a chain of considerations leading in an obvious way to the claimed subject-matter gets stuck at the start. It follows that the respective claimed subject-matter is non-obvious in the light of such art (T 644/97, Reasons 2.6.3 and Catchword).

(d) In the light of the foregoing considerations it has to be concluded the subject-matter of the operative claims is not obvious in the light of the disclosure of D17.

4.3.10 The conclusion is therefore that the subject-matter of operative claim 1 is not rendered obvious by the disclosure of D4 or D17, either alone or in combination with each other or with other documents.

4.3.11 The subject-matter of claim 1 of the first auxiliary request therefore meets the requirements of Art. 56 EPC. This conclusion applies to the subject-matter of the dependent claims 2-15.

5. Under these circumstances it is not necessary to consider the second auxiliary request.

Order

For these reasons it is decided that:

1. The main request of the appellant/patent proprietor is refused.

2. The appeals of the appellants opponent I and opponent II are dismissed.

3. The case is remitted to the first instance with the order to maintain the patent in amended form in the version upheld by the opposition division in its decision dated 24 October 2006 and posted 5 December 2006, corresponding to the first auxiliary request filed during the oral proceedings on 24 October 2006.

The Registrar:	The Chairman
E. Görgmaier	R. Young