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Datasheet for the decision
of 26 September 2007

Case Number:	T 0879/05 - 3.3.03
Application Number:	99106793.5
Publication Number:	0949282
IPC:	C08F 297/00
Language of the proceedings:	EN

Title of invention:
Process for producing isobutylene block copolymer

Patentee:
KANEKA CORPORATION

Opponent:
BASF Aktiengesellschaft, Ludwigshafen

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (main request - no)"
"Inventive step (first and second auxiliary requests - no)"

Decisions cited:
T 0002/83

Catchword:
Combining teachings (Reasons 5.7 to 5.13)

Case Number: T 0879/05 - 3.3.03

DECISION
of the Technical Board of Appeal 3.3.03
of 26 September 2007

Appellant:
(Opponent)

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Decision under appeal:

Decision of the Opposition Division of the European Patent Office dated 13 April 2005 and posted 29 April 2005 rejecting the opposition filed against European Patent No. 0949282 pursuant to Article 102(2) EPC.

Composition of the Board:

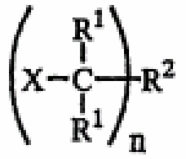
Chairman: R. Young
Members: C. Idez
H. Preglau

Summary of Facts and Submissions

I. The grant of the European patent No. 0 949 282 in the name of Kaneka Corporation in respect of European patent application No. 99 106 793.5 filed on 6 April 1999 and claiming JP priorities of 7 April 1998 (JP 9447298) and of 29 March 1999 (JP 8669699) was announced on 16 October 2002 (Bulletin 2002/42) on the basis of 9 claims.

Claim 1 read as follows:

"A process for producing an isobutylene block copolymer, which comprises performing cationic polymerization of a monomer component containing isobutylene as a major monomer for a polymer block composed of isobutylene as a major monomer and a monomer component whose major monomer is not isobutylene for a polymer block in which major monomer is not isobutylene in the presence of a compound represented by the following general formula (1) acting as an initiator and generating a carbon cation in the presence of a Lewis acid.



$$\left(X-\underset{R^1}{\overset{R^1}{C}}- \right)_n R^2 \qquad (1)$$

wherein
plural R^1 are the same or different and represent a hydrogen atom or a monovalent hydrocarbon group having one to six carbon atoms;

R^2 represents a monovalent or polyvalent aromatic hydrocarbon group or a monovalent or polyvalent aliphatic hydrocarbon group;
X represents a halogen atom, an alkoxyl group having one to six carbon atoms or an acyloxyl group having one to six carbon atoms;
n is equal to a valence number of R^2 and represents an integer of one to six; and plural X may be the same or different if n is two or more;
wherein
said polymerization is carried out in a mixed solvent containing a monohalogenated hydrocarbon solvent and a non-halogenated hydrocarbon solvent, said monohalogenated hydrocarbon solvent comprising a primary monohalogenated hydrocarbon having three to eight carbon atoms and/or a secondary monohalogenated hydrocarbon having three to eight carbon atoms, said non-halogenated hydrocarbon solvent comprising at least one member selected from the group consisting of hexane, cyclohexane, methylcyclohexane and ethylcyclohexane."

Claims 2 to 9 were dependent claims.

II. On 15 July 2003, a Notice of Opposition against the patent was filed by BASF AG.
The Opponent requested revocation of the patent in its entirety on the grounds of lack of novelty and lack of inventive step (Article 100(a) EPC).

The opposition was supported by the following documents:

Dl: US-A-4 946 899;
D2: EP-A-0 722 957; and

D3: Polymer Preprints, A. Chem. Soc., Div. of Pol. Chem., 1995, 36 (2), pages 176 and 177.

III. By a decision orally announced on 13 April 2005 and issued in writing on 29 April 2005, the Opposition Division rejected the opposition.

According to the decision, the Opposition Division decided not to introduce either the tests submitted by the Patent Proprietor with its letter dated 19 May 2004 or the tests submitted by the Opponent with its letter dated 14 February 2005. The Opposition Division did not admit the introduction of the ground of opposition under Article 100(b) EPC raised by the Opponent at the oral proceedings.

According to the decision, the subject-matter of the granted claims was novel over documents D1, D2 and D3. Concerning inventive step, D1 was considered as the nearest prior art document, the difference between the teachings of Dl and the patent in suit being the use of a different solvent mixture.
Starting from D1, the objective problem was seen in the provision of a process for producing an isobutylene block copolymer using a solvent mixture giving better results in respect of phase separation and less harmful renovation of waste water while obtaining an isobutylene block copolymer having a molecular weight distribution at least as narrow as that of the isobutylene block copolymers according to D1.
According to the decision, the examples of the patent in suit showed that this objective problem was solved.

According to the decision, D1 did not recommend to choose the specific solvent combination according to the patent in suit, document D2 was merely directed to a process for producing an isobutylene homopolymer or a random copolymer and D3 taught a process for producing an isobutylene block copolymer using a single solvent instead of a mixture of methylcyclohexane and methyl chloride, which was one of the preferred solvent mixtures used in Dl.
Consequently, the Opposition Division came to the conclusion that neither Dl alone nor Dl in combination with D2 or D3 could take away the inventive step of the subject-matter of the claims as granted. Therefore the opposition was rejected.

IV. A Notice of Appeal was filed on 8 July 2005 by the Appellant (Opponent) with simultaneous payment of the prescribed fee.
With the Statement of Grounds of Appeal filed on 9 September 2005, the Appellant submitted an experimental report.

It also argued essentially as follows:

(i) Document D1 represented the closest state of the art.

(ii) Starting from D1, the technical problem might be seen in the provision of a process which was easier to operate and whose waste waters contained less halogenated hydrocarbons.

(iii) It was not contested that this problem was effectively solved.

(iv) D2 taught to use a combination of a primary and/or secondary monohalogenated hydrocarbon with 3 to 8 carbon atoms with an aliphatic hydrocarbon (e.g. hexane cyclohexane, methylcyclohexane) and/or aromatic hydrocarbon as solvent in a process for (co)polymerization of isobutylene (page 4, lines 47 to 51).

(v) These solvents exhibited low water solubility and allowed an easy phase separation between organic and aqueous phases (page 2, line 54 to page 3, line 3).

(vi) According to the decision under appeal, the skilled person would not have combined D1 and D2, since D2 did not refer to block copolymers of isobutylene.

(vii) The disclosure of D1 however encompassed the solvent mixture according to the patent in suit.

(viii) Although D1 did not explicitly disclose a combination of n-butyl chloride with methylcyclohexane or hexane, the skilled person would have expected that similar block copolymers would be obtained when using such solvent mixture.

(ix) There was no hence prejudice against the combination of D1 with D2.

(x) Furthermore it was clear from the submissions of the Patent Proprietor (cf. letter of 8 April 2005; page 2, last paragraph) that block copolymers with constant properties could not be obtained over the whole scope of the claims of the patent in suit, since the properties depended on the solvent used.

(xi) If the properties of the obtained block copolymers were to be considered when assessing inventive step, this would raise the question of the comparison basis.

(xii) The comparison made in the examples of the patent in suit was not valid since the reaction speed was not the same.

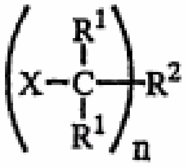
(xiii) The experimental report showed that the problem of providing block copolymers with a narrower polydispersity was not solved.

(xiv) The subject-matter of Claim 1 would also be obvious in view of the combination of D3 (taken as closest state of the art) with D1.

V. With its letter dated 27 January 2006, the Respondent (Patentee) submitted two auxiliary requests.

The first auxiliary request consisted of 10 claims. Claim 1 thereof read as follows:

"A process for producing an isobutylene block copolymer, which comprises performing cationic polymerization of a monomer component containing isobutylene as a major monomer for a polymer block composed of isobutylene as a major monomer and a monomer component whose major monomer is not isobutylene for a polymer block in which major monomer is not isobutylene in the presence of a compound represented by the following general formula (1) acting as an initiator and generating a carbon cation in the presence of a Lewis acid.



$$\left(X-\overset{R^1}{\underset{R^1}{C}} \right)_n R^2$$

(1)

wherein
plural R^1 are the same or different and represent a hydrogen atom or a monovalent hydrocarbon group having one to six carbon atoms;
R^2 represents a monovalent or polyvalent aromatic hydrocarbon group or a monovalent or polyvalent aliphatic hydrocarbon group;
X represents a halogen atom, an alkoxyl group having one to six carbon atoms or an acyloxyl group having one to six carbon atoms;
n is equal to a valence number of R^2 and represents an integer of one to six; and plural X may be the same or different if n is two or more;
wherein
said polymerization is carried out in a mixed solvent containing a monohalogenated hydrocarbon solvent and a non-halogenated hydrocarbon solvent, the content of said monohalogenated hydrocarbon solvent amounts 10 to 98 wt% based on the total weight of the mixed solvent, said monohalogenated hydrocarbon solvent comprising a primary monohalogenated hydrocarbon having three to eight carbon atoms and/or a secondary monohalogenated hydrocarbon having three to eight carbon atoms, said non-halogenated hydrocarbon solvent comprising at least

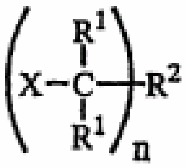
one member selected from the group consisting of hexane, cyclohexane, methylcyclohexane and ethylcyclohexane."

Claims 2 to 9 of the first auxiliary request corresponded to Claims 2 to 9 as granted. Dependent Claim 10 read as follows:

"The process according to claim 1, wherein the content of said monohalogenated hydrocarbon solvent amounts 20 to 90 wt% based on the total weight of the mixed solvent".

The second auxiliary request consisted of 8 claims. Claim 1 thereof read as follows:

"A process for producing an isobutylene block copolymer, which comprises performing cationic polymerization of a monomer component containing isobutylene as a major monomer for a polymer block composed of isobutylene as a major monomer and a monomer component whose major monomer is not isobutylene for a polymer block in which major monomer is not isobutylene in the presence of a compound represented by the following general formula (1) acting as an initiator and generating a carbon cation in the presence of a Lewis acid.



$$\left(X - \overset{\displaystyle R^1}{\underset{\displaystyle R^1}{C}} \right)_n R^2 \qquad (1)$$

wherein

plural R^1 are the same or different and represent a hydrogen atom or a monovalent hydrocarbon group having one to six carbon atoms;
R^2 represents a monovalent or polyvalent aromatic hydrocarbon group or a monovalent or polyvalent aliphatic hydrocarbon group;
X represents a halogen atom, an alkoxyl group having one to six carbon atoms or an acyloxyl group having one to six carbon atoms;
n is equal to a valence number of R^2 and represents an integer of one to six; and plural X may be the same or different if n is two or more;
wherein
said polymerization is carried out in a mixed solvent containing a monohalogenated hydrocarbon solvent and a non-halogenated hydrocarbon solvent, said monohalogenated hydrocarbon solvent comprising a primary monohalogenated hydrocarbon having three to eight carbon atoms and/or a secondary monohalogenated hydrocarbon having three to eight carbon atoms, said non-halogenated hydrocarbon solvent comprising at least one member selected from the group consisting of hexane, cyclohexane, methylcyclohexane and ethylcyclohexane:
and
wherein
said monomer component whose major monomer is not isobutylene is a monomer component containing an aromatic vinyl monomer as a major monomer."

Dependent Claims 2 to 6, and 7 to 8 corresponded to granted Claims 2 to 6, and 8 to 9, respectively.

The Respondent also argued essentially as follows:

(i) Concerning the experimental report submitted by the Appellant on 9 September 2005:

(i.1) The Appellant had conceded that the data of the experimental report of 14 February 2005 were not correct due to a transmission error.

(i.2) The experimental report of 14 February 2005, which had been replaced by the new experimental report as filed on 9 September 2005, had to be left out of consideration.

(i.3) The content of the new experimental report and the facts to be demonstrated therewith were unclear. Reference was made in that respect to Guidance for parties to appeal proceedings and their representatives (OJ EPO, 2003, 424; point 2.3).

(i.4) Neither the patent in suit nor Dl disclosed or used phenyl tri-ethoxy silane (PTES) as electron donor as used in the new experimental report.

(i.5) The Appellant evidently wished to demonstrate that the problem of preparing block copolymers having a narrower molecular weight distribution than those of D1 was not solved.

(i.6) Since this was not the aim to be considered, and since the selection of the electron donor phenyl tri-ethoxy silane was not supported by the patent in suit and/or by Dl, the intended subject of demonstration had no relevance to the real objective problem underlying the patent in suit.

(i.7) The experimental report of 9 September 2005 should be left out of consideration.

(ii) Concerning novelty:

The Appellant had not contested novelty as acknowledged by the Opposition Division.

(iii) Concerning inventive step:

(iii.1) The technical effect as achieved by the method according to the patent in suit was to provide a process for producing an isobutylene block copolymer using a solvent mixture that provided better results in respect of phase separation and less harmful renovation of waste water than the known solvent mixture made of methylene chloride and non-polar solvent such as hexane or methylcyclohexane, while obtaining an isobutylene block copolymer having a molecular weight distribution at least as narrow as the molecular weight distribution of the isobutylene block copolymers obtained with the known solvent mixture.

(iii.2) The Appellant had stressed the fact that the polymerization times in Comparative Example 1 and in Example 2 were not the same.

(iii.3) However, reaction speed was not of relevance, since the patent in suit did claim the method of preparing isobutylene block copolymer comprising a distinctive reaction speed or polymerization period.

(iii.4) It was however important to note that the block copolymer of Example 2 had a comparable number-average molecular weight but a narrower molecular weight distribution than the block copolymer of Comparative Example 1. Furthermore separation of organic phase and aqueous phase was easier in Example 2.

(iii.5) D1 should be considered as the closest state of the art.

(iii.6) Dl recommended the use of the monohalogenated hydrocarbon solvent having one carbon atom while the patent in suit claimed the use of the primary or secondary monohalogenated hydrocarbon solvent having three to eight carbon atoms.

(iii.7) As stated in the decision under appeal, starting from Dl the technical problem was to be seen as providing a process for producing an isobutylene block copolymer using a solvent mixture that provided better results in respect of phase separation and less harmful renovation of waste water while obtaining an isobutylene block copolymer having a molecular weight distribution that is at least as narrow as the molecular weight distribution of the isobutylene block copolymers according to Dl.

(iii.8) The objective problem as stated by the Appellant was contested, since it did not include the feature of the narrow molecular weight distribution.

(iii.9) The Appellant had not presented any facts, evidence and arguments which should support the replacement of the objective problem stated by the Opposition Division by the objective problem presented by the Appellant.

(iii.10) D1 did not address the aspect of separation between organic phase and aqueousphase, and further the aspect of waste water recovery.

(iii.11) Furthermore, Dl recommended in a clear manner and beyond all doubt the use of the mixed solvent made of methylcyclohexane or cyclohexane with methylene chloride or methyl chloride.

(iii.12) D2 was not concerned with the process for producing isobutylene block copolymer. This had been accepted by the Appellant.

(iii.13) D2 could not provide a hint of how to modify the teaching of Dl in order to obtain isobutylene block copolymers having at least the narrow molecular weight distribution of the isobutylene block copolymers as obtained according to Dl. Reference was also made to the decision T 2/83 (OJ EPO 1984, 265).

(iii.14) The Appellant had referred to a so-called "generic disclosure" of Dl (column 4, line 63 to column 5, line 12).

(iii.15) When applying the could-would-approach on this passage, nothing would incite the skilled person, to deviate from the preferred recommendation (i.e. a mixture containing methylcyclohexane or cyclohexane with methylene chloride or methyl chloride) and to try a mixture containing a monohalogenated primary or secondary hydrocarbon, having 3 to 8 carbon atoms.

(iii.16) D3 tried to replace the mixed solvent by the single solvent n-butyl chloride. It pointed away from the teaching as presented with Dl and the patent in suit.

(iii.17) Should the Board not intend to confirm the decision of the Opposition Division, reconsideration was requested on the basis of an amended technical problem according to which the objective problem to be solved over Dl was providing a process for producing an isobutylene block copolymer using a solvent mixture that provided better results in respect of phase separation and less harmful renovation of waste water while obtaining an isobutylene block copolymer having a molecular weight distribution narrower than the molecular weight distribution of the isobutylene block copolymers according to Dl.

(iii.18) The Examples and Comparative Example as presented in the patent in suit proved said narrower molecular weight distribution.

VI. Oral proceedings were held on 26 September 2007 before the Board.

(i) The Appellant indicated, at the beginning of the oral proceedings, that it no longer pursued the ground of lack of novelty.

(ii) Following preliminary observations from the Board concerning the various formulations of the technical problem presented by the Respondent in its letter dated 27 January 2006, the discussion firstly focused on the question of the admission of experimental report submitted by the Appellant with its Statement of Grounds of Appeal on 9 September 2005. The arguments presented by the Parties in that respect may be summarized as follows:

(ii.1) By the Respondent:

(ii.1.1) Although the Respondent was still of the opinion that the claimed process allowed the manufacture of isobutylene block copolymers having a narrower molecular weight distribution than those obtained according to D1, this was, however, very hard to demonstrate, in particular since the Examples of D1 were not easily comparable with those of the patent in suit.

(ii.1.2) The Respondent had hence accepted the proposal made by the Opposition Division at the oral proceedings of 13 April 2005, that it would be sufficient to show that the molecular weight distribution of the obtained block copolymer would be at least as narrow as those of the block copolymers of D1, i.e. a less demanding technical problem.

(ii.1.3) In that context the Experimental Report was hence not relevant, since it intended to show that a narrower molecular weight distribution was not obtained.

(ii.1.4) Furthermore, the tests presented in that report had been carried under conditions which did not reflect the teaching of the patent in suit in terms of electron donor (PTES), of amount of catalyst (i.e. titanium tetrachloride), and amount of polar solvent in the solvent mixtures. All these parameters had a strong influence on the molecular weight distribution of the block copolymers. The tests were therefore not pertinent.

(ii.2) By the Appellant:

(ii.2.1) The experimental report had been submitted with the Statement of Grounds of Appeal.

(ii.2.2) There was no limitation in Claim 1 as granted concerning either the electron donor or the amount of catalyst.

(ii.2.3) There was also no limitation in Claim 1 concerning the mixing ratio of the halogenated solvent to the non halogenated solvent.

(ii.2.4) The aim of the experimental report was to show the dependency of the molecular weight distribution of the block copolymer on the ratio of halogenated solvent to non halogenated solvent, i.e. that neither the more demanding technical problem nor the less demanding technical problem relied on by the Respondent were solved over the whole range claimed.

(iii) The Board, after deliberation, having informed the Parties that the experimental report submitted by the Appellant on 9 September 2005 would be introduced into the proceedings, the discussion moved to the assessment of inventive step of the subject-matter of the main request (Claims as granted). While, also relying on the arguments presented during the written phase of the appeal, the Parties made additional submissions which may be summarized as follows:

(iii.1) By the Appellant:

(iii.1.1) Starting from D1 as closest state of the art, the technical problem, in its less demanding formulation, consisted in two partial problems:

(a) the problem of improving the separation of the aqueous and organic phases when recovering the block copolymers and the consequential treatment of the waste waters generated, and
(b) the problem of providing block copolymers with a molecular weight distribution at least as narrow as that of the block copolymers according to D1.

(iii.1.2) According to Respondent (cf. letter of 28 February 2004; passage bridging pages 12 and 13), the kind of the non isobutylene monomer had a great influence on the molecular weight distribution of the block copolymer.

(iii.1.3) Furthermore, according to the Respondent (cf. letter of 8 April 2005; page 2, last paragraph), the ratio of non polar solvent to polar solvent had a strong influence on the result of the living cationic polymerization.

(iii.1.4) In granted Claim 1, neither the kind of non isobutylene monomer nor the ratio of non halogenated to the halogenated solvent were defined.

(iii.1.5) Consequently, it was not credible that the second part of the technical problem was solved over the whole range claimed.

(iii.1.6) D2 dealt with the cationic living polymerization of isobutylene (co)polymers.

(iii.1.7) D2 taught to use specific mixtures of non halogenated solvent with halogenated solvent in order to improve the phase separation and the environmental treatment of the waste waters.

(iii.1.8) D2 (cf. Tables 1 and 2) also showed the influence of the content of non halogenated solvent in the mixture on the molecular weight distribution of the polyisobutylene polymers. Furthermore, this step corresponded to the first step according to the claimed process, i.e. the manufacture of the polyisobutylene block.

(iii.1.9) The solvent mixtures disclosed in D2 were encompassed by the general disclosure of the solvent mixtures useful in the process of D1 (column 4, line 63 to column 5, line 5).

(iii.2) By the Respondent:

(iii.2.1) D1 would represent the closest state of the art.

(iii.2.2) The claimed process aimed at obtaining block copolymers having a molecular weight distribution as narrow as that of the block copolymers of D1.

(iii.2.3) Following observations of the Board concerning the fact that D1 disclosed a molecular weight distribution of 1.05 to about 2, the Respondent indicated that the claimed process aimed at obtaining block copolymers having a molecular weight distribution in that range. It further indicated that a more demanding problem (i.e. obtaining isobutylene block copolymers having a narrower molecular might, however, eventually be considered in respect of the auxiliary requests.

(iii.2.4) The Examples of the patent in suit showed that the technical problem of providing a process enabling the production of block copolymers with a molecular weight distribution in the range disclosed in D1 was solved, since the molecular weight distribution of the block copolymers of Example 1 (i.e. 1.14) and of Example 2 (1.10) was clearly within the range disclosed in D1.

(iii.2.5) According to D1, mixtures of methyl cyclohexane or cyclohexane with methyl chloride or methylene chloride were particularly preferred (column 5, lines 8 to 12). There was no reason to depart from that teaching.

(iii.2.6) Moreover, D1 (cf. column 1, lines 53 to 68). would have dissuaded the skilled person from looking at documents dealing with random copolymers of isobutylene, since they were known to exhibit some deficiencies (e.g. vulnerable to oxidative degradation).

(iii.2.7) Document D2 was not concerned with block copolymers. Furthermore, the polyisobutylene polymers obtained in D2 were of low molecular weight in contrast to the polyisobutylene block in the block copolymers obtained according to the claimed process.

(iii.2.8) Thus, the skilled person would not have combined D1 with D2.

(iv) The Board, after deliberation, having informed the Parties that the main request of the Respondent was refused, the discussion moved to the examination of the first auxiliary request as submitted by the Respondent with its letter dated 27 January 2006. Following preliminary observations of the Board concerning the allowability of this request under Rule 57(a) EPC in view of dependent Claim 10 thereof which had no counterpart in the granted claims, the Respondent replaced this request by a new first auxiliary consisting of 9 claims. Claims 1 to 9 thereof corresponded to Claims 1 to 9 of the previous first auxiliary request. The Appellant, having indicated that it had no formal objections against the claims of these requests, the discussion then focused on the assessment of inventive step of the subject of the first and second auxiliary request. The arguments presented by the Parties in that respect may be summarized as follows:

(iv.1) By the Appellant:

(iv.1.1) Figure 1 and 2 of D2 disclosed the ratio of hydrocarbon solvent to halogenated solvent in order to obtain a narrow molecular weight distribution.

(iv.1.2) As indicated for the main request the step of producing the polyisobutylene polymer corresponded to the step of preparing the polyisobutylene block. The molecular weight distribution of that block was the determining factor for the molecular weight distribution of the block copolymer.

(iv.1.3) Concerning the second auxiliary request, D1 disclosed and exemplified the manufacture of polyisobutylene/polystyrene block copolymers.

(iv.2) By the Respondent:

(iv.2.1) Figures 1 and 2 of D2 concerned homopolymers of isobutylene and not block copolymers.

(iv.2.2) Following observations from the Board concerning the volume ratio of non polar solvent to polar solvent disclosed at column 5, lines 12 to 15 of D1, the Respondent, while conceding that this range of volume ratio would be encompassed by the range of weight ratio incorporated in Claim 1 of the first auxiliary request, submitted that the range disclosed in D1 was limited to the preferred solvent mixtures mentioned at column 5, lines 8 to 12).

(iv.2.3) Concerning the second auxiliary request, the Respondent indicated that the limitation to vinyl aromatic monomer as non isobutylene monomer had been made only in order to overcome the formal objection concerning the definition of that monomer (cf. point (iii.1.2 above).

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

The Respondent requested that the appeal be dismissed, or in the alternative that the decision under appeal be set aside and that the patent be maintained on the basis of the first auxiliary request as filed during the oral proceedings or on the basis of the second auxiliary request submitted with the letter dated 27 January 2006.

Reasons for the Decision

1. The appeal is admissible.

2. *Procedural matters*

2.1 As indicated above in Section IV above, the Appellant submitted with its Statement of Grounds of Appeal filed on 9 September 2005 a new experimental report.

2.2 As indicated above in Section paragraph V(i) above, the Respondent submitted in its letter dated 27 January 2006 that this new experimental report should not be taken into consideration. At the oral proceedings before the Board, the Respondent maintained its position that this experimental report should not be introduced into the proceedings.

2.3 In that context the Board firstly notes that in the Statement of Grounds of Appeal (cf. page 1, first two paragraphs and reference to the tests submitted on 14 February 2005 and to the submissions of the Patent

Proprietor of 8 April 2005), the Appellant, in line with the recommendations made in the "Guidance for parties to appeal proceedings and their representatives" (cf. preliminary remarks and point 2.3 first paragraph thereof), has justified the filing of this experimental report by the necessity to elucidate the influence of the ratio of polar solvent to non polar solvent in the solvent mixture on the properties of the obtained block copolymers e.g. on their molecular weight distribution.

2.4 Furthermore, this experimental report appears *prima facie* as highly relevant in view of the considerations made by the Opposition Division in its decision concerning the influence of the choice of a specific combination of halogenated and non halogenated solvent on the molecular weight distribution of the obtained block copolymers (cf. decision under appeal point 6.4).

2.5 Consequently, the Board, taking further into consideration that this experimental report has, in accordance with Article 10a(2) of the Rules of Procedure of the Boards of Appeal, been submitted with the Statement of Grounds of Appeal, sees no reason not to introduce it into the proceedings.

Main Request

3. *Novelty*

3.1 Novelty of the subject-matter of granted Claims 1 to 9 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 proceedings before the Board, the Appellant indicated that it no longer pursued this ground of opposition.

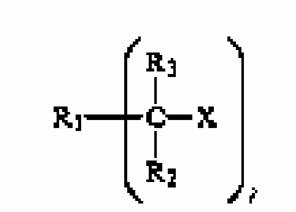
3.2 The Board is also satisfied that the requirements of Article 54 EPC are met by all the claims.

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

4.1 The patent in suit is concerned with a polymerization process for producing isobutylene block copolymer.

4.2 Such a process is known from document D1, which the Board in common with the Parties and the Opposition Division, considers as a suitable starting point for the assessment of inventive step of the claimed subject-matter.

4.3 D1 relates to a polymerization process for preparing isobutylene block copolymers. According to D1, the polymerization is conducted under conditions which would avoid chain transfer and termination of the growing polymer chains, i.e. anhydrous conditions are essential and reactive impurities, such as components containing active hydrogen atoms must be removed from both the monomer and solvents used. The temperature for the polymerization is usually between -10°C and -90°C. The midblock portion (i.e. polyisobutylene portion) of the thermoplastic elastomers of the invention is prepared in the presence of an initiator having the formula:



in which in which R_1, R_2 and R_3 are alkyl, aryl, or aralkyl groups and can be the same or different and X is a carboxyl, alkoxyl, hydroxyl or halogen group, and i is a positive whole number, and of Lewis acid such as titanium tetrachloride (column 3, lines 45 to column 4, line 32).

4.4 According to D1, the solvent used should preferably keep the polyisobutylene and the final block copolymer in solution and should provide a solvent medium having some degree of polarity in order for the polymerization to proceed at a reasonable rate. In order to fulfil these requirements a mixture of non polar and polar solvent is preferred. Suitable non polar solvents will include hydrocarbons and preferably aromatic or cyclic hydrocarbons such as methylcyclohexane, cyclohexane or toluene. Appropriate polar solvents include halogenated hydrocarbons, normal, branched chain or cyclic hydrocarbons, such as ethyl chloride, methylene chloride, methyl-chloride, n-butyl chloride, chlorobenzene, and other chlorinated hydrocarbons. To achieve suitable polarity and solubility, the ratio of the non polar solvent to the polar solvent, on a volume basis, should be from about 80/20 to about 50/50 (column 4, line 57 to column 5, line 15).

4.5 After obtaining the living polyisobutylene midblock of desired molecular weight and functionality, a suitable inherent electron pair donor having a donor number from about 15 to about 50, is added to the reaction medium. The addition of an electron pair donor is followed by the addition of the second monomer such as styrene or styrene derivative or indene or indene derivative, e.g. p-methylstyrene, p-tertiarybutylstyrene, p-chlorostyrene, indene, 6-methylindene, 5,7-dimethylindene, 4,6,7-trimethylindene. Formation of the end blocks at the polyisobutylene ends commences immediately upon addition of the aromatic monomer such as styrene or indene or their derivatives, or their mixtures, to the reaction mixture containing the mono-, di- or multifunctional polyisobutylene cations (column 5, lines 26 to 30; column 6, lines 28 to 35; lines 55 to 60).

4.6 According to D1, the molecular weight distribution of the polyisobutylene midblock is from 1.01 to 1.5, while the molecular weight distribution of the block copolymer can be between 1.05 and 2 (column 3, lines 19 to 30).

4.7 As can be understood from the patent in suit, its aim is to provide a process for the manufacture of isobutylene block copolymers having a narrow molecular weight distribution while enabling water washing of the obtained block copolymers to be carried out easily due to good separation of the aqueous phase and the organic phase and hence avoiding the discharge of halogenated solvent in the environment (cf. patent in suit paragraphs [0004], [0006] and [0044].

4.8 In that context, while one aspect of the technical problem starting from D1 may be seen in the achievement of a good phase separation and hence of a limitation of the discharge of chlorinated solvent in the environment, it is necessary, in the Board's view, to clarify the second aspect of this technical problem, i.e. the achievement of a "narrow" molecular weight distribution.

4.9 While it could have been considered that the aim of the claimed process was to obtain block copolymers with a narrower molecular weight distribution than those of D1, the Respondent has conceded that this would however be very hard to demonstrate, and has hence submitted that the molecular weight distribution of the block copolymers obtained by the process according to Claim 1 of the patent in suit should be as narrow as that of the block copolymers of D1, i.e. as further clarified by the Respondent, (cf. Section VI(iii.2.3) above), it should be in the range from 1.05 to 2 as disclosed in D1.

4.10 Under these circumstances, the Board can hence only consider that the second aspect of the technical problem is to provide a process allowing the manufacture of isobutylene block copolymers having a molecular weight distribution in the same range as those of D1.

4.11 The solution to the technical problem proposed by the patent in suit consists in carrying out the polymerization process in a specific solvent mixture comprising a monohalogenated hydrocarbon solvent and a non halogenated hydrocarbon solvent as defined in Claim 1.

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

4.13 In view of Examples 1 and 2 of the patent in suit which show that the claimed process allow the manufacture of isobutylene block copolymers with a molecular weight distribution of 1.14 (Example 1) and 1.1 (Example 2) and in which the phase separation was considered as good, the Board is satisfied that the claimed measures provide an effective solution to the technical problem.

5. *Inventive step*

5.1 It remains to be decided whether the claimed subject-matter was obvious to a person skilled in the art having regard to the relevant prior art.

5.2 While the solvent mixture according to Claim 1 of the patent in suit is not specifically mentioned in document D1, and while it is true, as submitted by the Respondent that solvent mixtures such as mixtures of methyl chloride or methylene chloride with cyclohexane, or methylcyclohexane are presented as particularly preferred in D1 (cf. column 5, lines 8 to 12), it still remains that mixtures of hydrocarbons such as methyl cyclohexane, cyclohexane and others, and halogenated hydrocarbons such n-butyl chloride, chlorobenzene and others are also presented as having a comparable suitability for enabling the manufacture of block copolymers having a molecular weight distribution in the range disclosed in D1.

5.3 Since the choice of the specific solvent mixture according to Claim 1 has not been presented to have any particular advantage with respect to the molecular weight distribution of the obtained block copolymers, over the solvents mixtures disclosed in D1 in that respect, the could/would approach, i.e. whether the skilled person would (or only "could") have chosen these specific mixtures in the expectation of some improvement or advantage (cf. T 2/83, referred to by the Respondent in Section V(iii.13) and V(iii.15) above) is therefore not applicable for this aspect of the technical problem.

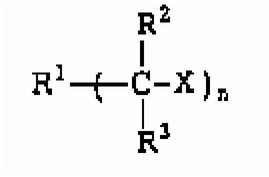
5.4 Consequently, this choice must be qualified as purely arbitrary with respect to the solution of the second aspect of the technical problem.

5.5 Thus, starting from D1, the question of inventive step boils down to the question as to whether the skilled person would (or only could) have chosen the specific solvent mixtures according to Claim 1 of the main request in the further expectation of having a good phase separation and hence a reduced discharge of chlorinated solvent in the environment.

5.6 In this connection, while it is true that this aspect of the technical problem is not as such mentioned in D1, the Board notes that document D2 relates to a process having a reduced impact on the environment for the manufacture of isobutylene polymer.

5.6.1 More precisely D2 refers to process for producing an isobutylene polymer, which comprises performing a cationic polymerization reaction in a polymerization solvent which contains primary and/or secondary monohalogenated hydrocarbon(s) having 3 to 8 carbon atoms (Claim 1). Said polymerization solvent may be a mixture of primary and/or secondary monohalogenated hydrocarbon(s) having 3 to 8 carbon atoms with aliphatic and/or aromatic hydrocarbon(s), such as butane, pentane, neopentane, hexane, cyclohexane, methylcyclohexane, heptane, octane, benzene, toluene and xylene (Claims 4 and 5).

5.6.2 The cationic polymerization is carried out at a temperature between 0°C and -100°C in presence of a Lewis acid, and a compound of formula (I):



$$R^1\!\left(\begin{array}{c} R^2 \\ | \\ C\!-\!X \\ | \\ R^3 \end{array}\right)_n$$

wherein R^1 represents an aromatic ring group, or a substituted or unsubstituted aliphatic hydrocarbon group; R^2 and R^3 may be the same or different and each represents a hydrogen atom, or a substituted or unsubstituted monovalent hydrocarbon group, provided that R^2 and R^3 do not represent a hydrogen atom at the same time when R^1 is an aliphatic hydrocarbon group; X represents a halogen atom, an R^4COO- group, in which R^4 represents a hydrogen atom or an alkyl group having 1 to 5 carbon atoms, or an R^5O- group, in which R^5 represents a hydrogen atom or an alkyl group having 1 to 5 carbon atoms; and n is an integer of from 1 to 8 (page 3, lines 16 to 33).

5.6.3 According to D2, while halogenated hydrocarbons having 1 or 2 carbon atoms, which can impart an appropriate dielectric constant to thereby stabilize the growth terminal or are excellent in the solubility of the polymer thus obtained, have been widely employed as solvents for cationic polymerization, these halogenated hydrocarbons having 1 or 2 carbon atoms however suffer from some problems such that they are poor in handling characteristics and that very careful attention should be paid to prevent the leakage into the environment (page 2, lines 21 to 25).

5.6.4 Thus, one object of D2 is to provide a novel solvent component which is capable of giving an excellent isobutylene polymer and less influential on the environment than halogenated hydrocarbons having 1 or 2 carbon atoms (page 2, lines 31 to 33).

5.6.5 According to D2, monohalogenated hydrocarbons having 3 to 8 carbon atoms have a smaller specific gravity due to a small halogen content and, therefore, the difference in the specific gravity between the organic layer and the aqueous layer during the washing step is enlarged, which facilitates the separation of these layers. Furthermore they also exhibit a lower water solubility (page 2, line 45 to page 3, line 5).

5.6.6 According to D2, by selecting the appropriate dielectric constant of the solvent mixture, isobutylene polymers with a narrow molecular weight distribution can be obtained (page 5, line 50 to page 6, line 19; cf. also Fig 1 and 2).

5.6.7 It follows from the above that D2 teaches how to obtain isobutylene polymers with a narrow molecular weight distribution by cationic polymerization in a solvent mixture comprising a halogenated hydrocarbon, while simultaneously solving the problem linked to the phase separation of the organic phase and hence to the discharge of halogenated solvent in the environment.

5.7 Consequently, the decisive question for the assessment of inventive step of the subject-matter of Claim 1 of the main request is whether the skilled person, starting from document D1, would have used the teaching of D2 in order to solve the technical problem underlying the patent in suit.

5.8 In that respect, the Respondent has argued against the combining of the teachings of D1 and D2, since D2 is not concerned with the manufacture of isobutylene block copolymers and, hence, the person skilled in the art faced with a problem in the field of block copolymers of isobutylene would not have looked for a solution in the field of isobutylene homopolymers or random copolymers, quite apart from the facts, that, in the Respondent's view, D1, cf. Section VI(iii.2.6) above) would have dissuaded the skilled person from doing so, and that D2 is concerned with isobutylene polymers of low molecular weight (cf. Section VI(iii.2.7) above).

5.8.1 In that respect, the Board, however, firstly observes that, contrary to the submissions of the Respondent, no prejudice against using technical teaching coming from the field of random copolymers can be discerned in D1, since the passage of D1 relied on by the Respondent for supporting that view (i.e. column 1, lines 53 to 68), does not at all relate to random copolymers but merely deals with some deficiencies (e.g. low glass transition temperature, vulnerability to oxidative degradation) of block copolymers such as polystyrene polybutadiene block copolymers.

5.8.2 The Board further observes that, independently of the fact that Claim 1 of the patent in suit contains absolutely no limitation in terms of molecular weight of the isobutylene block, the molecular weight (Mn) of the isobutylene polymer according to D2 can be in the range from 500 to 300 000 (page 6, lines 29 to 30) which range clearly overlaps not only with the range of molecular weight of the polyisobutylene midblock disclosed in D1, i.e. from 2000 (column 7, line 33) to 61900 (Example VII, column 12, line 31) but also with the range of molecular weight indicated as typical for the block copolymers of the patent in suit, i.e. also including the non isobutylene block(s) of the patent in suit, from 20 000 to 500 000 (cf. page 5, lines 40 to 41).

5.9 In any case, even if one would consider that document D2, which, admittedly, does not relate expressly to isobutylene block copolymers but to isobutylene homopolymers and random copolymers thereof (cf. page 6, lines 33 to 50), does not belong to the same technical field as document D1, it cannot be denied that D2 and D1 both refer to the cationic polymerization of isobutylene in a solvent mixture containing a halogenated hydrocarbon and a non halogenated hydrocarbon in the presence of a Lewis acid and of the same type of initiator compound, and at similar process temperatures (0 to -100°C in D2 and -10°C to -90°C in D1).

5.10 Furthermore, it also cannot be denied, in the Board's view, that the preliminary formation of a polyisobutylene polymeric block with a narrow molecular weight distribution is a prerequisite for obtaining isobutylene block copolymers with a narrow molecular weight distribution in D1 ((cf. D1, column 2, lines 56 to 63; column 3, lines 19 to 30), or that D2 is also concerned with the manufacture of polyisobutylene polymers having a narrow molecular weight distribution (cf. D2, page 6, lines 16 to 19).

5.11 Consequently, in view of these similarities in terms of process conditions as well in terms of molecular weight to be achieved between the cationic polymerization processes of D1 and D2, the alleged barrier between the two technical fields (i.e. that of block copolymers of isobutylene and that of homopolymers or random copolymers thereof) cannot, in the Board's view, be considered as so impenetrable as to have deterred the person skilled in the art from looking for the solution to his problem in this neighbouring field (e.g. manufacture of isobutylene homopolymers or random copolymers) in which such a problem is likely to occur.

5.12 In that context, taking further into account that mono halogenated solvents with 3 to 8 carbon atoms are expressly mentioned in D1 (butyl chloride, chlorobenzene) as suitable components of the solvent mixture, it thus follows, in the Board's view, that there would have been more than a reasonable expectation of success for the skilled person, if not a high degree of predictability of success, in the transfer of the measures taught in D2 (i.e. use of solvent mixtures containing a mono halogenated hydrocarbon with 3 to 8 carbon atoms) to the process disclosed in D1 in order to solve the technical problem underlying the patent in suit.

5.13 Consequently, the Board comes to the conclusion that the subject-matter of Claim 1 of the main request must be considered as obvious in view of the combination of D1 with D2.

5.14 The main request must hence be refused.

6. *First auxiliary request, second auxiliary request*

6.1 No objections under Article 123(2), 123(3) or 84 EPC have been raised by the Appellant against these requests.

6.2 The Board is also satisfied that the requirements of these articles are met by these requests.

6.3 *Inventive step*

6.3.1 Claim 1 of the first auxiliary request differs from Claim 1 of the main request in that it had been indicated that the content of monohalogenated hydrocarbon amounts to 10 to 98% by weight of the mixed solvent.

6.3.2 In that respect the Board notes that document D1 teaches that, for achieving the suitable polarity and solubility of the solvent mixture, the ratio of the non polar solvent (e.g. hydrocarbon solvent) to the polar solvent (e.g. chlorinated solvent), should be from 80/20 to 50/50 on a volume basis, (column 5, lines 12 to 15).

6.3.3 Furthermore, in view of the use of the generic terms "non polar solvent" and "polar solvent" in that passage and in view of Claims 5 and 6 of D1, it is evident that the ratio disclosed in D1 is, contrary to the submissions of the Respondent (cf. Section VI(iv.2) above), absolutely not limited to the preferred solvent mixtures mentioned on lines 8 to 12 of column 5 of D1, i.e. mixtures of cyclohexane or methylcyclohexane with methyl chloride or methylene chloride.

6.3.4 The Board also notes that document D2 also teaches to use the mono halogenated solvent in an amount of 10 to 98% by weight (page 5, lines 29 to 31) in the solvent mixtures.

6.3.5 The Board further notes that, although a reformulation of the technical problem in a more demanding form (i.e. achievement of a narrower molecular weight distribution) had been envisaged by the Respondent (cf. Sections V (iii.17) and VI(iii.2.3) above), the Respondent did not, however, at the oral proceedings before the Board present arguments in that respect for the assessment of the inventive step of the subject-matter of the first and second auxiliary requests using D1 as closest state of the art.

6.3.6 Even if this had been the case, in view of the dependency of the molecular weight distribution of the obtained isobutylene polymer on the polarity of the solvent mixture in which the cationic polymerization takes place, as documented by the Appellant (cf. Experimental report filed by the Appellant on 9 September 2005; cf. document D2 page 6, lines 16 to 19; Figures 1 and 2), and even conceded by the Respondent cf. also letter of the Respondent of 8 April 2005, page 2, last paragraph; cf. also Section VI(ii.1.4) above); it would not have been credible that this technical problem would have been solved over the whole range claimed, i.e. that block copolymers obtained according to the claimed processes would inevitably exhibit a narrower molecular weight distribution than those prepared according to D1.

6.3.7 Since the Respondent has conceded that the range of volume ratio disclosed in D1 is within the range of weight ratio required by Claim 1 of the first auxiliary request, and since that ratio has not been shown to be associated with any unexpected technical effect, the Board can only come to the conclusion that the incorporation of that feature cannot render the subject-matter of Claim 1 of the first auxiliary request inventive over the combination of D1 with D2.

6.3.8 Concerning the second auxiliary request, Claim 1 thereof differs from Claim 1 of the main request by the incorporation of the feature that the monomer component whose major monomer is not isobutylene is a monomer component containing an aromatic vinyl monomer as a major monomer.

6.3.9 Independently of the fact that styrenic monomers are expressly mentioned in D1 as monomers used in the end blocks of the block copolymers of D1 (column 6, lines 27 to 60), the Board also notes that the Respondent has admitted that this feature had been incorporated in Claim 1 only in order to overcome formal objections raised by the Appellant in view of the definition of that monomer component (cf. Section VI(iv.2.3) above).

6.3.10 Under these circumstances, the Board can only consider that this feature cannot contribute to the inventive step of the subject-matter of Claim 1 of the second auxiliary request over the combination of D1 and D2.

6.3.11 Consequently, both auxiliary requests must be refused.

7. Since none of the requests of the Respondent can be allowed, the decision under appeal must be set aside and the patent must be revoked.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

The Registrar: The Chairman:

E. Görgmaier R. Young