BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPÉEN DES BREVETS

Internal distribution code:

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

Datasheet for the decision of 27 May 2015

Case Number: T 0268/12 - 3.3.03

Application Number: 03291287.5

Publication Number: 1408056

IPC: C08F12/08, C08J9/20

Language of the proceedings: EN

Title of invention:
Preparation of expandable styrene polymers

Patent Proprietor:
Arkema Inc.

Opponents:
Akzo Nobel N.V.
BASF SE

Headword:

Relevant legal provisions:
EPC Art. 56, 123(2)
RPBA Art. 13(1)

Keyword:
Amendments - added subject-matter - main request (no)
Inventive step - main request (yes)
Late-filed argument - admitted (no)

Decisions cited:

Catchword:

Beschwerdekammern
Boards of Appeal
Chambres de recours

European Patent Office
D-80298 MUNICH
GERMANY
Tel. +49 (0) 89 2399-0
Fax +49 (0) 89 2399-4465

Case Number: T 0268/12 - 3.3.03

DECISION
of Technical Board of Appeal 3.3.03
of 27 May 2015

Appellant:
(Opponent 1)

Akzo Nobel N.V.
Velperweg 76
NL-6824 BM Arnhem (NL)

Representative:

Heinen, Annemieke Willemine
Akzo Nobel N.V.
Legal & IP
P.O. Box 9300
NL-6800 SB Arnhem (NL)

Respondent:
(Patent Proprietor)

Arkema Inc.
2000 Market Street
Philadelphia, PA 19103-3222 (US)

Representative:

Gavin, Pablo
Arkema France
Département Propriété Industrielle
420, rue d'Estienne d'Orves
92705 Colombes Cedex (FR)

Party as of right:
(Opponent 2)

BASF SE
67056 Ludwigshafen (DE)

Representative:

BASF SE
Global Intellectual Property
GVX / K- C 6
67056 Ludwigshafen (DE)

Decision under appeal:

Interlocutory decision of the Opposition Division of the European Patent Office posted on 15 December 2011 concerning maintenance of the European Patent No. 1408056 in amended form.

Composition of the Board:

Chairman	B. ter Laan
Members:	O. Dury
	C. Brandt

Summary of Facts and Submissions

I. The appeal by opponent 1 lies against the interlocutory decision of the opposition division posted on 15 December 2011 maintaining in amended form European patent No. 1 408 056, based on application No. 03 291 287.5.

II. The application as filed contained 12 claims, of which the claims relevant for the present decision read as follows:

"1. An improved process for the polymerization of styrene monomer to produce expandable polystyrene wherein styrene is polymerized in a process comprising the following steps:

A. heating an aqueous suspension comprising styrene monomer and at least two organic peroxide initiators, one of said organic peroxide initiators having a lower one hour half life decomposition temperature and at least one other of said organic peroxide initiators having a higher one hour half life decomposition temperature, for a time and at a temperature sufficient to effect at least partial decomposition of said lower half life organic peroxide and initiate polymerization of said styrene monomer, and

B. subsequently raising the temperature of said aqueous suspension above the initial heating temperature to complete decomposition of the organic peroxide initiators in said suspension and provide complete polymerization of said styrene monomer,
wherein the improvement comprises at least one of the organic peroxide initiators incorporated in said

suspension being an "intermediate" temperature peroxide."

"2. A process as defined in claim 1 in which styrene is polymerized in aqueous suspension at between 80 and 135 degrees Centigrade for up to 10 hours in the presence of at least two organic peroxide initiators where at least one organic peroxide initiator is an "intermediate" temperature peroxide, has a half life period of 1 hour at from 101° to 111° C as measured in cumene, and additional organic peroxides present have a half life period of 1 hour, as measured in cumene, at other than from 101 to 111°C."

"10. An improved aqueous suspension suitable for polymerization to provide expandable polystyrene, said suspension comprising styrene monomer and at least two organic peroxide initiators, one of said organic peroxide initiators having a lower one hour half life decomposition temperature and at least one other of said organic peroxide initiators having a higher one hour half life decomposition temperature, wherein the improvement comprises one of the organic peroxide initiators in said suspension being an "intermediate" temperature peroxide."

Claims 3-9 were directed to embodiments of the process according to claim 1.

III. The granted patent was based on the set of 12 claims as originally filed.

IV. Two oppositions against the patent were filed, in which the revocation of the patent was requested on the grounds of Art. 100 a) EPC (lack of novelty and lack of an inventive step) and Art. 100 b) EPC.

V. With the decision under appeal the patent was maintained on the basis of the main request (9 claims) filed during the oral proceedings held on 16 November 2011.

VI. The decision under appeal was based, *inter alia*, on the following documents:

D2: Initiators for High Polymers, brochure Akzo Nobel, June 2006
D6: US 5 004 780
D8: US 5 908 872
D13: experimental report filed by the patent proprietor with letter of 6 September 2011

According to that decision, the main request was held to fulfil the requirements of the EPC. An inventive step was in particular acknowledged over the combination of D8 as the closest prior art with D6.

VII. On 8 February 2012, opponent 1 (the appellant) lodged an appeal against the above decision. The prescribed fee was paid on the same day. With the statement setting out the grounds for the appeal, received on 30 March 2012, opponent 1 requested that the patent be revoked.

VIII. With its rejoinder received on 27 July 2012 the patent proprietor (respondent) requested that the opposition division's decision be set aside and the patent be maintained in amended form according to the main request (10 claims), or alternatively to any of auxiliary requests 1 to 3, all requests as filed therewith.

IX. With letter of 7 October 2014, the parties were summoned to oral proceedings to be held on 27 May 2015.

X. With a communication dated 18 February 2015 in preparation for the oral proceedings, the Board set out its preliminary view of the case. Concerns in respect of Art. 123(2) EPC in particular were identified for all pending requests.

XI. With a letter of 13 April 2015, opponent 2 requested that the patent be revoked and that the patent proprietor's main request and all auxiliary requests filed on 27 July 2012 be dismissed because they did not meet the requirements of Art. 84, 123(2) and 56 EPC.

XII. With a letter of 15 April 2015, the patent proprietor submitted further arguments and filed an amended main request as well as amended auxiliary requests 1 to 3. The relevant claims of the main request read as follows (in claims 1, 2 and 10, additions compared to claims 1, 2 and 10 of the application as filed, respectively, are indicated in **bold**, deletions in ~~strikethrough~~):

"1. An improved process for the polymerization of styrene monomer to produce expandable polystyrene wherein styrene is polymerized in a process comprising the following steps:

A. heating an aqueous suspension comprising styrene monomer and at least two organic peroxide initiators, one of said organic peroxide initiators having a lower one hour half life decomposition temperature and at least one other of said organic peroxide initiators having a higher one hour half life decomposition temperature, for a time and at a temperature sufficient to effect at least partial decomposition of said lower half life organic peroxide and initiate polymerization of said styrene monomer, and

B. subsequently raising the temperature of said aqueous suspension above the initial heating temperature to complete decomposition of the organic peroxide initiators in said suspension and provide complete polymerization of said styrene monomer,

and wherein the improvement comprises ~~at least one of the organic peroxide initiators~~ **the organic peroxide initiator having a lower one hour half life decomposition temperature** incorporated in said suspension being an "intermediate" temperature peroxide, **whose one hour half life temperature is from 101°C to 111°C as measured in cumene, which is selected from the group consisting of 1,1,3,3-tetramethylbutyl esters of alkaneperoxoic acids that are unsubstituted at the alpha position, 1,1,3,3-tetramethylbutyl diesters of alkanediperoxoic acids that are unsubstituted at the alpha positions, and 1-alkoxy-1-t-alkylperoxycyclohexanes, where the t-alkyl group contains 4 to 8 carbon atoms, the alkoxy group contains 1 to 8 carbon atoms and the cyclohexane ring may be substituted with 1 to 3 alkyl groups each, independently, having 1 to 3 carbon atoms.**"

"2. A process as defined in claim 1 in which styrene is polymerized in aqueous suspension at between 80 and 135 degrees Centigrade for up to 10 hours in the presence of at least two organic peroxide initiators where at least one organic peroxide initiator is an "intermediate" temperature peroxide~~, has a half life period of 1 hour at from 101° to 111° C as measured in~~

~~cumene,~~ and additional organic peroxides present have a half life period of 1 hour, as measured in cumene, at other than from 101 to 111°C."

"10. An improved aqueous suspension suitable for polymerization to provide expandable polystyrene, said suspension comprising styrene monomer and at least two organic peroxide initiators, one of said organic peroxide initiators having a lower one hour half life decomposition temperature and at least one other of said organic peroxide initiators having a higher one hour half life decomposition temperature, wherein the improvement comprises ~~one of the organic peroxide initiators~~ **the organic peroxide initiator having a lower one hour half life decomposition temperature** in said suspension being an "intermediate" temperature peroxide, **whose one hour half life temperature is from 101°C to 111°C as measured in cumene, which is selected from the group consisting of 1,1,3,3-tetramethylbutyl esters of alkaneperoxoic acids that are unsubstituted at the alpha position, 1,1,3,3-tetramethylbutyl diesters of alkanediperoxoic acids that are unsubstituted at the alpha positions, and 1-alkoxy-1-t-alkylperoxycyclohexanes, where the t-alkyl group contains 4 to 8 carbon atoms, the alkoxy group contains 1 to 8 carbon atoms and the cyclohexane ring may be substituted with 1 to 3 alkyl groups each, independently, having 1 to 3 carbon atoms.**"

Claims 3 to 9 depended on claim 1.

XIII. Oral proceedings were held on 27 May 2015 in the presence of all parties.

XIV. The opponents' arguments, in so far as relevant for the present decision, may be summarised as follows:

Art. 123(2) EPC

a) No support for the subject-matter of claim 1 could be found in the application as filed, in particular not in paragraphs [21], [24] and [27]. It was in particular not disclosed that the intermediate temperature peroxide should be the initiator having the lower half-life decomposition temperature. Claim 1 also did not reflect all the features specified in combination in said paragraph [27].

b) During the oral proceedings, opponent 1 considered that the wording of claim 1 defined that the intermediate temperature peroxide should be, among all initiators present, the one having the lowest one hour half life decomposition temperature. However, the application as filed provided no support for such a feature: it only disclosed that the intermediate temperature peroxide could be used as a first stage initiator.

During the oral proceedings, opponent 2 considered that peroxide initiators having a one hour half life decomposition temperature lower than that of the intermediate temperature peroxide could be present, which was also indicated in the description.

c) The deletion of the temperature range in claim 2 allowed the presence of further intermediate temperature peroxides having a one hour half life decomposition temperature outside said range, e.g.

an intermediate temperature peroxide having a one hour half-life decomposition temperature "higher than that of BPO but lower than that of TBP" according to paragraph [14] of the application as filed. Such embodiments were not disclosed in the application as filed.

d) For those reasons, the main request did not fulfil the requirements of Art. 123(2) EPC.

Art. 56 EPC

e) The subject-matter claimed differed from the closest prior art D8 in the nature of the intermediate temperature peroxide. As shown in D2, the structure of Trigonox 29, which is one of the two first stage peroxide specifically disclosed in D8, did not correspond to that of an intermediate temperature peroxide being defined in operative claim 1. Considering that D8 did not specify in which solvent the one hour half life decomposition temperatures were measured, any disclosure of D8 in that respect was unclear, and thus, not limiting.

f) The problem to be solved resided in providing a process to produce expandable polystyrene at accelerated conversion rates and with a reduced finishing temperature to obtain reduced amounts of residual monomer. The problem of providing a higher molecular weight, relied upon by the patent proprietor, was not supported by the application as filed and could not be considered.

g) The examples of the patent in suit were not illustrative of the closest prior art. Besides, the examples illustrative of claim 1 did not show any improvement in terms of residual styrene monomer or molecular weight as compared to examples 1-3, which represented the prior art.

The examples of D13 showed that the above problem was already solved when using Trigonox 29 as first stage initiator. Although D13 seemed to show that the use of a peroxide according to claim 1 (1-methoxy-1-t-amylperoxycyclohexane: TAPMC) resulted in a higher molecular weight and a lower residual styrene content than the use of Trigonox 29, those experiments were not comparable since different amounts of peroxide initiator were used.

Opponent 2 further argued that none of the examples on file related to the production of expandable polystyrene using a blowing agent. Therefore, there was no evidence illustrative of the subject-matter being claimed.

D13 comprised a single example illustrative of claim 1, in particular using TAPMC as intermediate temperature peroxide. There was no evidence that other intermediate temperature peroxides, in particular according to the other embodiments specified in claim 1, and/or combinations thereof with other second stage initiator behaved identically. Considering the chemical structure of the different embodiments for the intermediate temperature peroxide specified in claim 1, there was no reason to expect that they would behave identically to TAPMC.

During the oral proceedings, opponent 2 argued for the first time that it was explicitly indicated in D13 (page 2, last paragraph) that the improvement shown in D13 was due to the difference of 5 to 15°C in one hour half life decomposition temperature between the two initiators used. However, that feature was not reflected in the operative claims. Therefore, D13 could not demonstrate that an effect was obtained in relation to the distinguishing feature of the operative claims over the closest prior art.

For those reasons, the problem effectively solved had to be reformulated in the form of an alternative.

h) D6 disclosed the use of cyclic monoperoxyketals, which were peroxides according to one embodiment of the intermediate temperature peroxide specified in operative claim 1, as initiator for the polymerisation of styrene. D6 further taught that those cyclic monoperoxyketals resulted in higher polymerisation rates as compared to usual cyclic bisperoxyketals, in particular Trigonox 29 which was explicitly disclosed in D6. The examples of D6 further showed that cyclic monoperoxyketals, including TAPMC, were suitable for producing expandable polystyrene.

Therefore, it was obvious to solve the above problem by combining D8 and D6.

i) For those reasons, the main request was not inventive.

Art. 84 EPC

j) During the oral proceedings, opponent 2 argued that the discussion on Art. 123(2) EPC showed that the wording of the claims was unclear. Therefore, the objection already submitted in writing should be admitted to the proceedings. There was no reason not to admit a new argument.

XV. The patent proprietor's arguments, as far as relevant for the present decision, may be summarised as follows:

Art. 123(2) EPC

a) It was derivable from the application as filed in its whole that the intermediate temperature peroxide could be used as a first stage initiator i.e. the initiator that decomposed first. Therefore, claim 1 was to be read as imposing that the intermediate temperature peroxide should be, among all initiators present, the one having the lowest one hour half life decomposition temperature.

b) Claim 1 should be read taking into account the general framework of the invention, which dealt with well-known processes for polymerising polystyrene using two different temperature stages and different initiators having different one hour half-life decomposition temperatures for each of the temperature stages, as indicated in paragraphs [2], [3] and [10] of the application as filed.

With that in mind, it was further derivable from paragraphs [21], [23] and [24] that the groups of intermediate temperature peroxide now specified in operative claim 1 could be used as the peroxide initiator having the lower one hour half-life decomposition temperature.

The subject-matter of claim 1 represented the preferred embodiment of the application as filed, as was derivable from the fact that most of the examples of the application as filed illustrated said subject-matter.

For those reasons, the skilled person reading the application as filed would have seriously contemplated the combination of features specified in operative claim 1.

c) The wording of claim 2 imposed that only one intermediate temperature peroxide should be present. In view of the amendments made in claim 1 and the dependency of claim 2 on claim 1, the temperature range indicated in claim 2 as originally filed was superfluous and could be deleted.

d) For those reasons, the main request fulfilled the requirements of Art. 123(2) EPC.

Art. 56 EPC

e) The subject-matter claimed differed from the closest prior art D8 in the nature of the intermediate temperature peroxide.

f) The problem to be solved was defined as providing an alternative process to produce expandable polystyrene at good conversion rates at a reduced finishing temperature, the polystyrene having an acceptable molecular weight and low amounts of residual monomer.

g) The solution resided in the use of specific intermediate temperature peroxides as defined in claim 1.

h) The examples of the patent in suit and of D13 showed that the above problem was solved. There was no evidence on file showing the contrary. In that respect, the burden of proof was on the opponents.

i) Opponent 2's argument based on D13, regarding the effect being related to a feature not present in claim 1, was submitted for the first time during the oral proceedings. The patent proprietor was not prepared to reply to that. Further, considering that opponent 2 was not an appellant, said objection should not be admitted to the proceedings.

j) The skilled person had no good reason for combining the teaching of D8 and D6, in particular not for selecting a peroxide having a one hour half-life decomposition temperature in the range specified in claim 1. There was also no reason, in particular not in view of the data provided in respect of the examples of D6, to select TAPMC, which was the only cyclic monoperoxyketal of D6 that was shown to be an intermediate temperature peroxide according to claim 1.

k) Therefore, an inventive step had to be acknowledged.

Art. 84 EPC

l) Opponent 2 had not filed an appeal and had never contested the decision of the opposition division. Therefore, the clarity objection submitted for the first time with opponent 2's submission dated 15 April 2015 should not be admitted.

XVI. The appellant (opponent 1) and the party as of right (opponent 2) requested that the decision under appeal be set aside and that the patent be revoked.

The respondent (patent proprietor) requested that the decision under appeal be set aside and the patent be maintained in amended form on the basis of the main request, or alternatively, on the basis of any of the first to third auxiliary request, all requests filed with letter dated 15 April 2015.

XVII. The Board announced its decision at the end of the oral proceedings.

Reasons for the Decision

1. The appeal is admissible.

Main request

2. Art. 123(2) EPC

2.1 Claim 1 is based on claim 1 as originally filed, in which

(a) the wording "one of the organic peroxide initiators in said suspension being an "intermediate" temperature peroxide" was replaced by "the organic peroxide initiator having a lower one hour half life decomposition temperature in said suspension being an "intermediate" temperature peroxide";

(b) it was further specified that the organic peroxide initiator having a lower one hour half-life decomposition temperature is an intermediate temperature peroxide whose one hour half life temperature is from 101°C to 111°C as measured in cumene;

(c) it was also indicated that the organic peroxide initiator having a lower one hour half-life decomposition temperature "is selected from the group consisting of
  - 1,1,3,3-tetramethylbutyl esters of alkaneperoxoic acids that are unsubstituted at the alpha position,
  - 1,1,3,3-tetramethylbutyl diesters of alkanediperoxoic acids that are unsubstituted at the alpha positions, and
  - 1-alkoxy-1-t-alkylperoxycyclohexane, where the t-alkyl group contains 4 to 8 carbon atoms, where the alkoxy group contains 1 to 8 carbon atoms and the cyclohexane ring may optionally be substituted with 1 to 3 alkyl groups each, independently, having 1 to 3 carbon atoms.".

Hereinafter these three groups of peroxide compounds will be referred to as a1), a2) and a3), respectively.

2.2 Since the parties, following the amendments made, disagreed on the reading of claim 1 in respect of the definition of the initiators that could or should be present in the aqueous suspension defined in step A, the meaning of that claim has to be determined.

2.2.1 It follows from the literal wording of claim 1 "an aqueous suspension comprising ... at least two organic peroxide initiators, one of said ... having a lower one hour half life decomposition temperature and at least one other of said ... having a higher one hour half life decomposition temperature", that the only limitation set for the aqueous suspension defined in step A of claim 1 is that it must comprise two organic peroxide initiators, at least distinguished from one another in having different one hour half life decomposition temperatures.

Claim 1 further specifies that the organic peroxide initiator having a lower one hour half life decomposition temperature must be "an intermediate temperature peroxide whose one hour half life decomposition temperature is from 101°C to 111°C as measured in cumene" and that it should be selected from the groups consisting of a1), a2) and a3).

The combination of those requirements imposes that the aqueous suspension defined in step A must comprise:

- at least an intermediate temperature peroxide belonging to one of the groups a1) to a3), said component further having a one hour half-life decomposition temperature of 101 to 111°C; and
- at least one other organic peroxide initiator having a higher one hour half-life decomposition temperature than that of the above defined

intermediate temperature peroxide.

2.2.2 Accordingly, claim 1 comprises no further limitation regarding the presence or not of any other organic peroxide initiator, in particular in terms of the one hour half-life decomposition temperature thereof. Nor does the literal wording of claim 1 impose that said intermediate temperature peroxide should be, among all initiators present in the aqueous suspension defined in step A, the one having the lowest one hour half-life decomposition temperature. Consequently, said aqueous suspension can comprise e.g. i) other initiator(s) having a one hour half-life decomposition temperature that is either lower or higher than that of the intermediate temperature peroxide defined in claim 1 or ii) two intermediate temperature peroxides as defined in claim 1, provided that they have different one hour half-life decomposition temperatures.

2.2.3 That reading of claim 1 is in line with the general teaching of the description of the patent in suit, according to which other initiators may be present in addition to the intermediate temperature peroxide, including those having a one hour half-life decomposition temperature as low as 80°C (paragraph [23]: "partial" replacement of dibenzoyl peroxide or other first stage initiator with similar half life temperature; paragraph [33]). Under these circumstances, there is no reason to read claim 1 differently from its literal wording. There is in particular no passage in the whole of the description of the patent in suit that would support an interpretation of claim 1 as imposing that the intermediate temperature peroxide should be the initiator with the lowest one hour half-life decomposition temperature, as argued by either opponent 1 or the patent proprietor.

2.3 Regarding the definition of the subject-matter of claim 1, it is also explained in paragraphs [2], [3] and [10] of the application as filed (as well as in col. 1, lines 6-22 of D8), that expandable polystyrene is conventionally prepared using a two-step process comprising a first stage and a finishing stage. During the proceedings it was not contested that claim 1 is directed to such a two-step processes with step A being the first stage and step B the finishing stage. The requirement of claim 1 that step A should lead to "at least partial decomposition of said lower half life organic peroxide" further imposes that the intermediate peroxide defined in claim 1 is used as a first stage initiator, which mandatorily requires that a further initiator having a higher one hour half life decomposition is used as (one of) the finishing initiator(s).

2.4 Regarding the amendments made, although it is derivable from paragraphs [22] and [26]-[27] as well as from the examples of the application as filed that it was originally contemplated that the intermediate temperature peroxide could be used either as first stage or finishing initiator, paragraphs [27] and [28] as well as examples 5-8 and 11-12 of the application as filed explicitly disclose the use of an intermediate temperature peroxide as a first stage initiator as defined in operative claim 1. That the co-initiator should have a one hour half-life temperature 5-15°C higher than that of the "intermediate" is disclosed in said paragraph [27] only as a preferred embodiment ("most advantage").

Taking into account the reading of claim 1 (sections

2.3 and 2.4), it has not been shown that amendment a) (section 2.1) leads to a breach of Art. 123(2) EPC.

Regarding amendment b), it was not shown during the proceedings that the term "intermediate temperature peroxide" had an accepted definition in the art. Although it is indicated in the first sentences of paragraph [14] of the application as filed, that that term could encompass peroxide initiators having a one hour half-life decomposition temperature "higher than that of BPO (dibenzoyl peroxide) but lower than that of TBP (tertiary butyl peroxybenzoate", it is also stated e.g. in paragraphs [21], [23] and [28], that an intermediate temperature peroxide is a compound having a one hour half-life decomposition temperature in the range of from 101°C to 111°C. Those passages provide a clear and unambiguous definition of how the term intermediate temperature peroxide should be read in the context of the application as filed.

Concerning amendment c), it was not contested by the parties that it was supported by paragraph [24] of the application as filed.

2.5 It was not contested by the opponents that the combination of features now being defined in claim 1 could be arrived at by combining the passages of the application as filed indicated above, which amounted to a single selection within the ambit of the application as filed, namely to use the intermediate temperature peroxide as a first stage initiator. Nor were objections raised against the patent proprietor's argument that the skilled person would, on the basis of the application as filed, have seriously contemplated combining the technical features now being present in claim 1. Under those circumstances, there is no reason to consider that the amendments made contravene the requirements of Art. 123(2) EPC.

2.6 The Board adheres to the patent proprietor's view that the amendment of claim 2 amounts to the deletion of a feature that was rendered superfluous by the amendments made in claim 1. In particular considering the reading of claim 1 (see above sections 2.2 and 2.3), that amendment does not lead to an extension of the claimed subject-matter beyond the content of the application as filed.

2.7 Under those circumstances and in the absence of any further objections directed to the other claims of the main request, the opponents' objections pursuant to Art. 123(2) EPC cannot be followed.

3. Art. 56 EPC

3.1 Closest prior art

Both parties considered D8 as the closest prior art. The Board sees no reason to depart from that view.

3.2 Problem to be solved

It is derivable from paragraphs [3], [8] and [11] to [13] of the patent in suit that the problem solved over D8 may be seen, as argued by the patent proprietor, as providing a further process to produce expandable polystyrene at good conversion rates at a reduced finishing temperature, the polystyrene having an acceptable molecular weight and low amounts of residual monomers.

3.3 Solution

3.3.1 The solution proposed by the patent in suit resides in a process according to claim 1 and in an aqueous suspension according to claim 10.

3.3.2 D8 discloses a process for producing expandable styrene polymers (EPS) in which monomeric styrene is polymerized in aqueous suspension in the presence of at least two organic peroxides, A and B, wherein peroxide A has a half-life period of 1 hour at from 80°C to 100°C and peroxide B has a half-life period of 1 hour at from 110°C to 150°C, further wherein peroxide A decomposes at a lower temperature than peroxide B and is multifunctional; and whereby peroxide A initiates two or linked polymer chains on peroxide B to produce an expanded styrene polymer having a molar ratio B:A of the peroxides greater than 40:60 (claim 1). Preferably, peroxide A should have a one hour half-life decomposition temperature of 85-95°C (col. 2, lines 57-60). According to col. 3, lines 10-16, peroxide A is a multifunctional, preferably bifunctional, peroxide, particular preference being given to Triganox 141 which has a half life period of 1 hour at 86°C. However, Triganox 29 is also mentioned as suitable. In that respect, it was never disputed that "Trig**a**nox 29" of D8 was identical to "Trig**o**nox 29" of D2 (Board's emphasis), nor that it corresponded to the compound 1,1-bis(tert-butyl)(peroxy)-3,3,5-trimethylcyclohexane (the chemical name indicated in D8 in column 3, lines 14-15 does not correspond to a peroxide), which has a one hour half life decomposition temperature of 105°C (D2: page 10). In that respect, opponent 2's argument that the one hour half-life data of D2, measured in monochlorobenzene as solvent (D2: page 4), are representative for a one hour half-life measured in cumene as in the patent in suit, was not contested.

3.3.3 Therefore, the subject-matter of claims 1 and 10 differs from that of D8, in particular the embodiment directed to Triganox 29, in the chemical structure of the intermediate temperature peroxide being selected from the group consisting of a1) to a3).

3.4 Success of the solution - Problem effectively solved

3.4.1 Examples 5-8, 11 and 12 of the patent in suit disclose the preparation of polystyrene by a process comprising heating an aqueous composition comprising an intermediate temperature peroxide according to claim 1 (examples 5-8: "TOPA" or "TOPP" according to embodiment a1); example 11: "TAPMC" according to embodiment a3); example 12: "DTODPA" according to embodiment a2)) and one or two organic peroxide initiator(s) having a one hour half life decomposition temperature higher than that of said intermediate temperature peroxide (examples 5, 6, 11 and 12: "TAEC"; examples 7 and 8: "TAEC" and "TAP"). In that respect, although no data concerning the one hour half-life decomposition temperature of components TOPA, TOPP, TAPMC and DTODPA (the full chemical name of those compounds is not relevant for the present decision but may be found in paragraph [25] of the patent in suit) used in said examples were provided, those compounds are presented throughout the application as filed, as illustrative of intermediate temperature peroxides having a one hour half-life decomposition temperature of 101-111°C (see paragraphs [23]-[25] of the patent in suit); also, no evidence to the contrary was submitted. The compounds TAEC and TAP (the full chemical names of which is given e.g. in paragraph [45] of the patent in suit) are indicated in D13 (last paragraph on page 2) and in D2 (page 12: Trigonox 127) as having a one hour half-life decomposition temperature of 114°C and 118°C, respectively.

Example A of D13 is directed to a process similar to that of example 11, using TAPMC as intermediate temperature peroxide and TAEC as additional initiator having a higher one hour half-life decomposition temperature. Example B of D13 was run under the same conditions but using Trigonox 29 instead of TAPMC, i.e. according to the teaching of D8. In that respect, although the amounts by weight of initiator are different, the same amount of peroxy functionalities was used, so that those examples may be fairly compared, contrary to opponent 1's view. Also, the comparison of examples A and B shows that polystyrenes having similar properties are obtained, example A even showing some improvement in terms of residual styrene and molecular weight.

Although it is true that, as argued by opponent 2, there is no evidence on file, in particular neither in the patent in suit nor in D13, that expandable polystyrene was effectively produced using the polystyrenes so prepared, it is indicated in paragraphs [2] to [4] of the patent in suit that the preparation of expandable polystyrene belongs to the state of the art. It was also never contested that the polystyrenes prepared in examples 5-8, 11 and 12 of the patent in suit or in D13 were suitable for producing expandable polystyrene as specified in claim 1. This was also the conclusion of the first instance in respect of Art. 83 EPC (page 4 of the contested decision) for the patent in suit, which was not contested any further in the appeal proceedings. Under those circumstances and in the absence of any evidence to the contrary, there is no reason to consider that the problem identified above has not been solved at least when using TAPMC as intermediate temperature peroxide (i.e. according to embodiment a1)) and TAEC as additional initiator having a higher half-life temperature.

3.4.2 Examples 5-8 and 11-12 of the patent in suit and example A of D13 illustrate a process according to claim 1 using two embodiments of an intermediate temperature peroxide according to group a1) (TOPA and TOPP) and one embodiment of an intermediate temperature peroxide according to each of groups a2) (DTODPA) and a3) (TAPMC).

Although all those examples were performed using only TAEC as further organic peroxide initiator which has a higher one hour half-life decomposition temperature than that of the intermediate temperature peroxide (examples 5, 6, 11, 12) - optionally in combination with another organic peroxide initiator also having a higher one hour half-life decomposition temperature than that of the intermediate temperature peroxide (examples 7 and 8) - there is no evidence on file showing that the above problem is not solved over at least one part of the claims i.e. for at least one pair of initiators fulfilling the requirements of claim 1. Nor is there any reason to consider that that problem would not be solved by the polystyrenes prepared in examples 5-8 and 11-12 as characterised in Table 2 of the patent in suit. Therefore, the opponents' objection according to which the problem was not solved over the whole breadth of the claims is not supported by any evidence. In particular in the present circumstances of the case, in which the opponents contest the findings of the first instance in respect of an inventive step, it would have been the opponents' duty to submit convincing evidence or arguments in support of their objection or to show why the first instance decision was incorrect. Since that was not done, the opponents have not discharged their burden of proof. Therefore, their objection is not followed.

3.4.3 The same is valid regarding opponent 2's argument relying on the small difference between the one hour half-life decomposition temperatures of the initiators used in the examples of D13 or in the patent in suit. In the absence of any evidence that the problem is not solved when using initiators having more distinct one hour half-life decomposition temperatures, that objection is not supported by any evidence and cannot convince. Since that argument is not relevant for the present decision, there was no need for the Board to decide on its admission to the proceedings.

3.4.4 For those reasons, the above identified problem is held to be effectively solved for each of the alternative groups of intermediate temperature peroxides a1) to a3).

3.5 Obviousness

3.5.1 The question has to be answered if the skilled person desiring to solve the above identified problem would, in view of the prior art, have modified the disclosure of the closest prior art D8 in such a way as to arrive at the claimed subject matter.

3.5.2 During the oral proceedings before the Board, the opponents agreed that none of the documents disclosed organic peroxides according to embodiments a1) and a2) according to operative claim 1. Therefore, the opponents' objections were only directed to embodiment a3).

3.5.3 In that respect, D8 itself provides no hint at an intermediate temperature peroxide of group a3) and can, thus, not lead to the solution proposed by the main request.

3.5.4 The opponents' objection relied on the combination of D8 with D6, in particular using an initiator as disclosed in D6 instead of or in addition to Triganox 29 used as peroxide A according to D8.

(a) However, D8 specifically teaches to use as initiator A an organic peroxide having a one hour half-life decomposition temperature of 80-100°C, preferably 85-95°C (col. 2, lines 55-61).

Although it is true that D8 does not explicitly disclose the solvent to be considered for the measurement of the one hour half-life decomposition temperature and the parties all agreed that that information was essential in order for that parameter to make any sense, D8 discloses in col. 3, lines 11-14 that Triganox 141 has a one hour half-life decomposition temperature (or half-life period of 1 hour) at 86°C, which is identical to the value disclosed in D2 (page 9). Further considering that D2 is a commercial leaflet dealing with peroxide initiators and originating from the leading company Akzo Nobel (i.e. opponent 1 itself), the Board considers that the one hour half-life decomposition temperature values disclosed in D8 can be relied upon and may be compared to those of the patent in suit, in particular to the range of 101-111°C specified in operative claim 1.

Under these circumstances, the passage of D8 cited above teaches away from using a peroxide initiator having a one hour half-life decomposition temperature of 101-111°C as indicated in claim 1 instead of or in addition to Triganox 29 used as peroxide A.

(b) According to col. 1, lines 57-67 of D8, the use of multifunctional peroxide A instead of monofunctional peroxides is responsible for the improvement of the conversion rate while maintaining the molecular weight of polystyrene. In view of those considerations, the skilled person aiming at solving the above defined technical problem would be dissuaded from reducing the number of peroxide functional groups and substituting the multifunctional peroxides of D8 by a monofunctional peroxide according to embodiment a3) of operative claim 1 or to D6.

(c) In fact, D8 itself considers replacing part of the multifunctional peroxide A by conventional "monofunctional peroxide A'" which decompose at lower temperatures (col. 3, lines 35-42). However, it may be derived from the data provided in D2 that all the peroxides disclosed in that passage of D8 have a one hour half-life decomposition temperature significantly lower than the lower end of the range indicated in operative claim 1 for the intermediate temperature peroxide (101°C).

(d) When starting from the embodiment of D8 using Triganox 29 with a one hour half-life decomposition temperature of 105°C, which is not according to the general teaching of D8, the skilled person would have to decide to modify that teaching further and to use an additional organic peroxide which is also not as taught in D8. In the absence of any motivation to do so, such a modification of D8 cannot be considered obvious.

(e) D6 discloses the use as initiator for the polymerisation of styrene of cyclic monoperoxyketals (claims 1 and 7; col. 6, lines 45-49; examples 23-28), which exhibit a chemical structure that may correspond to that of group a3) according to operative claim 1. Example 24 of D6 in particular discloses the use of TAPMC, which is also used as an intermediate temperature peroxide in example 11 of the patent in suit and in example A of D13.

However, the teaching of D8 is to use as initiator A a multifunctional component i.e. a compound having at least two peroxide functionalities.

Under those circumstances, it is highly questionable if the skilled person would have considered D6, which is explicitly directed to monofunctional cyclic monoperoxyketals.

(f) Although D6 teaches that the cyclic monoperoxyketals disclosed therein may be advantageous as compared to cyclic bisperoxyketals (col. 19, lines 40-48), i.e. such as Triganox 29 and/or that they may be used as initiator for polymerising unsaturated monomers in combination with Triganox 29 (col. 7, lines 24-27 and 34-35), those statements are not made in respect of a process for producing expandable styrene polymers according to D8. Furthermore, those conclusions are drawn from experiments performed using a one-stage process in a sealed ampule and not a two-stage process carried out in an aqueous suspension as in D8. Therefore, the cyclic monoperoxyketals used in the examples of D6 are used as sole initiator and not as first stage initiators as in D8.

(g) In addition, the sole cyclic monoperoxyketal of D6 that was effectively shown to have a one hour half-life decomposition temperature in the range of 101-111°C, is TAPMC (see e.g. example 24 of D6). There is neither evidence on file nor was there any reason advanced by the opponents why the skilled person would have had any motivation to consider specifically TAPMC within the ambit of D6 and use it in replacement of or in addition to Triganox 29 according to D8.

(h) Under those circumstances, not only would the skilled person have to deviate significantly from the teaching of D8 in order to arrive at the subject-matter of operative claim 1, in particular initiator a3) (see above sections a-d), but also he would have had no good reason, without knowing the solution provided by the main request (hindsight), to combine the teaching of D8 and D6 (above sections e) to g)).

3.5.5 For those reasons the subject-matter of claim 1 is inventive.

3.5.6 The same reasoning is valid for claims 2-9 which depend on claim 1, as well as for claim 10.

3.5.7 Therefore, the main request fulfils the requirements of Art. 56 EPC.

4. Art. 84 EPC

4.1 Opponent 2, who was entitled to file an appeal but did not do so is, by virtue of Art. 107, second sentence, EPC, party as of right to these appeal proceedings initiated by opponent 1. Although opponent 2, as a non-appealing party as of right does not have the same procedural status in all respects as does an appellant (e.g. no right to continue appeal proceedings if the appellant withdraws its appeal), its right to be heard must be respected, in particular in respect of filing objections (Case Law of the Boards of Appeal of the EPO, 7th Ed., 2013, IV.E.2.4.3.b).

4.2 However, opponent 2's objection pursuant Art. 84 EPC was raised for the first time only about six weeks before the oral proceedings before the Board took place. The objection was related to the meaning of claim 1, in particular regarding the nature of the initiators that could or should be present in the aqueous suspension defined in step A of claim 1.

Filing a new objection at such a late stage of the proceedings is contrary to the stipulations of Art. 12 (2) RPBA, according to which opponent 2 should have presented its complete case in reply to the appellant's statement of grounds of appeal, which he had decided not to do. In the present case, opponent 2 also did not react to the summons to oral proceedings but made its first submission only in reply to the

Board's provisional opinion. No justification for such a late filing was provided by opponent 2, also not during the oral proceedings.

For the reasons given in sections 2.2 and 2.3 in respect of Art. 123 (2) EPC above, the Board did not consider that the main request *prima facie* lacked clarity as argued by opponent 2. Therefore, admitting said objection at such a late stage of the proceedings would have run counter the principle of procedural economy.

For that reason, the Board, making use of its discretionary power, did not admit that objection to the proceedings (Art. 13 (1) RPBA).

5. In view of the above the Board considers the patent proprietor's main request to be allowable. Therefore, there is no need to address the auxiliary requests.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to maintain the patent on the basis of the claims according to the main request filed with letter of 15 April 2015 and after any necessary amendment of the description.

The Registrar: On behalf of the Chairman
(according to Art. 8(3) RPBA):

Beschwerdekammern des Europäischen Patentamts
Boards of Appeal of the European Patent Office
Chambres de recours de l'Office européen des brevets

B. ter Heijden C. Brandt

Decision electronically authenticated