BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

Internal distribution code:
(A) [ ] Publication in OJ
(B) [ ] To Chairmen and Members
(C) [X] To Chairmen

D E C I S I O N
of 17 November 1999

Case Number: T 0272/98 - 3.3.3

Application Number: 90200762.4

Publication Number: 0390294

IPC: C08K 3/22

Language of the proceedings: EN

Title of invention:
Flame retardant composition

Patentee:
Shell Internationale Research Maatschappij B.V.

Opponent:
General Electric Company
BP International Limited Patents and Agreements Division

Headword:
-

Relevant legal provisions:
EPC Art. 114(1), (2); 56; 84; 123(2), (3)

Keyword:
"Inventive step - main request (no) - no limitation to comparable loadings of flame retardant"
"Inventive step - first auxiliary request (yes) - surprising increase in flame retardancy at comparable loadings of flame retardant"

Decisions cited:
G 0010/91; T 1002/92

Catchword:

-

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0272/98 - 3.3.3

D E C I S I O N
of the Technical Board of Appeal 3.3.3
of 17 November 1999

Appellant: (Proprietor of the patent)
Shell Internationale Research Maatschappij B.V.
Carel van Bylandtlaan 30
2596 HR Den Haag (NL)

Representative:
-

Respondent: (Opponent)
General Electric Company
1 River Road
Schenectady
NY 12345 (US)

Representative:
Grever, Frederik
General Electric Plastics B.V.
P.O. Box 117
4600 AC Bergen op Zoom (NL)

(Opponent)
BP International Limited Patents and Agreements Division
Chertsey Road
Sunbury-on-Thames
Middlesex TW16 7LN (GB)

Representative:
Hoey, Shona
BP International Limited
Patents and Agreements Division
Chertsey Road
Sunbury-on-Thames
Middlesex TW16 7LN (GB)

Decision under appeal:
Decision of the Opposition Division of the European Patent Office dated 26 November 1997, issued in writing on 4 February 1998 revoking European patent No. 0 390 294 pursuant to

Article 102(1) EPC.

Composition of the Board:

Chairman: C. Gérardin
Members: R. Young
J. A. Stephens-Ofner

Summary of Facts and Submissions

I. The mention of the grant of European patent No. 0 390 294 entitled "Flame retardant composition", in respect of European patent application No. 90 200 762.4, filed on 28 March 1990 and claiming a GB priority of 2 May 1989 (GB 8910011) as well as a US priority of 31 March 1989 (US 332250) was published on 7 June 1995 (Bulletin 95/23).

II. Notices of Opposition were filed, respectively, by General Electric Co., (Opponent OI), on 17 February 1996, and by BP Chemicals Limited (Opponent OII) on 7 March 1996, in each case on the ground of lack of inventive step (Article 100(a) EPC). The oppositions were supported *inter alia* by the documents:

D1: "Flame-Retardant Polymeric Materials", Edited by M. Lewin et al., vol. 3, 1982;

D2: Hornsby et al., "Mechanism of smoke suppression and fire retardancy in polymers containing magnesium hydroxide filler", Plastics and Rubber Processing and Applications, vol. 11, No. 1, 1989, pages 45 to 51;

D4: L. R. Holloway, "An introduction to Magnesium Hydroxide - A Flame Retardant and Smoke Suppressant", PRI and BPF Joint Conference on Fillers '86, London U.K., March 1986, Paper 22;

D6: L. Keating et al., "Magnesium Hydroxide: A Halogen Free Flame and Smoke Suppressant for Polypropylene", Joint Meeting of Society of

Plastics Engineers and The Fire Retardant Chemicals Association, March 1985; and

D9: M. Moseman et al., "Smoke properties of highly filled ethylene-propylene-diene terpolymer rubbers", Rubber Chemistry and Technology, vol. 51, 1978, pages 970 to 976.

A further document:

D10: US-A-4 761 449,

which was mentioned in the patent in suit itself, was cited by the Patentee in a submission filed on 31 October 1996.

III. By a decision which was given at the end of oral proceedings held on 26 November 1997 and issued in writing on 4 February 1998, the Opposition Division revoked the patent. The decision was based on a request including two amended sets of claims, both filed on 31 October 1996, and consisting of: a first set of Claims 1 to 10 for all designated Contracting States except ES, and a second set of Claims 1 to 10 for the designated Contracting State ES. Claim 1 of the set for all designated Contracting States except ES read as follows:

"Flame-retardant polymer compositions comprising a linear alternating copolymer of carbon monoxide and at least one ethylenically unsaturated compound, and at least a flame-retardant quantity, being at most 40% mass of the total composition, of a substance which is able to generate, upon decomposition, a

flame-retardant gaseous compound, and which is a metal compound selected from the group of compounds consisting of oxalates and hydroxides, which compound either is a basic reacting compound or forms a basic reacting compound upon decomposition, and has an initial decomposition temperature which is at least 25°C higher than the crystalline melting temperature of said polymer."

Claims 2 to 10 were dependent claims directed to elaborations of the compositions according to Claim 1.

Claim 1 of the set for the designated Contracting State ES read as follows:

"Process for preparing a flame-retardant polymer composition which process comprises combining a linear alternating copolymer of carbon monoxide and at least one ethylenically unsaturated compound, and at least a flame-retardant quantity, being at most 40% mass of the total composition to be prepared, of a substance which is able to generate, upon decomposition, a flame-retardant gaseous compound, and which is a metal compound selected from the group of compounds consisting of oxalates and hydroxides, which compound either is a basic reacting compound or forms a basic reacting compound upon decomposition, and has an initial decomposition temperature which is at least 25°C higher than the crystalline melting temperature of said polymer."

Claims 2 to 10 were dependent claims directed to elaborations of the process according to Claim 1.

According to the decision, the subject-matter of Claim 1 of the first set differed from the disclosure of D10, which was considered to be the closest state of the art, in that a metal compound selected from oxalates and hydroxides, which was either a basic reacting compound or formed a basic reacting compound on decomposition, was present as flame retardant instead of an alkaline earth metal carbonate. In view of the comparative data in the patent in suit, the objective technical problem solved by the distinguishing feature was to provide compositions of linear alternating copolymers of carbon monoxide and at least one ethylenically unsaturated compound with improved flame resistance. It was, however, known from D1, D6 and D9, that both calcium carbonate and magnesium hydroxide were applicable as a flame retardant to a wide range of unrelated polymers. Furthermore it was evident that in all cases magnesium hydroxide was more effective than calcium carbonate, which was attributed to magnesium hydroxide being an active filler, whilst calcium carbonate was inert. Consequently, the skilled person would expect the more efficient flame retardant, magnesium hydroxide, to be effective in amounts no higher and even lower than those disclosed in D10, which already gave good Limiting Oxygen Indices (LOI's). Consequently, the part of Claim 1 which concerned metal hydroxides did not involve an inventive step. The part of Claim 1 which concerned metal oxalates did involve an inventive step, however, since the relevant cited literature did not give any indication that the flame-resistance of polymers in general was improved by the addition of metal oxalates instead of carbonates.

IV. A Notice of Appeal against the above decision was filed on 11 March 1998, together with payment of the prescribed fee.

In the Statement of Grounds of Appeal, which was filed on 12 June 1998, as well as in further submissions filed on 1 June 1999 and 10 September 1999, respectively, the Appellant (Patentee) argued, in substance, as follows:

(a) Whilst the decision under appeal referred to the replacement of calcium carbonate by magnesium hydroxide, the solution to the technical problem should rather be seen as the replacement of a carbonate moiety according to D10 by a hydroxide or oxalate moiety of the **same** metal. Since none of the documents provided such a comparison, it could not be concluded that this solution was obvious.

(b) Even for a solution consisting of the replacement of calcium carbonate by magnesium hydroxide, the statement in the decision under appeal, that "in all cases magnesium hydroxide was more effective than calcium carbonate" was an unjustified generalisation of the state of the art and could not be considered as a general teaching for all polymer compositions. Furthermore, it was clear from the results in D10 that calcium carbonate was an active filler in polyketones. Consequently, there was no reason for expecting its replacement by another active filler, such as magnesium hydroxide, would lead to improved flame retardancy.

(c) Quite apart from this, a strong prejudice existed in the art against employing an amount of the flame retardant of at most 40% mass. Not less than six documents taught that magnesium hydroxide needed to be used at **high** loadings, D4 disclosing 55 to 60% mass and a further document teaching to use 100 to 200 parts by weight per 100 parts by weight plastics material in order to impart flame retardancy. Furthermore, it was not obvious that the treated polyketones could be successfully melt processed, because ketones were known to be reactive with bases.

The Statement of Grounds of Appeal referred for the first time to two further documents:

D12: GB-A-1 398 207; and

D13: Kirk-Othmer, Encyclopedia of Chemical Technology, 3rd Edition, Volume 10, page 351 (1980).

It was also accompanied by Additional Examples A-H comparing the flame retardant performance, in a polyketone polymer, of magnesium hydroxide with that of various commercially available flame retardants.

The submission filed on 1 June 1999 was accompanied by a passage from:

D26: K. P. C. Vollhardt, "Organic Chemistry", W. H. Freeman & Co., New York, USA, pages 689 to 691.

The submission filed on 10 September 1999 was accompanied by further experimental data to enable a comparison of the flame retardant effect of magnesium hydroxide with that of magnesium carbonate.

V. Respondent I (Opponent I) filed, in a submission filed on 5 January 1999, a general statement that it considered the grounds of opposition well founded.

VI. Respondent II (Opponent II) referred, for the first time, in a submission filed on 16 December 1998, to twelve further documents, numbered D14 to D25, and argued substantially as follows:

(a) It was part of the common general knowledge of the skilled person that metal hydroxides were effective flame retardants for polymer compositions. Consequently, by using a metal hydroxide as a flame retardant for a polyketone, the skilled person would be using a known compound on the basis of its known properties to obtain a known effect. It was not considered that the skilled person would be compelled to compare the flame retardant properties of compounds having the same metal.

(b) Whilst the Appellant's formulation of the technical problem was not accepted, nevertheless according to D1, D6 and D9, magnesium hydroxide was taught to be a better flame retardant than calcium carbonate for a range of polymeric materials. Consequently, the skilled person would expect an advantageous effect to result from using magnesium hydroxide as a flame

retardant for polyketones. Any "bonus" effect could not be used to substantiate an inventive step, as it would have been obvious for the skilled person to use magnesium hydroxide in the first place.

(c) As to the quantity of magnesium hydroxide to be used, there were widespread teachings in the state of the art which overlapped the percentages required in the patent in suit, and in any case the percentages taught in D10 corresponded to those amounts. Consequently, there was no prejudice in the art against using magnesium hydroxide in the relevant quantities.

VII. With a submission received on 14 October 1999, the Appellant filed alternative sets of claims forming three auxiliary requests, each request including one set of claims for all designated Contracting States except ES and one set for the designated Contracting State ES.

(a) *First auxiliary request*

(a1) "Alternative Claims I (for all designated Contracting States except ES)"

Claim 1 reads as follows, with expressions originally present in, but deleted from, the corresponding claim of the main request being in [square brackets], and newly added wording in **bold type**:

"Flame-retardant polymer compositions

[comprising] **consisting of** a linear alternating copolymer of carbon monoxide and at least one ethylenically unsaturated compound, and at least a flame-retardant quantity, being at most 40% mass of the [total] composition, of a substance which is able to generate, upon decomposition, a flame-retardant gaseous compound, and which is a metal compound selected from the group of compounds consisting of oxalates and hydroxides, which compound is either a basic reacting compound or forms a basic reacting compound upon decomposition, and has an initial decomposition temperature which is at least 25°C higher than the crystalline melting temperature of said polymer."

Claims 2 to 10 are dependent claims identical with Claims 2 to 10, respectively, of the corresponding set of claims of the main request, except for editorial amendment of Claims 4 and 5 for consistency with Claim 1.

(a2) "Alternative Claims I (for designated Contracting State ES)"

Claim 1 reads as follows, with expressions originally present in, but deleted from, the corresponding claim of the main request being in [square brackets], and newly added wording in **bold type**:

"Process for preparing a flame-retardant polymer composition [which process comprises combining] **consisting of** a linear alternating copolymer of

carbon monoxide and at least one ethylenically unsaturated compound, [and at least a flame retardant quantity, being at most 40% mass of the total composition to be prepared, of] a substance which is able to generate, upon decomposition, a flame-retardant gaseous compound, and which is a metal compound selected from the group of compounds consisting of oxalates and hydroxides, which compound either is a basic reacting compound or forms a basic reacting compound upon decomposition, and has an initial decomposition temperature which is at least 25°C higher than the crystalline melting temperature of said polymer**, which process comprises combining the said polymer and at least a flame-retardant quantity, being at most 40% mass of the composition to be prepared, of the said substance**."

Claims 2 to 10 are dependent claims identical with Claims 2 to 10, respectively, of the corresponding set of claims of the main request, except for editorial amendments in Claims 4 and 5 to provide consistency with Claim 1.

(b) *Second auxiliary request*

(b1) "Alternative Claims II (for all designated Contracting States except ES)":

Claim 1 is identical with Claim 1 of the corresponding set of claims of the main request, except that the expression "oxalates and hydroxides" has been amended by deletion of the

words "oxalates and".

Claims 2 to 10 are identical with Claims 2 to 10, respectively, of the corresponding set of claims of the main request.

(b2) "Alternative Claims II (for designated Contracting State ES)":

Claim 1 is identical with Claim 1 of the corresponding set of claims of the main request, except that the expression "oxalates and hydroxides" has been amended by deletion of the words "oxalates and".

Claims 2 to 10 are identical with Claims 2 to 10, respectively, of the corresponding set of claims of the main request.

(c) *Third auxiliary request*

(c1) "Alternative Claims III (for all designated Contracting States except ES)":

Claim 1 is identical with Claim 1 of the corresponding set of "Alternative Claims I", except that the expression "oxalates and hydroxides" has been additionally amended by deletion of "oxalates and".

Claims 2 to 10 are identical with Claims 2 to 10, respectively, of the corresponding set of "Alternative Claims I".

(c2) "Alternative Claims III (for designated Contracting State ES)":

Claim 1 is identical with Claim 1 of the corresponding set of "Alternative Claims I", except that the expression "oxalates and hydroxides" has been amended by deletion of "oxalates and".

Claims 2 to 10 are identical with Claims 2 to 10, respectively, of the corresponding set of "Alternative Claims I".

With the same submission, the Appellant furthermore filed a Declaration of the technical expert Dr Troitzsch (D27), as well as two documents pertaining thereto (D28 and D29).

VIII. Respondent II complained, in a letter filed on 2 November 1999, that the newly filed documents D27, D28 and D29 and the alternative sets of claims had been filed too late to allow of a written response.

IX. Oral proceedings were held on 17 November 1999, at which only the Appellant was represented, the Respondents having informed the Board by letters of 4 August 1999 and 11 August 1999, respectively, that they would not attend the hearing. The Board initially considered the admissibility of the further requests, as well as of the further facts, evidence and related arguments filed during the appeal proceedings. After hearing the Appellant, the Board decided to admit the sets of claims constituting the first, second and third auxiliary requests, as well

as the Declaration of Dr Troitzsch together with its enclosures (D27 to D29), all filed by the Appellant on 14 October 1999. It decided, however, to disregard the following late-filed submissions:

(i) Documents D12 and D13 cited for the first time by the Appellant with the Statement of Grounds of Appeal as well as D26 (passage of an ordinary textbook) cited for the first time in the Appellant's submission filed on 1 June 1999.

(ii) The documents numbered D14 to D25, filed by Respondent II with the submission of 16 December 1998.

During the presentation of the substantive part of its case, the Appellant filed a photocopy of a page from the document D2, showing a graph (Figure 2), which had been modified to illustrate a comparison with the subject-matter of the patent in suit. This was introduced into the proceedings as D30.

During the oral proceedings, the Appellant, at the Board's invitation, presented its substantive arguments in respect of all the sets of claims forming the main and auxiliary requests relied upon.

X. The final requests of the parties were as follows:

The Appellant requested that the decision under appeal be set aside, and the patent in suit maintained on the basis of the claims annexed to the decision under appeal (main request) or either of claim sets I, II and III filed by way of auxiliary

requests on 14 October 1999.

Respondent I requested that the appeal be dismissed (letter of 5 January 1999).

Respondent II requested (i) that the Board disregard the Declaration of Dr Troitzsch and its enclosures, as well as the alternative sets of claims filed with the submission of 14 October 1999 (letter of 2 November 1999); and (ii) that the decision of the Opposition Division be upheld, i.e. that the appeal be dismissed (letter of 16 December 1998).

Reasons for the Decision

1. The appeal is admissible.

2. *Admissibility of late-filed documents*

The primary function of an appeal, according to the principles set out in the Enlarged Board opinion G 10/91 (OJ EPO 1993, 420), is to give the losing party the chance to challenge the decision of the Opposition Division on its merits. This presupposes that the legal and factual framework of the proceedings does not change following the issue of the first instance decision (T 1002/92, OJ EPO 1995, 605; Reasons, 3.4 (2); supplementing G 10/91).

A large number of documents was, however, filed for the first time in appeal, specifically (i) documents D12 and D13, filed by the Appellant with the Statement of Grounds of Appeal; (ii) documents D14 to

D25, filed by Respondent II with the submission of 16 December 1998, and (iii) document D26 cited by the Appellant in the submission filed on 1 June 1999, as well as the Declaration of Dr Troitzsch (D27) and its enclosures (D28 and D29) filed by the latter party on 14 October 1999. They will be dealt with in turn.

2.1 Documents D12 and D13

Whilst it was argued by the Appellant at the oral proceedings that D12 was crucial to refute the point, made in the decision under appeal, that magnesium hydroxide was shown in the prior art "in all cases" to be a more efficient flame retardant than calcium carbonate, it was evident that the document related only to a class of narrowly defined copolymers containing acrylonitrile-vinyl chloride units, with which calcium carbonate is known to react, in contrast to the polymers disclosed in the documents already referred to in the proceedings. It thus did not relate to polymers of a sufficiently similar character to those in the documents hitherto cited, in the Board's view, to be capable of refuting the point at issue.

As to D13, this merely disclosed the amount, in tons per year, of the world production of certain commercially available flame retardants, none of which, however, had any discernible relationship to the flame retardants with which the patent in suit is concerned. Its relevance was not apparent to the Board.

Consequently, D12 and D13 were excluded from

consideration under Article 114(2) EPC.

2.2 Documents D14 to D25

The introduction of D14 to D25, filed by Respondent II with the submission of 16 December 1998, was objected to by the Appellant, principally on the grounds of lack of relevancy (submission filed on 1 June 1999).

On the basis of the written submissions in relation to the above documents, the Board has concluded that, to the extent that their disclosures relate to that part of the subject-matter of the patent in suit in respect of which the decision under appeal found a lack of inventive step (i.e. metal hydroxides as flame retardants), they are no more relevant than those already in the proceedings. Furthermore, to the extent that they relate to that part of the subject-matter in respect of which the decision under appeal was positive in that it recognised the presence of an inventive step (metal oxalates as flame retardants), they do not fulfil the criterion, set out in the decision T 1002/92, referred to above, of being *prima facie* highly relevant in the sense of being highly likely to prejudice maintenance of the patent in suit (Reasons for the decision, point 3.4).

Consequently, all these documents were excluded from consideration under Article 114(2) EPC.

2.3 Documents D26 to D29

2.3.1 Document D26 is an extract from an ordinary textbook

on Organic Chemistry, and concerns the reactions of ketones with bases. It was cited to support an argument of the Appellant concerning the melt processability of the compositions according to the patent in suit. Not only does the issue of melt processability not figure in the decision under appeal, but the document is in any case not concerned with linear polyketones as such. Consequently, neither the effect relied upon nor the document cited to support it are relevant to the appeal. Therefore, the Board has decided to exclude D26 from consideration pursuant to Article 114(2) EPC.

2.3.2 As regards the content of the Declaration of Troitsch (D27), this amounts only to new argumentation related to the case as it stands. There is no basis, in the Board's opinion, for objecting to the introduction of such new arguments, even when adduced at a late stage of the proceedings. On the contrary, one of the purposes of oral proceedings is to allow a party the opportunity better to present its original case. This must, in the Board's view, admit of the use of new arguments. The determination of another party not to attend such oral proceedings cannot, in the Board's view, qualify as a valid reason to confine the scope of those proceedings by suppressing such new arguments. Consequently, there was no valid reason for disregarding the content of D27.

2.3.3 The enclosure D28 which is a list of studies and expert opinions by Dr Troitzsch forms, in the Board's view, part of the *curriculum vitae* of Dr Troitzsch, and thus effectively forms part of the Declaration itself. There was equally no valid ground for

excluding it from consideration.

2.3.4 The content of D29, an excerpt from the "International plastics flammability handbook" (Hanser Verlag, 1983), by Dr Troitzsch, which is referred to in the Declaration (paragraph 8), is considered to relate to common general knowledge, cited in support of an argument put forward in the Declaration (paragraph 8). It is not considered to go beyond the factual framework of the case hitherto, since that framework also includes such common general knowledge. Consequently, there was no valid reason for excluding D29 from consideration.

2.3.5 In summary, D26 was excluded, but D27 to D29 admitted into the proceedings.

2.4 Document D30

Document D30, filed by the Appellant at the oral proceedings before the Board, consisted of the superimposition of data relating to the flame retardancy performance of magnesium carbonate and hydroxide in polyketone compositions according to the patent in suit, illustrating previous (admitted) submissions of the Appellant, on the background of a graph in Figure 2 of D2, the latter showing the flame retardant performance of magnesium hydroxide in other conventional polymers. The comparison thus presented involved only information which was already in the procedure, the difference lying solely in the visual presentation. Consequently, the new presentation amounted effectively only to further argument. The question of late submission therefore did not arise,

and the document was consequently admitted to the proceedings.

3. *Admissibility of further experimental evidence*

No objection was raised by either of the Respondents to the further experimental data filed by the Appellant, together with the Statement of Grounds of Appeal (additional Examples A-H) or together with the submission on 10 September 1999 (section IV, last two sentences, above). Consequently, they were taken into consideration by the Board.

4. *Admissibility of further requests*

Respondent II objected to the introduction of the sets of claims labelled "Alternative Claims I" to "Alternative Claims III", filed on 14 October 1999, as being too late. These claims were, however, filed more than one month before the oral proceedings, and furthermore involve only minor, restrictive amendments such as might have been expected in any case. They thus do not go beyond the framework of the case so far. Even if, as stated in the letter of 2 November 1999, the Respondent only received these claims three weeks before the oral proceedings, the amendments were of such a nature, in the Board's view, that their allowability and significance could be ascertained without undue difficulty in the time remaining. Consequently, the Board does not regard them as filed so late as to require a negative exercise of its discretion in this respect. Therefore, the sets of claims forming the auxiliary requests filed on 14 October 1999 were admitted into

the proceedings.

5. *Admissibility of amendments*

5.1 Main request

This corresponds to the two sets of Claims 1 to 10 underlying the decision under appeal. No objections were raised under Article 123(2) or (3) or Article 84 EPC to these claims by the Respondents, and none are apparent to the Board. Consequently, the requirements of these Articles of the EPC are held to be met.

5.1.1 In this connection, however, it is necessary to remark that Claim 1 of the main request (both sets of claims) does not require any particular ratio of metal hydroxide to polyketone, since it defines the quantity of the latter on the basis of "the total composition", the latter only "comprising" a polyketone and a metal hydroxide. Thus the claim evidently covers the possibility of a relatively large quantity of some further (possibly non-flammable) component being present.

5.1.2 This could result, at a content of metal hydroxide of, say, 40% by weight based on the total composition, in a loading **relative to the polyketone** well in excess of 40% by weight. Whilst not giving rise, in the Board's view, to an objection of lack of clarity under Article 84 EPC, it nevertheless means that the claim should be interpreted as covering the addition of metal hydroxide/oxalate in amounts limitlessly greater, relative to polyketone, than 40% by weight.

5.2 First auxiliary request ("Alternative Claims I")

5.2.1 Claims 1 to 10 (all designated States except ES)

Claim 1 differs from the corresponding claim of the main request by the replacement of "comprising" by "consisting of". This limits the compositions defined by the claim to only two components, namely the polyketone component and the flame retardant metal compound component, together with consequential amendment of the phrase "total composition" to "composition".

5.2.1.1 There is a basis for this amendment in the examples, in which only the polyketone and the flame retardant metal compound are present, and in the general description on page 4 at lines 37 to 38, according to which "The polymer composition, in addition to polymer and flame retardant compound, may incorporate other conventional additives which do not detract from the flame retardant character of the composition." Thus, it is evident that the preferred composition consists only of the polymer and the flame retardant compound. Hence, the amended claim meets the requirements of Article 123(2) EPC.

5.2.1.2 Furthermore, the fact that Claim 1 has been limited to a composition consisting of only two components instead of any number of components including two, means that Claim 1 as amended is narrower in scope than Claim 1 as granted. Consequently, the amended claim also meets the requirements of Article 123(3) EPC.

5.2.1.3 Finally, the amendment of "comprising" to "consisting of" also meets the requirements of Article 84 EPC in that it reflects the Appellant's actual contribution to the art and contributes to a clear definition of the claimed subject-matter. The term "consisting of", in this connection, is considered to include the flame retardant compound when applied in any of its pre-treated forms as foreseen, for instance in Claims 6 to 10.

5.2.1.4 As it emerges from the arguments put forward by the Appellant, the effect relied upon during the proceedings is to be found in the improved effectiveness of the flame retardants required according to the patent in suit, compared with calcium or magnesium carbonate according to D10, **at a comparable loading** of the polyketone. The present wording of Claim 1, which now explicitly requires a particular ratio of flame retardant compound to polyketone, makes it possible to accept, as relevant, the arguments of the Appellant in relation to relative flame retardancy and hence inventive step.

5.2.1.5 In summary, the amended set of claims (all designated Contracting States except ES) meets the requirements of Articles 123 and 84 EPC.

5.2.2 Claims 1 to 10 (for designated Contracting State ES)

Similar considerations apply to this set of claims, since these have been amended in an analogous manner to the set for all designated Contracting States except ES.

Consequently, this amended set of claims equally meets the requirements of Articles 123 and 84 EPC, and furthermore reflects the Appellant's actual contribution.

5.3 Second auxiliary request ("Alternative Claims II")

These claims (both sets) differ from the corresponding claims of the main request in that the alternative "oxalates" has been deleted. The deletion of this alternative embodiment does not comprise added subject-matter in the sense of Article 123(2) EPC. Furthermore, it involves a restriction in the scope of the relevant claim and thus does not infringe Article 123(3) EPC. Nor does any other objection arise as a result of the restriction. Consequently, this request meets the requirements of Articles 123 and 84 EPC.

5.4 Third auxiliary request (Alternative Claims III)

These claims (both sets) represent a combination of the limitations introduced in both the first and second auxiliary requests. The requirements of Articles 123 and 84 EPC are met for reasons analogous to those given in respect of those requests.

6. *Novelty*

The novelty of the claimed subject-matter was not disputed and indeed was conceded. Consequently, the only substantive issue remaining in the case is that of inventive step.

7. *The patent in suit; the technical problem*

The patent in suit is concerned with flame retardant compositions comprising a linear alternating copolymer of carbon monoxide and at least one ethylenically unsaturated compound (i.e. a polyketone), and at least a flame-retardant quantity of a substance which is able to generate, upon decomposition, a flame-retardant gaseous compound, the substance being a metal oxycompound which has an initial decomposition temperature at least 25°C higher than the crystalline melting temperature of the polymer (cf. Claim 1).

Such a composition is known, however, from the state of the art, in particular as represented by D10 which was, by general consent, the closest state of the art.

7.1 According to D10, there is disclosed such a composition which contains from about 2% to 30%, preferably 5% to 15% by weight, based on the total composition, of an alkaline earth metal carbonate selected from magnesium carbonate and calcium carbonate (Claims 1, 2). According to an illustrative embodiment, a terpolymer of carbon monoxide, ethylene and propylene having a limiting viscosity number (LVN) of 1.60 measured at 60°C in m-cresol, and a melting point of 219°C, which had been blended with calcium carbonate in amounts of 5%, 10% and 25% by weight based on the total composition, had a limiting oxygen index (LOI) of 23-23.5, 25.5-26 and 27-27.5, respectively, compared with 18.5-19 for a control containing no calcium carbonate ("Illustrative Embodiment I" and "Illustrative Embodiment II"; column 4, line 30 to column 5, line 18). According to

a further embodiment, similar results were obtained when a blend of such a polymer and magnesium carbonate was produced by a similar procedure ("Illustrative Embodiment III"; column 5, lines 20 to 26).

7.2 Compared with the above disclosure, the technical problem arising is seen, in accordance with the decision under appeal, as being to provide compositions of linear alternating copolymers of carbon monoxide and at least one ethylenically unsaturated compound with **improved** flame retardancy (emphasis by the Board).

7.2.1 The solution proposed according to Claim 1 of the **main request** (both sets) of the patent in suit is to provide, instead of the alkaline earth metal carbonate flame retardant according to D10, at least a flame-retardant quantity, being at most 40% mass **of the total composition**, of a flame retardant compound selected from the group of compounds consisting of metal oxalates and hydroxides, which compound is a basic reacting compound or forms a basic reacting compound on decomposition.

7.2.2 The solution proposed according to Claim 1 of the **first auxiliary request** (both sets) of the patent in suit is to provide at least a flame-retardant quantity of the same flame retardant compound, being at most 40% mass of a composition **consisting of** the polyketone and the flame retardant compound.

7.2.3 The solution proposed according to Claim 1 of the **second auxiliary request** (both sets) of the patent in suit corresponds to that of the main request, except that the flame retardant compound may **no longer be selected** from a group of compounds including **oxalates**.

7.2.4 The solution proposed according to Claim 1 of the **third auxiliary request** (both sets) of the patent in suit corresponds to that of the first auxiliary request, except that the flame retardant compound may **no longer be selected** from a group of compounds including **oxalates**.

7.3 The effectiveness of the solution will be investigated for each request in turn.

It can be seen from a comparison of Experiments 9 or 11 with Experiment 7 of Example X of the patent in suit, that the presence, in a polyketone terpolymer, of magnesium hydroxide at a level of 20% by weight, based on the composition, provided a LOI of 32.5 or 30.5, respectively, compared with 22.5 for a similar amount of calcium carbonate (Table II). The value of LOI for such a terpolymer without the addition of any such compound was 19 (Table I). Thus the difference in LOI, corresponding to the increase in flame retardancy, compared with an untreated control polyketone terpolymer, is about 11 units for magnesium hydroxide at the stated level, compared with 3 units for a similar level of calcium carbonate addition.

The results of replacing magnesium carbonate in accordance with D10 by magnesium hydroxide at a similar additive level can be elucidated in the light

of the "Further Experimental Data" filed by the Appellant on 10 September 1999, which have not been challenged as to their accuracy. According to the latter, the LOI for the addition of magnesium carbonate at 20% by weight of the total composition of a polyketone terpolymer, is 27.6 compared with 21 for the untreated polymer. This corresponds to an increase in LOI, consequent upon adding magnesium carbonate, of 6.6 units. Reference to Example VII (Table I) or Experiment 9 of Example X (Table II) according to the patent in suit shows, furthermore, that a similar loading of magnesium hydroxide according to the patent in suit leads, compared with the untreated polymer, to an increase in LOI of about 11 units.

Consequently, it is evident that the extent of flame retardancy is very substantially improved - indeed it is practically doubled - using a calcium hydroxide or magnesium hydroxide flame retardant according to the patent in suit, rather than calcium carbonate or magnesium carbonate, respectively, according to the closest state of the art.

Similar conclusions may be drawn in relation to the use of a metal oxalate, from the results of using calcium oxalate at a level of 20% by weight of the polyketone composition. This gives a LOI of 29, compared with 19 for the untreated polymer (Example VI, Table I).

7.3.1 Whilst Respondent II indicated that it rejected the statement of problem adopted (section VI(b), above), which corresponds to that formulated in the decision under appeal, it did not directly challenge the

accuracy of the experimental data supplied by the Appellant, whether in the patent specification itself, or in its subsequent submissions. These data demonstrate, however, an improvement in flame retardancy, at comparable loading, of metal hydroxides and metal oxalates over the corresponding metal carbonates, which represents a considerable technical advantage over D10. Consequently, the Board sees no reason to resile from the formulation of the technical problem in terms of an "improvement" in flame retardancy, or, therefore, to relegate the observed improvement in flame retardancy to a mere "bonus effect".

7.3.2 As to the requirement on the solution imposed by the Appellant, that it involve the replacement of a carbonate according to D10 by a hydroxide of the **same** metal (section IV(a), above), whilst it is of course necessary that the relevant effect is obtained even when the metal used is the same as that in the prior art flame retardant, the Board sees no justification for formulating the solution in such narrow terms, because Claim 1 of the patent in suit contains no such limitation. Quite to the contrary, the nature of the metal in the hydroxide or oxalate is left unspecified. The effectiveness of such a solution has, however, in the Board's view, been adequately demonstrated by the data already on file, even when the metal is the same.

7.3.3 In summary, the Board finds it credible that the application of the relevant flame retardant compounds (hydroxide or oxalate) at loadings relative to polyketone comparable with to those set out in D10 results in an improved level of flame retardancy.

Consequently, it is credible to the Board that the measures claimed in each of the main and first, second and third auxiliary requests provides an effective solution of the technical problem.

8. *Inventive step*

Whilst it was not disputed that the use of the flame retardant metal compounds according to the patent in suit resulted in an improvement in the flame retardancy of a polyketone, compared with the use, at similar loadings, of calcium or magnesium carbonate according to D10 (section 7.1, etc., above), nevertheless the significance for and, more particularly, the predictability by the skilled person, of such an increase in flame retardancy was a matter of disagreement between the Appellant and the Respondents. It is the task of the Board, in determining the issue of inventive step, to ascertain to what extent the observed increase was indeed predictable and therefore obvious. It will be necessary to deal with each of the relevant requests in turn.

8.1 Main request

In practice, the relevant question boils down to whether the skilled person, starting from D10, would have expected that replacing calcium carbonate by a metal hydroxide such as calcium or magnesium hydroxide, or by a metal oxalate, in an amount up to 40% by weight **based on the entire composition** would lead to an improved flame retardant performance.

8.1.1 There is no suggestion to make such a replacement in D10 itself, since the latter teaching is exclusively concerned with the carbonates themselves (Claim 1). There is thus no basis in the teaching of D10 itself for the skilled person to expect any particular level of flame retardant performance from an additive other than the calcium and magnesium carbonates specifically disclosed in this respect.

8.1.2 The essence of the Respondents' case relied upon a general teaching, derivable from other documents in the proceedings, in particular D1, D6 and D9, that magnesium hydroxide was a better flame retardant than calcium carbonate, at comparable loadings, in a wide variety of conventional polymer systems other than polyketones.

8.1.2.1 It is certainly true that, according to D1, in a comparison of fillers added, at a level of 53% by weight, to a styrene-butadiene rubber (SBR) foam, the following results were obtained in terms of oxygen index:

Filler	OI
None	18.5
$CaCO_3$	18.5
$Al(OH)_3$	24.0
$Mg(OH)_2$	24.0

(page 59, Table 10 in conjunction with first full paragraph).

Thus, it is evident that magnesium hydroxide provided an increase in LOI of 5.5 points, compared with

calcium carbonate, which provided no LOI increase at all, over that of the untreated SBR foam.

8.1.2.2 A like conclusion can be reached from the disclosure of D6 in relation to the addition of fillers to polypropylene (PP), since magnesium hydroxide, at a loading of 60% by weight achieved the maximum level of flame retardancy "V 0", according to the Underwriter's Laboratory "UL V O" test, whereas calcium carbonate did not result in a complete flame retardancy, the performance only reaching the level termed "V 1", at a correspondingly high loading (page 131, Table 2).

8.1.2.3 Finally, a similar pattern of performance is evident from D9, according to which the presence of various fillers, at a level of 64% by weight in EPDM rubber gave the following results:

Filler	LOI
$Mg(OH)_2$	34.0
$Al(OH)_3$	31.0
Soft clay	25
$CaCO_3$	21

(page 974, Table III).

Whilst the LOI of the untreated host polymer is not stated in D9, it is nevertheless evident that the presence of magnesium hydroxide gives a higher value of the LOI than does calcium carbonate.

8.1.3 The evidently higher flame retardant efficiency of magnesium hydroxide compared with calcium carbonate, at comparable loadings, in the above classes of

polymers, is reflected, in D1, in a correspondingly different categorisation of the two fillers.

8.1.3.1 In this connection, it is stated in D1 that calcium carbonate belongs to a category of fillers which are termed "inert", and which act by a diluting and heat absorbing effect. Such fillers usually give only marginal improvements in flame resistance, unless present at very high concentrations (page 56, sub-paragraph 3.2.1.1, section a).

8.1.3.2 In contrast, magnesium hydroxide is attributed to the category of "active" fillers, which not only serve the same diluent and heat absorption functions, but also absorb more heat per unit weight through endothermal processes such as dehydration or calcination (page 57, sub-paragraph 3.2.1.1, section b).

8.1.4 The additional flame retardant efficiency of magnesium hydroxide is attributed to its capability, not shared by calcium carbonate, of decomposing endothermically with loss of water at about 300°C (page 59, first full paragraph).

8.1.5 Closer examination of the flame retardant performance of calcium carbonate in polyketones according to D10, however, indicates that the addition of calcium carbonate at a level of 25% by weight to a polyketone can produce an increase in LOI of 8 to 9 units compared with the untreated polymer (column 5, Table I). When added to a styrene-butadiene (SBR) foam rubber at a level of 53% by weight, as taught in D1, however, calcium carbonate makes no difference at all to the Oxygen Index (section 8.1.2.1, above). These

results are not inconsistent with those in D6 and D9 (sections 8.1.2.2 and 8.1.2.3, above).

8.1.6 In summary, the use of calcium carbonate as a flame retardant in a polyketone results in a greater increase in LOI, at less than half the loading, than that taught in D1, D6 or D9, for its addition to other polymers.

8.1.7 Such a quantum leap in flame retardant efficiency when added to a polyketone can hardly be regarded as compatible with the categorisation of calcium carbonate as an "inert" filler as described in D1 (section 8.1.3.1, above). Yet D10, the source of this further elucidation of the flame retardant behaviour of calcium and magnesium carbonates, is a closer state of the art than any of D1, D6 or D9, since it is the only state of the art under consideration which relates to linear polyketones. Consequently, the information contained in D1, D6 and D9 regarding the flame retardant performance of these additives in various other polymers is evidently not a valid guide to its behaviour in a linear polyketone.

8.1.8 On the contrary, the skilled person, reviewing the relative flame retardant performance of calcium carbonate as between the closest state of the art D10 and the remainder of the state of the art relating to the other polymers, would conclude that there was a discontinuity in its flame retardant behaviour between the teachings of D1, D6 and D9 on the one hand and that of D10 on the other.

8.1.9 It is not permissible, in the Board's view, to assume

that the skilled person would ignore such a glaring discontinuity and rely instead on the pattern of behaviour derivable from the teachings of D1, D6 and D9 alone, since to do so would be to ignore the closest state of the art in favour of something more remote. Consequently, the further elucidation of flame retardant behaviour made available by D10 must prevail over the conflicting picture presented by D1, D6 and D9.

8.1.10 In the light of the above, it must be concluded that the flame retardant performance of calcium carbonate in a polyketone as reported in D10 is indicative of a different, and indeed "active" role, such as that which had hitherto been attributed to magnesium hydroxide, despite inability of calcium carbonate endothermally to decompose with loss of water (section 8.1.4, above).

8.1.11 Furthermore, the flame retardant performance of magnesium hydroxide, when added to various commercially available polymers, in particular polyphenylene oxide (PPO), acrylonitrile-butadiene styrene (ABS) terpolymer, polypropylene (PP) or polybutylene terephthalate (PBT) is illustrated in D2. According to the latter, in particular the graph shown in Figure 2 (page 46), it is evident that the change of LOI brought about by adding magnesium hydroxide at a concentration of 25% is, with the exception of PPO, which possesses considerable inherent flame retardancy of its own, about 3 units. This is, however, about half that reported in D10 for the addition of calcium carbonate, at a similar loading, to a polyketone (section 8.1.5, above).

8.1.12 Consequently, it is evident that, when the flame retardant performance of calcium carbonate in a polyketone according to D10 is superimposed on that of magnesium hydroxide in a variety of other conventional polymers as set out in D2, the effectiveness of calcium carbonate, at a comparable loading, is the same or better than that of magnesium hydroxide.

8.1.13 In summary, the disclosure of D2 corroborates the finding that calcium carbonate functions as an "active" flame retardant filler in a polyketone according to D10, and not as an "inert filler" as might have been concluded from the teachings of D1, D6 and D9.

8.1.14 It follows from the above, that there is no evidential basis in the relevant state of the art for expecting that magnesium hydroxide will have an improved flame retardant efficiency compared with calcium carbonate when applied in a polyketone system.

8.1.15 Thus, whilst the skilled person might speculate, or indeed even hope, that magnesium hydroxide might be a better flame retardant for polyketones than calcium carbonate, he would not have a basis for expecting such an additional benefit, at least insofar as the two flame retardants were used in comparable loadings relative to the polyketone polymer.

8.1.16 In this connection, however, it is necessary to recall that Claim 1 (both sets) of the main request does not require any particular ratio of metal hydroxide to polyketone, since it defines the quantity of the metal hydroxide as being "at most 40% mass of the total

composition", the latter only "comprising" a polyketone and a metal hydroxide. Thus, it is not limited to a "comparable" loading, relative polyketone in the sense referred to above. On the contrary, it evidently covers the possibility, in the case of a relatively large quantity of some further (possibly non-flammable) component being present (section 5.1.1, above), of the addition of metal hydroxide/oxalate in amounts limitlessly greater, relative to polyketone, than 40% by weight (section 5.1.2, above).

8.1.16.1 The maximum loading of carbonate relative to polyketone according to D10 is, however, 30% by weight (section 7.1, above). Hence, in a case where magnesium hydroxide was added in an amount, relative to polyketone, substantially higher than this maximum loading, it would be expected to function as a flame retardant simply by dilution. It follows that, regardless of its flame retardant efficiency relative to calcium carbonate in a polyketone, the flame retardant effect of the magnesium hydroxide would, at some point, inevitably begin to outweigh the effect achievable with the more limited amount of calcium carbonate.

8.1.16.2 At such a point, moreover, the skilled person would have a justifiable expectation that the flame retardant effect of the magnesium hydroxide would finally exceed that of the calcium carbonate.

8.1.16.3 Thus, to the extent that the terms of the solution of the stated problem cover the addition of metal hydroxide in amounts limitlessly greater, relative to the polyketone, than the amount of calcium carbonate

disclosed in D10, the solution of the technical problem as set out in Claim 1 of the main request (both sets of claims) must be regarded as covering an embodiment which arises in an obvious way from the state of the art.

8.1.16.4 Consequently, the main request must be rejected.

8.2 First auxiliary request ("Alternative Claims I")

The restriction of solution of the technical problem in respect of Claim 1 (both sets of claims), compared with that of the main request, means that there is an explicitly limited maximum loading of metal hydroxide/oxalate flame retardant compound relative to the polyketone (sections 5.2.1, etc. and 5.2.2, above). This maximum loading, at 40% by weight of the polyketone and the flame retardant compound, whilst admittedly somewhat higher than the maximum of 30% by weight maximum disclosed in D10, is still substantially lower than the 50 to 60% by weight reported in, say D2, as necessary to give adequate fire retardance in other, conventional polymers (page 46, section 3.1), and in any case contrastingly lower than the unrestricted ceiling covered by the main request. The limit of 40% is not such, in the Board's view, as to destroy the validity of the comparison in terms of a "comparable loading" to that disclosed in D10.

The argument of the Respondents, that a comparable level of loading was taught in relation to calcium or magnesium carbonate in D10 itself is not convincing, since there is no suggestion in D10 that the loadings

taught are applicable to any other flame retardant than the specified alkaline earth metal carbonates (section 8.1.1, above).

Since, furthermore, the reservation made in respect of the main request (section 8.1.16) does not apply in the present case, the remainder of the finding in relation to the main request, namely that there was no basis in the state of the art for the skilled person to expect the improved flame retardancy actually observed when replacing the calcium or magnesium carbonate flame retardant by a comparable loading of metal hydroxide applies fully in the present case (cf. sections 8.1.1 to 8.1.15, above). Consequently, the solution of the technical problem, as far as it concerns replacement of a carbonate according to D10 by a metal hydroxide, does not arise in an obvious way from the state of the art.

As far as the solution concerns the use of a metal oxalate, furthermore, there is nothing in any of the state of the art on file suggesting that such an oxalate would be an advantageous replacement for calcium or magnesium carbonate according to D10. Consequently, and *a fortiori*, the solution of the technical problem as far as it applies to the metal oxalates does not arise in an obvious way from the state of the art.

On the contrary, the very large increase in flame retardancy observed according to the experimental data relating to the patent in suit for both hydroxide and oxalate must be regarded as a surprising effect.

Consequently, the subject-matter of Claim 1 (both sets) involves an inventive step in the sense of Article 56 EPC.

It follows subject-matter of dependent Claims 2 to 10 (both sets) also involves an inventive step.

Consequently, the first auxiliary request ("Auxiliary Claims I") in both sets of claims is allowable.

8.3 It is thus not necessary for the Board further to consider the remaining auxiliary requests of the Appellant.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The main request is refused.

3. The case is remitted to the Opposition Division with the order to maintain the patent with the sets of claims specified as "Alternative Claims I" i.e. Claims 1 to 10 for all designated Contracting States except ES, and Claims 1 to 10 for the designated Contracting State ES and after any consequential amendment of the description.

The Registrar: The Chairman:

E. Görgmaier C. Gérardin