

Internal distribution code:

- (A) Publication in OJ
(B) To Chairmen and Members
(C) To Chairmen
(D) No distribution

D E C I S I O N
of 20 April 2005

Case Number: T 1248/03 - 3.3.3

Application Number: 96945580.7

Publication Number: 0866824

IPC: C08G 65/20

Language of the proceedings: EN

Title of invention:

Alkanolysis of polyether polyol esters by reactive distillation

Patentee:

E.I. DU PONT DE NEMOURS AND COMPANY

Opponent:

BASF Aktiengesellschaft, Ludwigshafen

Headword:

-

Relevant legal provisions:

EPC Art. 56

RPBA Art. 10(a)(2), 10(b)(1)

Keyword:

"Inventive step (yes)"

Decisions cited:

T 0013/84, T 0229/85, T 0326/87, T 0686/91

Catchword:

-



Case Number: T 1248/03 - 3.3.3

D E C I S I O N
of the Technical Board of Appeal 3.3.3
of 20 April 2005

Appellant: BASF Aktiengesellschaft, Ludwigshafen
(Opponent) -Patentabteilung - C6-
Carl-Bosch-Strasse 38
D-67056 Ludwigshafen (DE)

Representative: -

Respondent: E.I. DU PONT DE NEMOURS AND COMPANY
(Proprietor of the patent) 1007 Market Street
Wilmington
Delaware 19898 (US)

Representative: Freiherr von Wittgenstein, Arved, Dr.
Patentanwälte Abitz & Partner
Postfach 86 01 09
D-81628 München (DE)

Decision under appeal: Decision of the Opposition Division of the
European Patent Office dated 29 July 2003 and
posted 24 October 2003 rejecting the opposition
filed against European patent No. 0866824
pursuant to Article 102(2) EPC.

Composition of the Board:

Chairman: R. Young
Members: C. Idez
H. Preglau

Summary of Facts and Submissions

I. The grant of the European patent No. 0 866 824 in the name of E.I. Du Pont de Nemours and Company in respect of European patent application No. 96 945 580.7 filed on 5 December 1996 and claiming the priority of US patent application No. 572556 filed on 14 December 1995 was announced on 28 February 2001 (Bulletin 2001/09) on the basis of 8 claims.

Independent Claim 1 read as follows:

"A method for converting the diester of a polyether polyol to a corresponding dihydroxy polyether polyol comprising the steps of:

(a) feeding to the upper portion of a distillation column at least one diester of polyether polyol and an effective amount of at least one alkali metal or alkaline earth metal oxide, hydroxide or alkoxide catalyst and with a C₁ to C₄ alkanol to convert said diester of polyether polyol to dihydroxy polyether polyol;

(b) adding to the lower portion of said distillation column hot alkanol vapor to sweep any alkanol ester formed by alkanolysis of said diester of polyether polyol upwardly in said distillation column;

(c) recovering overhead of said distillation column alkanol and alkanol ester formed by alkanolysis; and

(d) recovering from the bottom of said distillation column dihydroxy polyether polyol free of alkanol ester formed by alkanolysis."

Claims 2 to 8 were dependent claims.

II. A Notice of Opposition was filed against the patent by BASF Aktiengesellschaft on 28 November 2001. The Opponent requested complete revocation of the patent based on Article 100(a) EPC (lack of inventive step) and on Article 100(b) EPC (insufficient disclosure).

The opposition was supported by the following documents:

D1: JP-A-54 119 405 (English translation thereof);
D2: DE-A-2 820 521;
D3: Diagramme dynamischer Viskositäten von PTHF/Methanol (a diagramm showing dynamic viscosities of THF/Methanol);
D4: EP-A-0 040 724;
D5: US-A-4 584 414;
D6: US-A-4 230 892; and
D7: US-A-5 298 530.

III. By a decision announced orally on 29 July 2003 and issued in writing on 24 October 2003 the Opposition Division rejected the opposition.

IV. According to the decision of the Opposition Division, the grounds of opposition raised by the Opponent i.e. lack of inventive step and insufficiency of disclosure did not prejudice the maintenance of the patent as granted.

Concerning Article 100(b) EPC, the decision held that the requirements of Article 83 EPC were met, since a concrete example was disclosed in the patent in suit. On the basis of this example, parameters like the number of plates and the residence time of reactants could be measured and adapted to different types of columns and processes.

Concerning inventive step: the decision held that taking either D5 or D6 as closest prior art, the subject-matter of the patent in suit could not be rendered obvious in view of D5 and/or D6 since these documents were both concerned with discontinuous processes which were focussed on the reduction of the contamination of the polytetramethylene glycol by catalyst residues. There was no hint that a continuous reaction distillation process could be considered.

The decision further stated that D1 and D2 could also be used as closest state of the art. These documents were both concerned with the reaction distillation of monomeric tetramethylene ether glycol diacetate in order to obtain monomeric tetramethylene ether glycol. According to the decision, D1 did not explicitly disclose the addition of methanol in the upper portion of the reaction column, and further required countercurrent measures. D2 did not mention the additional feed of methanol at the lower part of the column, which was an essential feature of the process according to the patent in suit. Thus, the Opposition Division came to the conclusion that D1 and/or D2 even combined with D5 or D6 could not lead to the claimed process.

V. A Notice of Appeal was filed on 17 December 2003 by the Appellant (Opponent) with simultaneous payment of the requested fee. With the Statement of Grounds of Appeal filed on 3 March 2004, the Appellant submitted the following document:

D8: Diagrams concerning the transesterification of Polytetrahydrofurane diacetate and the transesterification of butanediol diacetate, as well as the standard EN ISO 3681.

The arguments submitted by the Appellant may be summarized as follows:

(i) Document D1 was the document which exhibited the most technical features in common with the process of the patent in suit.

(ii) According to the decision of the Opposition Division, D1 differed from the claimed process by the following features:

(a) D1 was concerned with monomeric diesters;

(b) no additional methanol was fed with the diester, and methanol was not fed in excess;

(c) D1 required countercurrent measures; and

(d) a further distillation step was necessary in D1 to obtain the diol in a purity higher than 99,0 Mol%.

(iii) Since the process of the patent in suit did not differ in terms viscosity and reactivity (cf. D8) from

that of D1 in an unexpected manner, feature (a) could not justify inventive step.

(iv) The ratio of added methanol to diester was not mentioned in Claim 1. Thus, feature (b) was not precisely disclosed. Furthermore, it could be determined without inventive activity in view of the well known rules governing transesterification reactions.

(v) The countercurrent measures appeared to refer to a recycling. This step was carried out for separating the azeotropic mixture at the head of the distillation column. This step was not related to the transesterification.

(vi) Furthermore, in the process of the patent in suit as in the process of D1, the diester was in countercurrent with the alkanol. Thus, step (c) could not justify inventive step.

(vii) The degree of purity of the obtained product and the degree of conversion of the diester did not represent technical features of the claimed process. They only represented the result to be achieved.

(viii) Thus, feature (d) could not justify inventive step.

VI. In its letter dated 22 November 2004, the Respondent (Patentee) argued essentially as follows:

(i) A person skilled in the art would have assumed that higher viscosities and other factors would make it

impossible to apply the process of D1 to polymeric substances.

(ii) According to D1, methanol was added in the middle of the column only when sodium hydroxide was used as catalyst, and then only in the amount needed to dissolve the catalyst.

(iii) In contrast, according to the patent in suit an excess of methanol was fed in the upper portion of the column.

(iv) According to D1 part of the reaction product was circulated to the top of the distillation column. This step was not required in the claimed process. This step was necessary in D1 for improving the efficiency of the reaction and not for splitting the azeotropic mixture.

VII. With its letter dated 2 March 2005, the Appellant submitted 9 new documents referred to as D9 to D17:

D9: DE-A-2 425 761;

D10: "The Nobel Prize in Chemistry 1974" Internet document from Nobelprize.org (2003);

D11: Paul. J. Flory, "Kinetics of Polyesterification: A study of the Effects of Molecular Weights and Viscosity on Reaction Rate" Journal of Applied Chemical Science, Vol. 61 (1939); pages 3334-3340;

D12: R.Senzyo et al "Ueber die spezielle Reaktionsfähigkeit der beiden Endgrupe von langer Kette";
Bull. Chem. Soc. Jpn; Vol. 25; No. 5; (1952);
pages 312-314;

- D13: Ullmann's Encyclopaedia of Industrial Chemistry; Fifth, Completely Revised Edition; Vol. A 10; VCH Verlagsgesellschaft mbH (1987); pages 23-25;
- D14: K. Peter C. Vollhardt "Organische Chemie" VCH Verlagsgesellschaft mbH (1988); pages 826-827;
- D15: P. Dreyfuss, "Poly(tetrahydrofuran)", Gordon and Breach Science Publishers (1982); pages 188,189, 218 and 219;
- D16: Ullmann's Encyclopaedia of Industrial Chemistry; Fifth, Completely Revised Edition; Vol. B4; VCH Verlagsgesellschaft mbH (1992); pages 321-323;
- D17: Graph showing the dependency of reaction constant K on reaction temperature.

It also argued essentially as follows:

(i) Document D9 which related to a continuous process for the manufacture of diol (e.g. butanediol) by transesterification of a diester thereof in a distillation column clearly disclosed the following technical features:

(a) feeding a mixture of diester, alkanol and catalyst in the upper part of the column;

(b) feeding alkanol vapour in the lower part of the column;

(c) the component fed in the upper part and the alkanol fed in the lower part being in counter current; and

(d) the molar ratio alkanol/diester being between 1 to 10.

(ii) The skilled person would have applied the well known transesterification process of butanediol in reaction distillation column (cf. D9 or D1) to the transesterification of polyether polyol with a reasonable expectation of success, since there was no substantial difference in viscosity and reactivity between diester of butanediol and diester of polytetramethylene glycol (cf. D10, D11, D12).

(iii) Starting from D5 or D6 which related to the transesterification of polyether polyol in cascade reactor the skilled person looking for an easier and more economical process would have try to carry this process in a reaction distillation column. As shown by documents D16 and D17 reaction distillation column were particularly suitable for carrying out equilibrium reactions such as transesterification of polyether polyols.

VIII. Oral proceedings were held on 20 April 2004 before the Board.

At the oral proceedings, the Appellant having indicated that it no longer pursued the ground of opposition under Article 100(b) EPC, the discussion was essentially focussed on (i) the admission into the proceedings of the documents D9 to D17 submitted by the Appellant with its letter dated 2 March 2005, and (ii) on the assessment of inventive step.

Concerning point (i):

Following the preliminary observation by the Board that new Article 10b of the Rules of Procedure of the Boards

of Appeal of the European Patent Office (cf. OJ EPO 2003, 061) would apply to the present case, since the Notice of Appeal had been filed after the 1 May 2003, the Parties made the following submissions which could be summarized as follows:

(i.a) By the Appellant:

(i.a.1) In view of the arguments presented by the Respondent in its letter dated 22 November 2003, a further search had become necessary and the resulting documents had been submitted as soon as possible.

(i.a.2) The late filing of documents D9 to D17 was, hence, not deliberate and could not amount to a tactical abuse.

(i.a.3) Furthermore, documents D10 to D16 merely illustrated the common general knowledge.

(i.b) By the Respondent:

The Respondent argued that the documents D9 to D17 had been cited at a very late stage and that they were in any case not relevant.

The Board, having informed the Parties that documents D9 to D17 would not be admitted into the proceedings, the discussion on inventive step was essentially based on the documents D1, D5, and D6.

The arguments presented by the Parties could be summarized as follows:

(ii.a) By the Appellant:

(ii.a.1) Starting from D5 or D6 as the closest state of the art, the technical problem might have been seen in the provision of a process for transesterification of esters of polyether polyols being less energy demanding than cascade reactors, and having a higher efficiency.

(ii.a.2) It belonged to the general knowledge of the skilled person that the use of reaction distillation was more favourable in terms of energy consumption.

(ii.a.3) It also belonged its general knowledge that the use of a reaction distillation column was suitable for carrying out equilibrium reactions, such as transesterifications.

(ii.a.4) It was further known from D1 to use a reaction distillation column for the transesterification of butanediol diacetate with methanol.

(ii.a.5) The skilled person knew that the thermodynamical characteristics of the reaction between polytetramethylene glycol and methanol (i.e. reaction constant; activation energy; time to reach equilibrium) was similar to those of the reaction of butanediol diacetate with methanol (cf. D8) and that the viscosity of mixtures of methanol with polytetramethylene glycol was close to that of butanediol (cf. D3).

(ii.a.6) It was also obvious to use an excess of methanol in order to increase the degree of conversion of the esters of the polyether polyol. In that respect, the lower degree conversion observed in the comparative

example of D1 in which the recirculation step was not used was only related to the lesser amount of methanol in the reaction column.

(ii.a.7) Thus, the claimed process was obvious in view of the combination of D5/D6 with D1, taking into account the general knowledge of the person skilled in the art.

(ii.a.8) D1 would represent the most appropriate starting point for the assessment of inventive step. Starting from D1, the technical could be seen in the extension of this process to further transesterification reactions.

(ii.a.9) In view of the similarity in reactivity and viscosity between the reaction mixture of D1 and that of the patent in suit, it would have been obvious to apply the process of D1 to the transesterification of esters of polyether polyols.

(ii.b) By the Respondent:

(ii.b.1) The technical problem underlying the patent in suit had been defined on the basis of D5/D6 (cf. column 1, line 45 to column 2; line 6 of the patent in suit).

(ii.b.2) The skilled person would disregard the teaching of D1 since it would have been expected that the reaction kinetics of the transesterification reactions could not be similar in view of the difference in molecular weight between the diester of butanediol and the ester of polyether polyol, and in

view of the differences in viscosity of the reaction mixtures.

(ii.b.3) This had been also acknowledged by the Opponent in its Notice of Opposition (cf. page 6, last three lines thereof).

(ii.b.3) Documents D3 and D8 were not available at the priority date of the patent in suit.

(ii.b.4) Furthermore, it could have been expected that the presence of ether groups in the polyether polyol might lead to different reactions.

IX. The Appellant requested that the decision under appeal be set aside and the European patent No. 866 824 be revoked.

The Respondent requested that the appeal be dismissed and that the patent be maintained.

Reasons for the Decision

1. The appeal is admissible.

2. *Procedural matters*

2.1 As mentioned above in Section V above, the Notice of Appeal of the Appellant was received on 17 December 2003. Consequently the new Rules of Proceedings of the Boards of Appeal (below RPBA) according to the decision of the Administrative Council of 12 December 2002 (OJ EPO 2003, 61) apply to the present case.

- 2.2 In that context, according to Article 10(a)(2) RPBA, the statement of grounds of appeal shall contain a party's complete case, shall set out clearly and concisely the reasons why the decision under appeal is challenged or supported and should contain, expressly or by specific reference to material filed in the first instance proceedings, all the facts, arguments and evidence relied on, and according Article 10(b)(1) RPBA, any amendment to a party's case after it has filed its grounds of appeal may be admitted and considered at the Board's discretion, and this discretion "shall be exercised in view of *inter alia* the complexity of the new subject matter submitted, the current state of the proceedings and the need for procedural economy" (emphasis by the Board).
- 2.3 It thus follows that the filing of nine new documents, i.e. documents D9 to D17 by the Appellant with its letter dated 2 March 2005 indisputably represents an amendment to its case in the sense of Article 10(b)(1) RPBA and that the admission of these documents is, hence, at the discretion of the Board.
- 2.4 While Article 10(b)(1) RPBA mentions factors such as the complexity of the new subject-matter, the current state of the proceedings, and the need for procedural economy which might be taken into account by the Board when exercising its discretion, it does not give a restrictive list thereof. In the Board's view, the introduction by a Party of new facts or evidence at a very late stage of the appeal proceedings without cogent reasons for the delay, would also justify it to

make use of its discretion according to Article 10(b)(1) RPBA not to admit them.

2.5 In the present case, the Board notes that the Opposition Division has, in substance, considered in its decision that the inventive step of the subject-matter of Claim 1 could not be challenged taking either documents D1/D2 or documents D5/D6 as closest prior art.

2.6 While, in the Board's view, it is justified that a party which has lost in the opposition proceedings tries in the appeal proceedings to fill a presumed missing link, i.e. in the present case by trying to demonstrate that the method disclosed in D1/D2 for ester of monomeric alcohols is, in its view, obviously applicable to the esters of polyether polyols, or by trying to show that the use of a reaction distillation column is, in its view, an obvious alternative to the use of cascade reactors disclosed in D5/D6 by filing additional documents in order to improve its position with respect to the issue of inventive step, so that the filing of additional documents could be seen as a reaction to the decision of the Opposition Division, this should be made at the earliest possible moment, i.e. in accordance with Article 10(a)(2) RPBA, namely with the submissions of the Statement of Grounds of Appeal in order to present a complete case.

2.7 In that respect, the Board notes, in view of the letter of 2 March 2005 of the Appellant, that documents D10 to D14 were cited in support of the objection of lack of inventive step based on document D1 and/or on new document D9 as closest state of the art, and that documents D15 to D17 were cited in support of the

objection of lack of inventive step based on documents D5/D6 as closest state of the art.

2.8 In this connection, the Board, however, observes that documents D10 to D16 have been said by the Appellant, to belong to the general knowledge of the skilled person, and that D9 is a German patent application belonging to the same technical field in which a Japanese patent application (i.e. D1) and a German patent application (i.e. D2) have been previously found.

2.9 Thus, the Board can only come to the conclusion that there were no specific difficulties of obtaining documents D9 to D16, which might have rendered plausible their belated submissions (cf. T 326/87; OJ EPO 1992, 522). The same is even more true for document D17 which is based on own experiments of the Appellant concerning the kinetics of the transesterification.

2.10 Nor could the late filing of documents D9 to D14 be justified, as argued by the Appellant at the oral proceedings, by the submissions made by the Respondent in its letter dated 22 November 2004,

(i) firstly since this letter was not accompanied with amended sets of claims or new documents in order to counter the reasoning of the Appellant in view of D1 taken as closest state of the art,

(ii) secondly, the mere fact that the Respondent in its letter, in substance, contested the applicability of the process of D1 to polymeric substances cannot be considered as an open invitation for the Appellant to file additional documents on that aspect, and

(iii) since, thirdly, D9 to D14 could indeed have already been submitted by the Appellant, for the sake of completeness according to Article 10(a)(2) RPBA, in support of its main argument concerning the alleged applicability of the process of D1 to the esters of polyether polyols as set out in its Statement of Grounds of Appeal.

2.11 The same is even more true for the filing of documents D15 to D17 in support of the objection of lack of inventive step on the basis of D5/D6 as closest state of the art, because this issue was absolutely not dealt with in the letter dated 22 November 2004.

2.12 Thus, under these circumstances, the Board sees no justification for the late filing of documents D9 to D17 and makes use of its discretion not to admit them according to Article 10(b)(1) RPBA.

Main request

3. *Sufficiency of disclosure*

3.1 The sufficiency of disclosure of the subject-matter of the patent in suit has been acknowledged by the Opposition Division and has not been challenged by the Appellant in the course of the written appeal procedure. Furthermore, at the oral proceeding before the Board, the Appellant indicated that it no longer pursued this ground of opposition.

3.2 The Board is also satisfied that the requirements of Article 83 EPC are met by all the claims.

4. *Problem and solution*

4.1 The patent in suit relates to a continuous process for the alkanolysis of polyether polyol.

4.2 According to both the decision under appeal and the Appellant document D1 can represent the closest state of the art.

4.3 D1 relates to the preparation of 1,4-butanediol or 2-butene-1,4-diol by reacting acetic acid ester of 1,4-butanediol or 2-butene-1,4-diol with methanol in the presence of basic catalyst such as sodium hydroxide, the acetic ester of the diol in a liquid state being continuously fed to the distilling tower from the middle stage of the tower, preferably, together with the catalyst dissolved in methanol, and the methanol being fed from the lower stage, thus allowing the methanol and the diester to contact with each other counter-currently for a gas/liquid reaction (Claim 1; page 9, lines 13 to 18). As further stated in D1, a part of the reaction product containing the diol obtained from the bottom of the distilling tower is recirculated to the upper stage of the distilling tower, thereby recovering from the top of the distilling tower methyl acetate free of methanol (Claim 1).

4.4 While it might be true, as submitted by the Appellant in its Statement of Grounds of Appeal, that the process disclosed in document D1 exhibits the greatest number of operative technical features in common with the subject-matter of the patent in dispute, it remains, however, undisputable that D1 does not refer to a

process for the production of polyether polyol by alkanolysis of esters thereof.

4.5 In contrast to D1, such process is disclosed in documents D5 and D6, both referred to in the patent in suit at column 1, line 45 of the description.

4.6 Document D5 relates to a method for preparing poly(tetramethylene ether) glycol (PTMEG) from poly(tetramethylene ether) diester by alcoholysis with the aim of reducing the contamination of the obtained PTMEG with residue catalyst.

According to D5, a mixture of poly(tetramethylene ether) diester starting material, catalyst and an alkanol is first prepared. This may be done by simply bringing the components together in a reactor. Preferably, the catalyst is first slurried in the alkanol and this slurry then mixed with a solution of the diester in the alkanol. The diester starting material will ordinarily be a diacetate. The catalyst used may be any alkali metal hydroxide or alkoxide, sodium hydroxide being preferred. The alkanol used may be one containing 1-4 carbon atoms, and will preferably be methanol.

The mixture is prepared so that it contains

- (a) diester, 5-80% by weight, preferably 20-60%;
- (b) alkanol, 20-95% by weight, preferably 40-80%; and
- (c) catalyst, about 1-25 mol percent based on the diester, preferably 8-20 mol percent. The reaction mixture is brought to its boiling point and held there, with stirring, while vapours of the alkanol-alkyl ester azeotrope are continuously withdrawn from the reaction zone. In the usual case, the boiling point of the

mixture will be in the range of about 50°C-150°C. This boiling and withdrawal of azeotrope is continued until alcoholysis is substantially complete, i.e., until no more alkyl ester is detected in the distillate being removed, as determined by gas chromatography.

At this point, a slight excess over the stoichiometric amount of an acid such as acetic acid is added to the reaction mass, with stirring. The mass is then brought to a temperature of 100°C-150°C and a pressure of less than 50 mm of Hg to remove unreacted alkanol and acid. The product is then filtered to remove the solid catalyst-acid reaction product. The resulting PTMEG may contain as little as 2 ppm of alkali metal (column 1, line 29 to column 2, line 19).

- 4.7 Document D6 relates to a process for converting a poly(tetramethylene ether) diester to PTMEG, the process comprising (A) preparing a mixture of (1) a poly(tetramethylene ether) diester having a pH of about 7, (2) an alkanol of 1-4 carbon atoms, and (3) 1-25 mol percent, based on the diester, of a catalyst which is an oxide or hydroxide of calcium, strontium or barium; (B) bringing the mixture to its boiling point and holding it there while the vapours of the alkanol/alkyl ester azeotrope which form are continuously removed from the reaction zone, until conversion is substantially complete; and then (C) removing the catalyst, and optionally the residual alkanol and residual alkyl ester, from the reaction mass (Claim 1). According to D6, the process can be conducted batchwise or in continuous fashion. The continuous mode is preferred for its efficiency, and although the process can be run in a single stage, it is preferably run in

two or more stages, especially when run continuously, because this gives a higher degree of conversion. The continuous multi-stage process is run exactly as the one-stage process except that the contents of the first reactor are transferred sequentially to the others, where alcoholysis is completed in continuous fashion (Column 2, lines 36-45).

- 4.8 As stated in the decision T 0686/91 of 30 June 1994 (not published in OJ EPO), a document not mentioning a technical problem that is at least related to that derivable from the patent specification, does not normally qualify as a description of the closest state of the art on the basis of which the inventive step is to be assessed, regardless of the number of technical features it may have in common with the subject-matter of the patent concerned.
- 4.9 Since, as disclosed in the specification of the patent in dispute, its object is to provide an improved method for the manufacture of polyether polyols by alkanolysis of polyether polyol esters in terms of energy consumption and of degree of conversion in comparison with previously suggested processes such as those disclosed in D5 and D6 (cf. column 1, line 45 to column 2, line 15), it thus follows that D1 which is not concerned at all with the alkanolysis of polyether polyol esters cannot for the reasons indicated above in paragraph 4.8 qualify as the closest state of the art.
- 4.10 While documents D5 and D6 could be regarded as equally qualified to be used as closest prior art, document D6, which expressly refers to the use of a continuous process, would constitute, in the Board's view, a more

appropriate starting point for the assessment of inventive step than document D5.

- 4.11 Starting from D6, the technical problem might be seen as indicated in the patent in suit, in the provision of a less energy demanding process for the manufacture of polyether polyols by alkanolysis of esters thereof and allowing higher conversion rates.
- 4.12 The solution proposed according to Claim 1 of the patent in suit is to carry out the alkanolysis of the polyether polyol esters in a distillation reaction column under the specific conditions set out in Claim 1.
- 4.13 In view of the Example of the patent in suit which shows that a conversion of 99.9% is achieved, the Board is satisfied that the technical problem has indeed been solved by the claimed measures and this fact has not been challenged by the Appellant.

5. *Inventive step*

- 5.1 It remains to be decided whether the proposed solution was obvious in respect to the cited prior art.
- 5.2 As it appears from the disclosure of D6 (cf. point 4.3 above), this document relates to the use of cascade reactors for the alkanolysis of polyether polyol esters and cannot evidently suggest itself the solution proposed in the patent in suit.
- 5.3 Nor could D5 provide a hint to the solution of the technical problem, since it is focussed on the avoidance of catalyst residues in the obtained

polyether polyol and since it merely refers to a batch process in one stirred reactor.

- 5.4 Nevertheless, at the oral proceedings, the Appellant further relied on the combination of documents D6/D5 with document D1 in order to challenge the inventive step of the subject-matter of Claim 1.
- 5.5 In that respect, the Appellant submitted, in substance, that it belonged to the common general knowledge of the skilled person that the use of a reaction distillation column was generally more favourable than the use of cascade reactors in terms of energy consumption and that such apparatus is suitable for carrying out equilibrium reactions, such as transesterification reaction as further evidenced by D1. Consequently, the use of distillation reaction column would, in its opinion, have constituted an obvious alternative to the process disclosed in either D6 or D5 taking into account the thermodynamical (e.g. reactivity, time to reach the equilibrium, or activation energy) and physical (i.e. viscosity of reaction components) similarities between the transesterification reaction of diester of polytetramethylene glycol and that of diester of butanediol as shown in documents D3 and D8.
- 5.6 Even if it were accepted that reaction distillation reaction columns are generally more favourable in terms of energy consumption and are suitable for carrying out equilibrium reactions, although there is no evidence for this on file, the Board firstly notes that document D1 relates only to the transesterification of diacetic esters of butanediol or of butenediol, i.e. of

monomeric compounds, with methanol in a reaction distillation column.

5.7 Thus, in the Board's opinion, the skilled person would have reasonably expected that polymeric compounds, having in principle a higher viscosity than monomeric components would exhibit a different behaviour in a distillation reaction column, where as indicated in D1 (Claim 1) a gas-liquid contact reaction takes place.

5.8 This reasonable expectation could not be altered by the statements of the Appellant based on document D8 that the kinetics of the reaction of butanediol diacetate with methanol would be similar to that of the reaction of polytetramethylene glycol diacetate with methanol, and on document D3 that mixtures of polytetramethylene glycol with methanol would have a low viscosity at 75°C,

(i) firstly, because D8 compares the kinetics of the reactions in the liquid phase while, as indicated above, D1 clearly refers to a gas-liquid contact reaction, and

(ii) secondly, because documents D3 and D8, being both based on experiments made by the Appellant after the publication date of the patent in suit, there is no evidence that such data was also available to the skilled person before the priority date of the patent in suit, so that these statements would amount to *ex post facto* considerations made in the knowledge of the invention.

5.9 Furthermore, the Board notes that comparative Example 1 of D1, which is carried out without recirculating the reaction product as required by the process of D1,

shows that the reaction product obtained at the bottom of the column contained only 93% by mol butanediol and a high amount of acetic ester of butanediol. This implies, in the Board's view, that this recirculation step is an essential feature of the process of D1 in order to obtain a high conversion rate of the diester into butanediol. In contrast to D1, the process of the patent in suit allows a very high conversion rate without the need of such recirculating step.

5.10 In that respect, the Appellant has argued that the lower conversion rate observed in the comparative Example of D1 would have been merely related, according to the Le Chatelier's principles governing equilibrium reactions, to a lesser amount of methanol in the distillation column for the reaction with the diester of the butanediol in the absence of recirculation. In the Board's view, this argument cannot be considered as pertinent since the recirculated product not only contains methanol but mainly butanediol which would, according to the same principles, negatively affect the conversion rate.

5.11 For these reasons, the Board comes to the conclusion that the combination of D6 with D1, even in the light of the alleged but not substantiated general knowledge of the skilled person referred above in paragraph 5.5, cannot render obvious the subject-matter of Claim 1 of the patent in suit, since there is no indication in these documents for the skilled person that the reaction distillation process would be adapted to the transesterification reaction of polyether polyols, let alone that it would allow a very high conversion of the

polyether polyol ester (e.g. up to 99.9% as shown by the Example of the patent in suit).

- 5.12 Document D2, which relates to the manufacture of alcohols such as butanediol or butenediol by transesterification of esters thereof by an alkanol such as methanol, is even less relevant than D1 since it does not teach to introduce the alkanol in the gas form in the lower part of the column (cf. D2, claims 1-4; Figure). Hence, it cannot provide a hint to the solution of the technical problem.
- 5.13 Document D4 which deals with the manufacture of acetic acid esters and document D7 which refers to a process for recovering components from scrap polyester are far more remote so that they can be of no help for solving the technical problem.
- 5.14 Thus, it follows that the subject-matter of Claim 1 of the patent in suit does not arise in an obvious manner from the cited prior art relied on by the Appellant.
- 5.15 One would have come to the same conclusion, even if for sake of argument, one would have considered, as done by the Appellant, D1 as the closest state of the art for the following reasons:
- (i) Starting from D1, the Appellant has tried to reformulate the technical problem as the extension of the applicability of the process of D1 to further transesterification reactions.
- (ii) In that context, it is firstly evident that this definition of the technical problem would not be

admissible, since it cannot be deduced from the patent in suit (cf. T 13/84, OJ EPO 1986, 253), and since it would contain a pointer to the solution adopted (cf. T 229/85, OJ EPO 1987, 237); and, secondly,

(iii) even if one would consider this technical problem as admissible, it would not have been obvious, for the same reasons indicated above in paragraphs 5.7 and 5.8 above, to apply the process of D1 to the transesterification of esters of polyether polyols, let alone to delete the essential recirculating step of this process for the reasons set out in paragraphs 5.9 and 5.10 above.

5.16 Consequently, the Board comes to the conclusion that the subject-matter of Claim 1, and by the same token that of dependent Claims 2 to 8 meet the requirements of Article 56 EPC.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

E. Görgmaier

R. Young