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DECISION
of 15 May 2003

Case Number: T 0414/02 - 3.3.3

Application Number: 96106290.8

Publication Number: 0745619

IPC: C08F 212/08

Language of the proceedings: EN

Title of invention:
Syndiotactic terpolymers of styrene

Patentee:
ENICHEM S.p.A.

Opponent:
THE DOW CHEMICAL COMPANY

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56, 100(c), 123(2), 123(3)

Keyword:
"Amendments - broadening of claim (first auxiliary request: yes; second auxiliary request: no)"
"Novelty (main request and second auxiliary request: yes)"
"Inventive step - problem and solution (main request: no; second auxiliary request: yes)"

Decisions cited:
-

Catchword:
-

Case Number: T 0414/02 - 3.3.3

DECISION
of the Technical Board of Appeal 3.3.3
of 15 May 2003

Appellant: (Proprietor of the patent)	ENICHEM S.p.A. Piazza della Repubblica, 16 I-20124 Milano (IT)
Representative:	De Gregori, Antonella Ing. Barzano & Zanardo Milano S.p.A. Via Borgonuovo 10 I-20121 Milano (IT)
Respondent: (Opponent)	THE DOW CHEMICAL COMPANY 2030 Abbott Road Dow Center Midland, Michigan 48640 (US)
Representative:	Sternagel, Fleischer, Godemeyer & Partner Patentanwälte Braunsberger Feld 29 D-51429 Bergisch Gladbach (DE)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office dated 6 February 2002 and issued in writing on 21 March 2002 revoking European patent No. 0 745 619 pursuant to Article 102(1) EPC.**

Composition of the Board:

Chairman: R. Young
Members: A. Däweritz
E. Dufrasne

Summary of Facts and Submissions

I. The grant of European patent No. 0 745 619 in respect of European patent application No. 96 106 290.8, filed on 22 April 1996 and claiming priority of 1 June 1995 of an earlier application in Italy (MI951138), was announced on 1 December 1999 (Bulletin 1999/48) on the basis of ten claims.

The independent claims as granted read as follows:

"1. Syndiotactic terpolymers of styrene comprising repetitive units deriving from:
a) 99.5-60% in moles of styrene;
b) 0.1-15% in moles of p-methylstyrene; and
c) 0,4-25% in moles of m-methylstyrene
having a weight average molecular weight of more than 20,000 and a stereoregularity of the syndiotactic type of more than 90%."

"4. Process which consists in the copolymerization of styrene with vinyltoluene where vinyltoluene is a mixture containing 35 to 40 % by weight of p-methylstyrene and 60 to 65 % by weight of m-methylstyrene in the presence of a catalytic system comprising a catalyst selected from titanium, zirconium and hafnium (Group IVa), in any oxidation state, and a co-catalyst selected from aluminoxane and a compound of boron having the formula $BX_1X_2X_3$ (I), wherein X_1, X_2 and X_3, the same or different, represent a C_1-C_{20} perfluorinated hydrocarbon radical."

The remaining dependent claims concerned specific embodiments of the subject-matter of the above claims.

II. On 30 August 2000, a Notice of Opposition was filed in which revocation of the patent in its entirety was requested on the grounds of lack of novelty within the meaning of Article 54(1) and (2) EPC and of inventive step within the meaning of Article 56 EPC as well as on the ground that the subject-matter of the patent in suit extended beyond the content of the application as originally filed (Article 100(c) EPC).

The objections were supported by the following documents:

D1: EP-A-0 276 801,

D2: R. H. Boundy, R. F. Boyer, "STYRENE - Its Polymers, Copolymers and Derivatives", Reinhold Publishing Corp., New York 1952, pages 1232 to 1245 and

D3: US-A-4 230 836.

III. By decision of 6 February 2002, issued in writing on 21 March 2002, the patent in suit was revoked.

(i) With respect to the objection under Article 100(c) EPC, the Opposition Division held that the subject-matter of the patent in suit complied with the requirements of Article 123(2) EPC, because the wording of Claim 1 as granted was based on original Claim 1 and the passage on page 3, line 24 to page 4, line 7 of the original application.

(ii) Whilst novelty of the subject-matter of all claims was acknowledged with respect to the cited prior art, the Opposition Division found that the subject-matter of Claim 1 lacked an inventive step in view of D1 in combination with D3.

1. In particular, the Opposition Division took the position that the subject-matter of the claims as granted, which concerned syndiotactic terpolymers derived from styrene, para-(or p- or 4-)methylstyrene and meta-(or m- or 3-)methylstyrene, differed from D1 by the fact that in that document only one of the two methylstyrenes was used in pure form to copolymerise with styrene.

2. Two comparative tests filed by the Applicant during the examination proceedings (annexed to the letter of 6 October 1997, and referred to in this decision as: "Applicant's Tests" 1 and 2) were considered as covering the copolymers of D1 and their preparation. These tests were considered as proof that the methods of preparation disclosed in D1 led to copolymers having virtually the same combination of melting points, weight average molecular weights and stereoregularity as the terpolymers of the patent in suit. Hence, the latter did not show an unexpected advantage over the copolymers of D1.

   Since it had been known from D3 that commercially pure p-methylstyrene or pure m-methylstyrene were not available at reasonable costs, the technical problem to be solved with respect to D1 was seen in the provision of a less expensive alternative for the pure p-methylstyrene or the pure m-methylstyrene used in the examples of D1.

The solution of this problem as disclosed in the patent in suit, ie the provision of terpolymers of styrene with m- and p-methylstyrene, was held obvious in view of the combination of D1 and D3, because the broad scope of Claim 1 also covered terpolymers which were obtained by copolymerising, respectively, mixtures of, on the one hand, styrene and, on the other, either p-methylstyrene or m-methylstyrene as commercially available, each of which contained a few percent of the respective other isomer.

IV. On 24 April 2002, a Notice of Appeal was lodged by the Proprietor (Appellant) against this decision with simultaneous payment of the prescribed fee.

(i) In the Statement of Grounds of Appeal, received on 4 July 2002, the Appellant concurred with the findings of the Opposition Division as to the objection under Article 100(c) EPC and the question of novelty, but disputed the conclusions of the Opposition Division as to inventive step.

(ii) Additionally, a first auxiliary request was filed. It differed from the granted version of the claims only by the wording of Claim 1 reading as follows:

> "1. Syndiotactic terpolymers of styrene comprising repetitive units deriving from:
> a) 99.5-60% in moles of styrene;
> b) 0.5-40% in moles of vinyltoluene, vinyltoluene being a mixture containing 35-40 % by weight of p-methylstyrene and 60-65 % by weight of m-methylstyrene,
> having a weight average molecular weight of more than 20,000 and a stereoregularity of the syndiotactic type of more than 90%."

The amendments in this claim were said to be based on Claim 1 as originally filed and on page 5, lines 3 to 5 of the initial application documents, referring to "The use of vinyltoluene (a mixture containing about 35-40% by weight of p-methylstyrene and 60-65% by weight of m-methylstyrene) ...", which meant that the requirements of Article 123(2) and (3) EPC were met.

(iii) The technical problem to be overcome with respect to D1, which was identified as representing the closest state of the art, was seen in giving further, maybe also less expensive, syndiotactic copolymers of styrene having a reduced melting point and a stereoregularity of the syndiotactic type of more than 90% (page 2, last paragraph of the Statement of Grounds of Appeal).

(iv) The solution differed from the polymers of D1 by the simultaneous presence of m-methylstyrene and p-methylstyrene in the syndiotactic copolymers according to the patent in suit, whilst in D1 only one of these comonomers was incorporated at a time. Although mention was made in the description of the general possibility to the preparation of syndiotactic copolymers of styrene comprising moieties of several different comonomers, the examples would direct in the opposite direction, ie to bipolymers of styrene with only one of the above methylstyrene isomers.

(v) Document D3 provided no incentive to modify the teaching of D1 so as to arrive at the solution within the ambit of the claims, because it referred to the preparation of *atactic* polymers of meta- and para-methylstyrene at a ratio of from 10/90 to 1/99 also in combination with styrene (claims and column 7, lines 24 to 30). Indeed, D3 pointed to a prejudice to the effect that vinyltoluene could be used with styrene to produce atactic polymers but not syndiotactic polymers.

V. In its counterstatement dated 21 November 2002, the Respondent (Opponent) supported the findings of the decision under appeal, in particular, as follows:

(i) The fact that D3 taught atactic terpolymers of styrene, meta- and para-methylstyrene did not amount to a prejudice in the art that syndiotactic terpolymers could not be made from these monomers. At the date of filing of D3, no appropriate catalyst had been available for the provision of such syndiotactic terpolymers. However, D3 already mentioned a possible advantage resulting from a use of stereospecific catalysts, eg those of the Ziegler-type. Consequently, the use of the stereospecific catalysts of D1 in the process of D3 would lead to the subject-matter of the patent in suit, which, therefore, lacked an inventive step.

(ii) The teaching of D1 was not restricted to the disclosure of the examples. Moreover, the skilled person was aware of the fact that each of the methylstyrenes in question, even in fine chemicals grade qualities, always contained small amounts of the other isomer as demonstrated by

D7: page 918 of the sales catalogue of Aldrich Chemical Company, Inc., Milwaukee, Wisconsin, USA 1990.

Thus, 4-methylstyrene contained "round about 3%" of 3-methylstyrene. Hence, the styrene-4-methylstyrene copolymers of D1 were actually terpolymers.

(iii) None of the examples as originally filed would comply with the definition of the terpolymer in Claim 1 of the first auxiliary request. Hence, there was no reasonable further argument in support of an inventive step of this auxiliary request.

VI. By letter dated 9 January 2003, a second auxiliary request was filed by the Appellant, restricted to the process of independent Claim 4, as quoted in the above section I, with dependent Claims 5 to 10 as granted, all renumbered ("Claims 1 to 7") with corresponding adaptations of the references to previous claims.

VII. Oral proceedings were held on 15 May 2003. The essence of the arguments provided by the parties with respect to the various objections raised against the above requests may be summarised as follows:

(i) With regard to Article 100(c) EPC, the Respondent argued that the two paragraphs in the application as originally filed, which concerned (i) the total amount of vinyltoluene (page 3, lines 16 to 23), and (ii) the individual amounts of components (b) and (c) involved in the claimed polymer (page 3, line 24 to page 4, line 7), respectively, did not relate to two alternative equally important definitions of the claimed terpolymers. Rather, the formulation referred to above under (ii) as used in Claim 1 as granted and in the main request would have referred to a more precise definition of the general range according to (i) which had been used in Claim 1 as originally filed. This was seen in line with the introductory words in (ii) ("More specifically ..."). Moreover, the composition of vinyltoluene as given on page 5, lines 3 to 5, as mentioned above, was always the composition of vinyltoluene as obtained in the normal technical process (D2: page 1235, lines 3 to 6, ie catalytic dehydrogenation of ethyltoluene). Since this composition had to be taken into account as a mandatory feature, Claim 1 of the main request violated Article 123(2) EPC. Further support for this view was seen in the fact that none of the examples met the composition requirements calculated from the respective percentages of vinyltoluene and its constituents.

The comparison between the percentages of (b) and (c) in Claim 1 as granted and the percentages calculated on the basis of the passages relating to the composition of vinyltoluene further demonstrated that the first auxiliary request also violated Article 123(2) and (3) EPC.

The Appellant pointed out that, in the examination proceedings, the scope of a claim could be extended provided such an extension was supported by the wording of the application as originally filed, which had actually been the case in Claim 1 as granted. The original disclosure was neither limited to nor required a vinyltoluene of a certain composition to be used.

(ii) As regards novelty, the Respondent stressed the fact that, in Example 1 of D1, the same catalyst was used as in the patent in suit, so that the amount of the meta-isomer in that example was the only missing feature in D1. However, since D7 showed that p-methylstyrene always contained some m-methylstyrene, it was evident that the resulting copolymer in Example 1 of D1 was a terpolymer containing enough m-methylstyrene to fall with the claimed range of Claim 1 of the main request.

Thus, as shown in D7, even the fine grade methylstyrene products of one of the big suppliers of fine grade chemicals were not 100% pure but contained minor amounts of certain other compounds. For example, the para-isomer

"4-Methylstyrene 97%" contained about 3% 3-methylstyrene, and the corresponding fine grade meta-isomer product was indicated to contain only 99% of 3-methylstyrene.

The Appellant disputed the arguments raised against the novelty of Claim 1.

(iii) On the basis of the technical problem as formulated by the Appellant (see section IV.iii), above), the Respondent argued that, in the absence of any surprising technical effect vis-a-vis D1 which taught that more than two monomers could be copolymerised to syndiotactic copolymers, the skilled person had all motivation to make further copolymers of styrene and vinyltoluene (cf. D2: page 1241, Table 17-G), in particular, having regard to a desired reduction in costs.

Thus, the prices of the products in D7 showed that, with increasing purity of one of these isomers, the costs rose significantly, due to the difficulties of separating the two isomers from each other. Thus, whilst 5g of 3-methylstyrene cost $28.80, and the price of 500g of 4-methylstyrene was $38.70, the costs for the isomeric mixture were significantly lower (1l, ie approx. 896g: $23.90).

Furthermore, it was also known from D3 (in particular, Example 9) that styrene and the two methylstyrene isomers could be copolymerised with any type of catalysts, including stereospecific catalytic systems (column 3, lines 4 to 13 and 55 to 60) in order to reduce the glass transition temperature.

The Appellant disputed these arguments as being based on a hindsight selection, because all combinations of monomers as contained in the list on page 5 of D1 would have been equally possible in that document. Moreover, D2 and D3 related to atactic polymers which fact would have prevented the skilled person from taking note of their teachings for the preparation of syndiotactic polymers. As demonstrated by the "Applicant's tests", which further included copolymerisation reactions of styrene with only one methylstyrene isomer at a time, the terpolymerisation of styrene and the two methylstyrenes resulted in higher yields of terpolymer, which contained higher amounts of the syndiotactic fraction, thus allowing to use it as obtained in the reaction without previous extraction of atactic polymer.

(iv) It was undisputed between the parties, that the NMR-measurements of the product for evaluating the syndiotacticity could and, in practice, would be carried out only with the insoluble fraction ("SPS") after extraction with a solvent such as methyl ethyl ketone ("MEK") to remove any atactic polymer ("APS"), because the presence thereof would have affected the results of the measurements (D1: Example 1, page 8, line 46 *et seq.*; explanations presented orally by the Inventor Mr Po').

On the basis of these explanations, the Respondent interpreted Claim 1 according to the main request as not relating to the crude product of the polymerisation, but only to the insoluble fraction optionally after purification, which would include the syndiotactic fraction of polymers according to D1.

Moreover, in Example 1 of D1 due to the content of the m-isomer in p-methylstyrene, a terpolymer had been obtained which had an insoluble content of 99% by weight and a syndiotacticity of 100% (page 8, line 43 and page 10, line 15), whilst the maximum value of the content of the insoluble fraction in the patent in suit was only 97%, at a percentage of syndiotactic pentad of only "more than 95%" (Example 3 of the patent in suit).

However, according to the Appellant, the percentages of pentads provided in the examples of the patent in suit demonstrated only the inability at the time of the filing to carry out more accurate measurements of the pentads content. More generally, a great advantage of the patent in suit was seen by the Appellant in that the product claimed did not require any purification and so that the crude product as obtained from the polymerisation could directly be used, whereas the products of the prior art required removal of the noncrystalline APS by extraction.

These assertions were disputed by the Respondent, because the definition in Claim 1 concerned only the SPS fraction, irrespective of any contents of APS in the crude product and of any necessity for purification before the use of the polymer.

In summary, the Respondent argued that the asserted increases of the yield and in the fraction of syndiotactic portion in the polymer obtained were features only related to the polymerisation process, but not to the product claims, and the Appellant as the patentee had failed to demonstrate that similar results were obtainable in the whole range of the claims.

VIII. The Appellant requested that the decision under appeal be set aside and that the patent be maintained as granted (main request) or, in the alternative, on the basis of Claims 1 to 10 of the first auxiliary request filed with the Statement of Grounds of Appeal or on the basis of Claims 1 to 7 of the second auxiliary request filed with the letter dated 9 January 2003.

The Respondent requested that the appeal be dismissed.

Reasons for the Decision

1. The appeal is admissible.

Main request

2. *Article 100(c)*

2.1 Having regard to the objection under Article 100(c) EPC raised by the Respondent against the wording of Claim 1 (section VII.i), above) it is observed that the comparison of the percentages as defined in features (b) and (c) of Claim 1 as granted, on the one hand, and respective values calculated on the basis of the range of 0.5 to 40 mol % of vinyltoluene (Claim 1 as filed) in the light of the composition of vinyltoluene as disclosed on page 5, lines 3 to 5, on the other, shows that they do not represent identical ranges:

Comonomer contents	calculated from "vinyltoluene"	Claim 1 as granted
(b) p-methylstyrene	0.175 to 16 mol %	0.1 to 15 mol %
(c) m-methylstyrene	0.3 to 26 mol %	0.4 to 25 mol %

Consequently, the use of "More specifically" (page 3, line 24) in the introduction the passage corresponding to features (b) and (c) in granted Claim 1 cannot be taken as a definition of a preferred embodiment, nor as reducing the content and meaningfulness *per se* of the information given in the passage so introduced.

Furthermore, whilst the two definitions (in terms of 0.5 to 40 mol % vinyltoluene on the one hand and features (b) and (c) on the other) both relate directly to the terpolymer claimed, the definition of the composition of vinyltoluene relied upon to generate the "calculated" from "vinyltoluene" values of comonomer percentages is disclosed only in relation to a production process for such a terpolymer (page 5, lines 3 to 5), and this in terms of simplification rather than a mandatory feature of such a "production process of syndiotactic polystyrene". The latter is, moreover, limited to the presence of a particular catalytic system (cf. the preceding statement on page 4, line 15 to 20: "A further object ... relates to a process ... which comprises the copolymerization of styrene with vinyltoluene ...").

Consequently, the Board sees no obstacle, whether grammatical or technical, to the percentages recited in the sentence on page 3, line 24 to page 4, line 7 being used as a suitable basis for the features (b) and (c) in the granted patent.

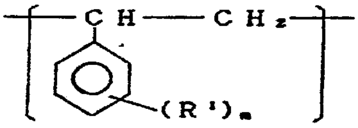
2.2 Therefore, the Board concurs with the findings of the Opposition Division that the wording of Claim 1 is based on the wording of the application as originally filed, and does not contravene the requirements of Article 123(2) EPC.

2.3 Consequently, the objection raised under Article 100(c) EPC does not prejudice the maintenance of the patent as granted (main request).

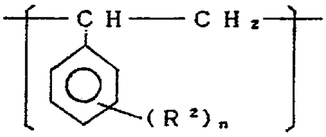
3. *Problem and solution*

3.1 Document D1 discloses styrene copolymers in which the stereoregularity of side chains to the polymer main chain is mainly syndiotactic (page 3, lines 6 to 8).

3.1.1 The copolymers comprise structural units (I) of the general formula (A)



wherein R^1 is a hydrogen atom, a halogen atom, or a carbon, oxygen, nitrogen, sulfur, phosphine or silicon-containing group, m is 1, 2 or 3, and when m is 2 or 3, R^1s may be the same or different, and structural units (II) of the general formula (B)



wherein the definitions of R^2 and n have the same meanings as R^1 and m in the above formula (A), with the proviso that the units (II) are not identical to the units (I). The copolymers have a polymerisation degree of at least 5 (preferably at least 10) (Claim 1; page 3, line 28 to page 4, line 1; page 5, lines 55/56).

The copolymers comprise "at least one structural unit (I) ... and a structural unit (II)" or "one structural unit (I) and one or more structural units (II)", and, therefore, include "two component copolymers, three component copolymers, four component copolymers and so forth" (Claim 1; page 3, lines 28 and 40/41; page 5, lines 16 to 22).

3.1.2 A list of styrenic compounds names more than thirty individual examples of suitable monomers providing moieties according to the above structural formulae (A) and (B) (page 5, lines 3 to 15). Amongst these monomers, p-methylstyrene, m-methylstyrene, p-tert-butylstyrene, p-fluorostyrene, p-chlorostyrene and p-bromostyrene are particularly accentuated in the examples as possible comonomers of styrene (Table 2 on pages 14/15 and bottom of page 15). Whilst it is true that, in the examples, the preparation of copolymers of styrene with one of the above comonomers is disclosed, the teaching of the document, as a whole, is not limited to binary copolymers - as shown above.

3.1.3 The molecular weight of the polymers is not particularly limited (page 5, lines 55/56). The Mw values given in the examples are all above the lower limit in Claim 1.

3.1.4 The stereoregularity of the copolymers is expressed in terms of proportions of the diad of at least 85% or of the pentad of at least 50%, determined by NMR (page 5, lines 23 to 41).

3.1.5 The copolymers are prepared by copolymerisation of monomers of the above types in the presence of a catalyst comprising (a) a titanium compound (exemplified by titanium tetraethoxide and cyclopentadienyltitanium trichloride) and (b) a contact product of an organoaluminium compound and a condensing agent (Claim 2). A typical example for component (b) of the catalyst system is aluminoxane of the structural formula $-(AlR^9-O-)_j$, wherein R^9 is an C_1 to C_8 alkyl group and j is a number of 2 to 50 (page 6, line 20 to page 7, line 42).

3.1.6 In all examples of D1, styrene and one of the above particular comonomers in specific amounts are copolymerised by means of catalyst systems of the above type (Table 2). After extraction with MEK, the resulting MEK-insoluble copolymers (Example 1(2): page 8, lines 42 to 45; in other examples: "a styrene copolymer was produced in the same manner as in Example 1(2)") are identified by their respective composition, weight and number average molecular weights (Mw, Mn), melting points Tm, and extraction residues after extraction with MEK. Furthermore, the yields of the crude product (in grams), glass transition points Tg, a number of NMR-spectra or selected areas of such spectra are given (D1: page 8, line 41; Table 2; Figures 1(a1) to 21).

Contrary to Example 1, wherein 100% of the styrene-p-methylstyrene copolymer is said to be of syndiotactic structure, in Comparative example 1, an atactic copolymer is prepared from styrene and p-methylstyrene by means of an organic peroxide, in Comparative example 2, the same monomers are copolymerised to an isotactic copolymer by using a $TiCl_4$-$Al(C_2H_5)_3$-$Al(C_2H_5)_2Cl$-catalyst system (page 9, lines 14/15). The identification of the stereostructures of these products are based on NMR measurements, as explained on pages 8 and 9 of D1 in further detail. The other examples are silent as to the degrees of syndiotacticity of their respective products.

3.1.7 However, the document does not provide any data as to the origin and the purities of the monomers to be used. As conceded *expressis verbis* by the Respondent during the oral proceedings, no mention is made in D1 of the contents of isomers in the comonomer as used in the examples (in particular, of the m-methylstyrene content in the p-methylstyrene used in Example 1).

3.2 According to the Statement of Grounds of Appeal (section IV.iii), above) and in line with the introductory parts of the description (sections [0001] to [0007] of the patent in suit), the technical problem underlying the patent in suit was to provide "further, may be also less expensive, syndiotactic copolymers of styrene having a reduced melting point and a stereoregularity of the syndiotactic type of more than 90%". This problem will be referred to as "first group of aspects" herein below.

Yet another ("second") group of aspects of the technical problem to be solved was referred to by the Appellant on the basis of page 3, lines 9 to 11 of the patent in suit (page 5, lines 11 to 16 of the application as filed): "increases in the yield and in the fraction of syndiotactic portion in the polymer obtained, with respect to the values obtained using p-methylstyrene alone or m-methylstyrene alone".

3.3 The first part of the solution of these aspects of the technical problem, as asserted by the Appellant, related to syndiotactic terpolymers of styrene *per se* comprising repetitive units derived from specific amounts of styrene, p-methylstyrene and m-methylstyrene (in terms of mol %), and further characterised by their weight average molecular weight (Mw) and their stereoregularity of the syndiotactic type (Claim 1).

The second part of the solution was seen in a process of copolymerisation of specific amounts of styrene and vinyltoluene in the presence of a specific catalyst system (Claim 4).

3.3.1 In each of the examples of the patent in suit, the percentage of syndiotactic polymer in terms of MEK insolubles, Mw and Mn values, ^{13}C-NMR data, thermal properties (Tm, Tg, crystallisation temperature Tcc; the latter value is not provided in Example 1), the contents of the two methylstyrene isomers in the terpolymer and the yields of terpolymers obtained are given. These data demonstrate that the first group of aspects of the above technical problem has actually been solved. This fact was accepted by both parties.

3.3.2 However, the above "second group of aspects" of the technical problem was disputed by the Respondent based on the argument that the asserted increases in the yield and in the syndiotactic portion were features related only to the process claims (section VII.iv), above), which could not serve to assess inventive step of product Claim 1.

3.3.3 According to the explanations given by both parties (section VII.iv), above), the meaningful evaluation of syndiotacticity by means of NMR-measurements can only be carried out with the insoluble fraction of the polymer ("SPS") after having extracted the atactic portion ("APS") from the crude product. It follows therefrom that the stereoregularity as defined in Claim 1, which is based on NMR-measurements, is a feature of the refined polymer after purification.

This feature is, however, related neither to the amount of the MEK-insoluble fraction isolated from the crude polymer, nor an increase in this amount.

3.3.4 Therefore, the modifications in the yield and in the fraction of syndiotactic portion of the polymer obtained are not related to the polymer as claimed. In other words, none of the features of Claim 1 is susceptible, even in principle, of providing a solution to a technical problem corresponding to the "second group of aspects".

3.4 Consequently, only the "first group of aspects" of the technical problem as formulated in section 3.2, above, can be taken into account for the assessment of the inventive step of the product according to Claim 1.

3.5 The question of whether the process according to Claim 4 involved an inventive step must only be examined when the patentability of the subject-matter of Claim 1 has been determined.

4. *Novelty*

4.1 As shown above (sections 3.1 to 3.1.6), document D1 relates to various types of copolymers of styrenic monomers. The Board is, however, convinced that the specific ranges of 0.1 to 15 mol % of para- and 0.4 to 25 mol % of meta-methylstyrene as required by the definitions of features (b) and (c) in Claim 1 of the patent in suit can neither be considered as being inherently disclosed in D1, nor as being meaningless. This view is confirmed eg by the Tg values of the copolymers in Examples 2 and 8, the first of which contained 63 mol % of p-methylstyrene and had a Tg of 104°C, whilst the second comprised 63 mol % of m-methylstyrene and had a Tg of only 80°C.

Nor has the Respondent (Opponent), who, according to established case law, had the burden of proof, provided any data which would have demonstrated the identity of the products of D1 to those of Claim 1 of the patent in suit in this respect.

4.2 In fact, the Respondent has only argued in its counter-statement dated 21 November 2002 that terpolymers would be obtained automatically in any case if allegedly pure 4-methylstyrene as disclosed in D7 was used to produce styrene/p-methylstyrene copolymers (page 2, first paragraph, last sentence), or the vinyltoluene known from D3, according to which p-methylstyrene, in general, was a mixture of the p- and the m-isomers (column 1, lines 24 to 27, the table at the top of column 2 and column 3, lines 4 to 15).

4.3 However, D1 contains no references to D3 or D7, nor is there any evidence that it was a product of D3 or D7 which had been used in D1. Consequently, the above deficiencies of D1 as evidence for lack of novelty cannot be remedied either by D3 or by D7, because according to established case law of the Boards of Appeal, for the assessment of novelty, each document has to be considered separately, and different documents can only be considered together under specific circumstances which are not fulfilled in the present case (see Case Law of the Boards of Appeal of the EPO, 4th Edition, 2002, chapter I.C.3.1).

4.4 In summary, D1 does not provide sufficient information, which would allow the clear and unambiguous establishment of the identity as between the products of Claim 1 and those of D1.

4.5 It follows that the alleged lack of novelty has not been shown. Consequently, the Board has come to the conclusion that the subject-matter of Claim 1 is novel over D1 (Articles 52(1), 54(1) and (2) EPC).

4.6 Novelty of the process of Claim 4 has not been disputed by the Respondent, and in the decision under appeal novelty of the subject-matter of all claims was accepted (point 4.1 of the reasons). Furthermore, in the Notice of Opposition (page 7), the difference between the subject-matter of Claim 4 and D1 was seen in the specific range of p- and m-isomers of the vinyltoluene used in the patent in suit. In view of these considerations, the Board sees, therefore, no reason to call novelty of Claim 4 into question.

5. *Inventive step*

It remains to be decided whether the above solution was obvious for a person skilled in the art having regard to the state of the art relied upon by the Respondent.

5.1 Document D1 was acknowledged by the parties and by the Opposition Division to represent the closest state of the art. The Board sees no reasons to deviate from this finding.

5.2 As already set out (sections 3.1 to 3.1.6, above), D1 does not specifically relate to terpolymers of styrene, para- and meta-methylstyrene in the specific molar amounts, but it indicates that styrene can be copolymerised with more than one of the further comonomers disclosed.

5.3 Otherwise than in the examination of novelty, the disclosures of D3 and D7 can be taken into account for the assessment of inventive step. Thus, D3 clearly indicates that in each of the isomers of methylstyrene, eg p-methylstyrene, certain amounts of the respective other isomer are present, as a result of their manufacture resulting in a mixture of isomers ("vinyltoluene"; cf. also D2 as referred to in D3: column 1, lines 35 to 39). The skilled person is aware of this fact (cf. section 4.2, above).

5.4 The argument provided by the Respondent, that technical grade p- or m-methylstyrene would result in a terpolymer was not disputed by the Appellant. However, the Appellant put emphasis on the argument that the product according to Claim 1 needed no purification before use. As already discussed above, Claim 1 relates, however, to polymerisation products after purification (sections 3.3.2 to 3.3.4).

5.5 These facts and findings, taken together with the option of selection of monomers from the list in D1, eg a mixture of individual comonomers, evidently provides an incentive to make alternative products (section 3.2, above). Applying this finding, in particular, to Example 1 of this document, when taking the general knowledge into account that neither para- nor meta-methylstyrene is a 100% pure isomer and vinyltoluene as a mixture of these isomers is available at lower costs due to lower purification or separation requirements (see D3 or D7), it follows that the result of such a step would inevitably be the provision of a terpolymer within the terms of Claim 1 at reduced costs. In other words, the solution according to Claim 1 arises in an obvious way from the state of the art.

5.6 Hence, the subject-matter of Claim 1 is not based on an inventive step (Article 56 EPC). It follows that the main request is not allowable.

First auxiliary request

6. *Article 123(3) EPC*

6.1 The rewording of Claim 1 results in ranges of contents of components (b) of 0.175 to 16 mol % of p-methylstyrene and (c) 0.3 to 26 mol % of m-methylstyrene, respectively, to be covered by the claim. In view of the respective ranges of (b) 0.1 to 15 mol % and (c) 0.4 to 25 mol % in Claim 1 as granted (section 2.1, above), this means that Claim 1 is broader in scope that Claim 1 as granted which constitutes a violation of Article 123(3) EPC.

6.2 Consequently, the first auxiliary request is not allowable.

Second auxiliary request

7. *Article 123(2) and (3) EPC*

7.1 No objection has been raised under Article 123(2) EPC with respect to Claim 1, which is based on Claim 4 and page 5, lines 3 to 5, as originally filed. The Board has no reason to deviate from the finding in section 3.9 of the decision under appeal, according to which the patent in suit met the requirements of this Article. Nor were objections as to the formal requirements of the claims raised by the Respondent in the oral proceedings.

7.2 Moreover, the wording of Claim 1 is identical to that of Claim 4 as granted (main request). Consequently, it complies also with Article 123(3) EPC.

8. *Novelty*

Since Claim 1 is identical to Claim 4 of the main request, the findings in section 4.6, above, apply here as well, ie the subject-matter claimed is novel.

9. *Problem and Solution*

9.1 As considered in the above sections 3.2 to 3.3.4, the technical problem which, according to the Appellant, was to be solved with respect to D1, concerned two groups of aspects, only the first of which could be taken into account for product Claim 1 of the main request. In this auxiliary request, the situation is different. It is evident from those considerations that increases in the yield and in the fraction of syndiotactic portion in the polymer obtained are aspects to be taken into account with regard to the claimed process.

9.1.1 Consequently, the technical problem underlying the patent in suit within the ambit of the second auxiliary request may be seen as the definition of a process resulting in increased yields of highly syndiotactic polymer with improved insolubles contents in the crude product (ie a reduction of the content of atactic polymer) compared to copolymerisations of styrene and only one of the methylstyrene isomers (patent in suit: page 3, lines 8 to 11).

9.1.2 In an experimental report submitted in the examination proceedings, Example 3 of the application had been compared with the copolymerisation of styrene with only one of the two isomers of methylstyrene ("Applicant's Tests", section III.(ii)2), above). All the other reaction conditions had been identical in the experiments. According to the data in this report, the yield achieved with m-methylstyrene was 8.2 (Test 1), with p-methylstyrene the yield was 22.7% (Test 2), respectively, whilst in Example 3 the yield was 50%.

Additionally, the Appellant asserted that the amount of syndiotactic polymer in Example 3 was also improved in terms of MEK insolubles in comparison to the two tests (Example 3: 97%; Test 1: 85%; Test 2: 87%).

9.1.3 Although these results *per se* were not disputed by the Respondent, it was argued that the Appellant had failed to demonstrate that these aspects of the technical problem would be solved within the whole range of the independent claim.

However, no data are available to the Board which would support any doubts in this respect. In accordance with established case law, the onus of proof in this respect has therefore been, in the Board's view, on the Respondent who had opposed the patent in suit, but has not discharged this burden.

The fact that in Example 1 of D1 the insolubles amounted to 99% whilst, in Example 3 of the patent in suit, only 97% were achieved, cannot throw a shadow on the meaningfulness of the above experimental results, because the reaction conditions in the two examples were different.

9.2 It follows that it is credible to the Board that these additional aspects of the technical problem have effectively been solved by the process as claimed in Claim 1.

10. *Inventive step*

It remains to be decided whether the above solution (the process) was obvious to a person skilled in the art having regard to the state of the art relied upon by the Respondent.

10.1 Apart from the numerical value of the insolubles content in Example 1, Document D1 (see sections 3.1 to 3.1.6, above) is completely silent about the insoluble contents of the crude products, and the stereoregularity of the polymers claimed in D1 is only said to be "mainly syndiotactic" in the sense that, in the extraction insolubles, the proportion of the diad be at least 85% and of the pentad be at least 50% (Claim 1 and page 5, lines 34 to 37). However, these statements do not allow to deduce from D1 that the selection of specific combinations of monomers may have a particular effect on the insolubles content of the polymer. Nor would D1 suggest that the yield could be improved when replacing an individual comonomer as used in D1 by the isomeric mixture as defined in Claim 1.

10.2 It follows that D1 by itself does not provide any incentive to achieve any improvements in this respect by selecting a particular combination of monomers which are then copolymerised in accordance with Claim 1.

10.3 The two "Applicant's Tests" which had been deemed in the decision under appeal to "cover the processes and the copolymers of D1" (point 6.3 of the reasons) are not state of the art. Hence, they cannot serve to demonstrate that the specific combination of features in Claim 1 would have been known from or suggested by D1. In particular, they cannot provide any incentive in which way the teaching of D1 would have to be modified in order to solve the above aspects of the technical problem.

10.4 None of the further documents discussed in these proceedings point to the above aspects of the technical problem or provide the missing information which would render the claimed process obvious. No assertions were made by the Respondent to this effect.

10.5 It follows that the process according to Claim 1 would not be obvious to a person skilled in the art and, therefore, that the subject-matter of this claim involves an inventive step.

11. Claims 2 to 7, which relate to preferred embodiments of the process according to Claim 1, by the same token also involve an inventive step .

12. Hence, the second auxiliary request is allowable.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The main and the first auxiliary requests are refused.

3. The case is remitted to the first instance with the order to maintain the patent on the basis of Claims 1 to 7 filed as second auxiliary request by letter dated 9 January 2003 and after any necessary consequential amendment of the description.

The Registrar: The Chairman:

E. Görgmaier R. Young