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Datasheet for the decision of 17 January 2013

Case Number: T 1569/10 - 3.3.09

Application Number: 04102405.0

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Title of invention:
Method for producing rigid polyurethane foam

Patent Proprietor:
Samsung Electronics Co., Ltd.

Opponent:
Bayer MaterialScience AG

Headword:
-

Relevant legal provisions:
EPC Art. 56, 100(a), 123(2)

Keyword:
"Inventive step: main request (no), first and second auxiliary requests (no), third auxiliary request (yes)"

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T 1711/06

Catchword:
-

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Case Number: T 1569/10 - 3.3.09

D E C I S I O N
of the Technical Board of Appeal 3.3.09
of 17 January 2013

Appellant: (Patent Proprietor)
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Decision under appeal:
Decision of the Opposition Division of the European Patent Office posted 11 May 2010 revoking European patent No. 1553129 pursuant to Article 101(3)(b) EPC.

Composition of the Board:

Chairman: W. Sieber
Members: N. Perakis
K. Garnett

Summary of Facts and Submissions

I. Mention of the grant of European patent No. 1 553 129 in the name of Samsung Electronics Co. Ltd. was published on 25 July 2007 (Bulletin 2007/30). The patent was granted with 18 claims, independent claims 1, 13, 14, 16 and 18 reading as follows:

"1. A method of producing a rigid polyurethane foam, comprising preparing a polyol mixture comprising polyol and a nucleating agent, and reacting the polyol mixture with polyisocyanate, wherein the preparation of the polyol mixture comprises emulsifying the nucleating agent with some or all of the polyol to produce an emulsion, said nucleating agent comprising a perfluorinated alkene containing at least 6 carbons."

"13. A rigid polyurethane foam obtainable by a method according to any one of the preceding claims."

"14. A rigid polyurethane foam having a closed cell structure, and containing at least a trace of a hydrocarbon blowing agent and a nucleating agent comprising a perfluorinated alkene containing at least 6 carbons, wherein the average closed cell size is in the range 100-199 µm."

"16. A rigid polyurethane foam, containing at least a trace of a hydrocarbon blowing agent and a nucleating agent comprising a perfluorinated alkene containing at least 6 carbons, which has a K-factor of 0.015 kcal/m.h.°C or less."

"18. An emulsion comprising polyol and a nucleating agent comprising a perfluorinated alkene containing at least 6 carbons, suitable for use in a method of rigid polyurethane foam production."

II. Bayer MaterialScience AG filed an opposition on 25 April 2008 requesting revocation of the patent in its entirety on the grounds of Article 100(a) EPC (lack of novelty and inventive step).

Together with the notice of opposition the opponent filed *inter alia* the following documents:

D1: WO 00/24815 A1;
D2: US 5 539 008 A;
D3: US 5 290 823 A;
D4: US 5 258 418 A;
D5: US 5 260 347 A;
D6: WO 97/35899 A1; and
D8: Handbook of Industrial Mixing: Science and Practice, Chapter 8: Rotor-Stator Mixing Devices, E.L. Paul *et al*, John Wiley & Sons, Inc., 2004, 489.

Additional experimental evidence D9 and D9a was filed with the opponent's letters dated 18 January 2010 and 5 February 2010, respectively.

III. By its decision announced orally on 17 March 2010 and issued in writing on 11 May 2010, the opposition division revoked the European patent as none of the numerous requests on file fulfilled the requirements of the EPC. The requests:

- contained claims whose subject-matter did not fulfil the requirements of Article 123(2) EPC; or
- contained a claim whose subject-matter lacked novelty in view of the disclosure of D2; or
- contained claims whose subject-matter did not involve an inventive step in view of the closest prior art documents D1 or D2 in combination with either D3 or D6.

IV. On 19 July 2010 the patent proprietor (in the following: the appellant) filed a notice of appeal against the decision of the opposition division and paid the appeal fee on the same day. The statement setting out the grounds of appeal was filed on 20 September 2010 including a main request, 11 eleven auxiliary requests and

D10: Table showing results of further experiments carried out under the same conditions as described in relation to examples 1 to 6 of the patent, using a homomixer and varying the amount of TDA polymer.

V. The opponent (in the following: the respondent) filed its observations on 25 January 2011 and requested that the appeal be dismissed.

VI. By letter dated 23 June 2011, the appellant withdrew its previous requests and filed a new main request and three new auxiliary requests. For the purposes of this decision only the new main, first and second auxiliary requests are of relevance.

Main request

Independent claims 1, 13, 15 and 17 of the main request read as follows:

"1. A method of producing a rigid polyurethane foam, comprising preparing a polyol mixture comprising polyol and a nucleating agent, and reacting the polyol mixture with polyisocyanate, wherein the preparation of the polyol mixture comprises emulsifying the nucleating agent with some of the polyol to produce an emulsion, and combining the emulsified nucleating agent with the remaining polyol, said nucleating agent comprising a perfluorinated alkene containing at least 6 carbons."

"13. A rigid polyurethane foam having a closed cell structure, and containing at least a trace of a hydrocarbon blowing agent and a nucleating agent comprising a perfluorinated alkene containing at least 6 carbons, wherein the average closed cell size is in the range 100-199 µm, and wherein the polyurethane is made from a polyol mixture, 15-70 parts by weight of which is a toluenediamine-based polyol."

"15. A rigid polyurethane foam, containing at least a trace of a hydrocarbon blowing agent and a nucleating agent comprising a perfluorinated alkene containing at least 6 carbons, which has a K-factor of 0.015 kcal/m.h.°C or less, wherein the polyurethane is made from a polyol mixture, 15-70 parts by weight of which is a toluenediamine-based polyol."

"17. An emulsion comprising polyol and a nucleating agent comprising a perfluorinated alkene containing at

least 6 carbons, suitable for use in a method of rigid polyurethane foam production, wherein 15-70 parts by weight of the polyol mixture is a toluenediamine-based polyol."

First auxiliary request

Claim 1 of the first auxiliary request corresponds to claim 1 of the main request with the following additional feature:

"…, wherein emulsifying the nucleating agent comprises agitating with a homomixer at approximately 1000-6000 rpm".

Independent claims 12, 14 and 16 of this request are identical to independent claims 13, 15 and 17 of the main request, respectively.

Second auxiliary request

Claim 1 of the second auxiliary request corresponds to claim 1 of the main request with the following additional feature:

"…, wherein 15-70 parts by weight of the total amount of polyol in the polyol mixture is a toluenediamine-based polyol".

Independent claims 11, 13 and 15 of this request are identical to independent claims 13, 15 and 17 of the main request, respectively.

VII. On 18 December 2012 the board issued a communication expressing a non-binding opinion on some of the relevant issues of the appeal.

VIII. By letter dated 11 January 2013 the appellant filed a fourth auxiliary request which is, however, not relevant for this decision.

IX. Oral proceedings before the board were held on 17 January 2013. During these proceedings the patent proprietor submitted a new third auxiliary request and an amended description adapted to this request.

Third auxiliary request

The new third auxiliary request contains only two independent claims, namely claim 1, which is directed to a method of producing a rigid polyurethane foam and is identical to claim 1 of the second auxiliary request (point VI above), and claim 11, which is directed to an emulsion and is identical to claim 17 of the main request (point VI above).

Dependent claims 2-7 correspond to dependent claims 2-7 as granted and dependent claims 8-10 correspond to dependent claims 10-12 as granted.

X. The relevant arguments put forward by the appellant in its written submissions and during the oral proceedings may be summarised as follows:

- Claim 1 of the main request fulfils the requirements of Article 123(2) EPC because the originally filed application does not disclose that the features

concerning the chain length of the perfluorinated alkene and its boiling point must necessarily be combined.

– Claim 1 of the main request involves also an inventive step. D1 should be considered to represent the closest state of the art because, as with the patent in suit, it relates to the stability of the polyol emulsion. D1 controls the emulsion stability by using as blowing agent a composition comprising a perfluorochemical compound dissolved or dispersed in a hydrofluoroether. Contrary to D1, claim 1 provides a simpler and more cost effective way for controlling the stability of the polyol emulsion by carrying out the emulsification of the same perfluorochemical compound (comprised in the nucleating agent composition) with some of the polyol needed for the foam production. This provides the additional technical advantage of enabling the method to be used on a commercial scale. This solution is not alluded in any of the prior art documents cited by the respondent.

– Claim 1 of the first auxiliary request involves an inventive step since the use of a homomixer when emulsifying the nucleating agent at approximately 1000-6000 rpm provides better results regarding the stability of the emulsion (see examples of the patent in suit). The use of a homomixer at high shear is not disclosed in the state of the art.

– Claim 1 of the second auxiliary request fulfils the requirements of Article 123(2) EPC. The skilled reader would directly and unambiguously derive from

the originally filed application that the polyaromatic polyol comprised in the polyol mixture can be preferably a toluenediamine-based polyol.

– Claim 1 of the second auxiliary request also involves an inventive step. D1 should be considered as the closest state of the art since it relates to the preparation of stable emulsions. As said in the context of the main request, D1 achieves the sought-after goal by dissolving/dispersing the blowing agent in a hydrofluoroether (D1: table 1, comparison of example 2 with comparative example C-1) whereas claim 1 achieves this goal by monitoring the amount of the toluenediamine-based polyol in the polyol mixture (patent: table 1, comparison of examples 1, 2 with examples 3-6; D10: comparison of formulations 1-3 with formulations 4-6). The skilled person looking for a simpler, more cost effective method for the production of polyurethane foam *via* a stable emulsion would not find any hint in the state of the art (see D4 to D6) to use a polyol mixture comprising 15-70 pbw of a toluenediamine-based polyol in the preparation of polyurethane foams.

– Claim 11 of the second auxiliary request also involves an inventive step. Even if the skilled person started from D2, as the respondent argued, the skilled person seeking to improve the K-factor of the polyurethane foam would not find any hint in the art to use a polyol mixture comprising 15-70 pbw of a toluenediamine-based polyol in the preparation of polyurethane foams. The skilled person would not consider D6 (page 10, table) because the disclosure of a thermal conductivity improvement when adding o-

toluenediamine-based polyol is not a sufficient hint (corresponding to an improvement of the K-factor). In fact, the disclosed values for the thermal conductivity (22.7-23.5 mW/mK) are worse (i.e. higher) than the value disclosed in D2 example 1 (22.3 mW/m(K)), which means that the corresponding K-factor value is also worse. Therefore the skilled person would not combine D6 with D2.

– This reasoning applies to claim 13 of the second auxiliary request, which requires that the K-factor value is 0.015 Kcal/m.h.°C or less. The K-factor is a technical feature (see examples 1 and 2 of the patent in suit) and is not mere wishful thinking, contrary to the allegation of the respondent. Thus even if the skilled person combined D6 with D1 (example 2, showing the lowest thermal conductivity value corresponding to the least K-factor) he would not arrive at the claimed K-factor. The most favourable value of thermal conductivity in D6 (example 4) is 22.7 mW/mK which, according to the respondent, corresponds to a K-factor value of 0.0168 Kcal/m.h.°C.

– Claim 15 involves an inventive step for the reasons given regarding the inventive step of claim 1.

XI. The relevant arguments put forward by the respondent in its written submissions and during the oral proceedings may be summarised as follows:

– Claim 1 of the main request does not fulfil the requirements of Article 123(2) EPC. The originally filed application always combines the chain length

of the perfluorinated alkene with its boiling point range. The passage on page 10, lines 30-31, relates exclusively to the specific embodiment of Figure 2. Moreover, this passage is in contradiction with the passage on page 5, lines 24-26.

- Claim 1 lacks an inventive step even considering D1 to represent the closest state of the art (following the argument of the appellant). The emulsification of the nucleating agent composition with some of the polyol mixture instead of the entirety of the polyol according to D1 (sole differentiating feature in view of the wording of claim 1) does not provide any technical advantage. No relevant technical evidence has been submitted by the appellant (see the technical evidence in the patent in suit and D10) in support of its allegations. On the contrary, the technical evidence filed by the respondent (D9a) demonstrates that no technical effect is obtained when comparing the emulsification using some of the polyol with the emulsification using the entire polyol mixture. In the absence of a technical advantage the claimed method is simply an alternative of the method of D1. Nevertheless, the claimed emulsification is a trivial, conventional modification of the method of D1, which means that the claimed method is deprived of any inventive merit.

- Claim 1 of the first auxiliary request is also not inventive for the reasons given for claim 1 of the main request. The additional feature of a homomixer working under high shear is disclosed in D1 (examples 2 and 3).

– Claim 1 of the second auxiliary request does not fulfil the requirements of Article 123(2) EPC because the originally filed application contains no implicit or explicit disclosure which could provide basis for the feature "15-70 parts by weight of the total amount of polyol in the polyol mixture is a toluenediamine-based polyol". The application as filed discloses a polyaromatic polyol. This term does not comprise the toluenediamine-based polyol, which seems to be a monoaromatic polyol.

– Claim 1 of the second auxiliary request does not involve an inventive step. Considering D1 as the closest state of the art, the claimed method does not improve the emulsion stability since formulation 4 of D10 (technical evidence filed by the appellant) corresponding to the claimed method has an emulsion stability of 3 days which is the same with the emulsion stability of examples 2 and 3 of D1. Under these circumstances the claimed method is considered as an alternative to the method of D1. This alternative is obvious since the use of 15-70 pbw of toluenediamine-based polyol in the polyol mixture is disclosed in D6 and the skilled person would combine it with the disclosure of D1.

– If one followed the argument of the appellant and the technical problem in view of D1 was considered to be the provision of a method which improves the emulsion stability, this problem would not be solved over the whole claimed range. On the one hand, formulation 4 of D10 (falling within the claim) close to the lower limit of 15 pbw of

toluenediamine-based polyol does not show an improvement over D1. On the other hand the upper limit of 70 pbw of the toluenediamine-base polyol is arbitrary since formulations 7 and 8 (not falling within the claim) show improved emulsion stability.

- Anyway the improvement of the emulsion stability is a bonus effect when the skilled person starts from D1 and seeks to improve the K-factor of the polyurethane foam. The skilled person would find in D6 the disclosure that by adding toluenediamine-base polyol in the polyol mixture at the claimed concentration the K-factor of the foam is improved. He would therefore combine D6 with D1 and would arrive at the subject-matter of claim 1 without an inventive step.

- Claim 11 of the second auxiliary request does not involve an inventive step. D2, which discloses polyurethane foams with the claimed average closed cell size, should be considered to represent the closest state of the art. D2 does not disclose polyol mixtures containing a toluenediamine-based polyol. However, the skilled person starting from D2 and seeking to improve the insulating properties of the foam would consider D6, which discloses the use of a polyol mixture with a toluenediamine-based polyol in the claimed amount in order to improve the insulating properties of a polyurethane foam. He would therefore combine D6 with D2 and would arrive at the claimed foam without any inventive step.

- Claim 13 of the second auxiliary request also does not involve an inventive step. D1 (example 2), which

discloses a K-factor of 0.0168 Kcal/m.h.°C should be considered to represent the closest state of the art. The skilled person aiming at reducing further the K-factor of D1 would find in D6 the hint to use a polyol mixture with a toluenediamine-based polyol in the claimed amount. By the obvious combination of D6 with D1 he would arrive at the claimed foam. The claimed K-factor value of 0.015 Kcal/m.h.°C or less is a functional feature expressing a desired value which the skilled person knows how to achieve.

– Claim 15 of the second auxiliary request does not involve an inventive step for the reasons given regarding claim 1 of this request.

XII. The appellant (patent proprietor) requested that the decision under appeal be set aside and the patent be maintained on the basis of the main request, alternatively the first or second auxiliary requests, all filed with letter dated 23 June 2011, alternatively on the basis of the third auxiliary request filed during the oral proceedings.

XIII. The respondent (opponent) requested that the appeal be dismissed.

Reasons for the Decision

1. The appeal is admissible.

Main request

2. Article 100(c) EPC - claim 1

2.1 Claim 1 as granted as well as claim 1 of the main request contain the feature:

"said nucleating agent comprising a perfluorinated alkene containing at least 6 carbon atoms".

This feature, which had been added to claim 1 during examination, was objected to by the opposition division under Article 123(2) EPC. This objection was in fact a new ground of opposition under Article 100(c) EPC raised by the opposition division on its own motion. The opposition division considered that the addition of this feature extended the claimed subject-matter beyond the content of the application as filed. According to the opposition division the application as filed (page 5, lines 24-26) disclosed this feature **only in conjunction with** a boiling point of 20-80°C for the perfluorinated alkene. As regards the disclosure relied upon by the appellant (page 10, lines 30-31), where the number of carbon atoms of the perfluorinated alkene was not associated with the boiling point, it was held that the skilled reader would interpret this passage as being part of the discussion of the specific method of figure 2 described in the immediately preceding paragraph. Aside from that, the passages on pages 5 and 10 were contradictory and did not provide a clear and unambiguous basis for the contested feature. The feature could also not be considered to derive from claims 12 and 13 as filed because these claims were dependent on claim 8, an independent claim relating to a more restricted method than claim 1 as filed (see appealed decision, point 3 of the grounds).

2.2 The respondent adopted this position in its reply to the appeal (point 2.1 of the letter dated 25 January 2011).

2.3 The board does not agree with the position of the opposition division and the respondent in this respect. The passage on page 10, lines 30-31 is a clear and unambiguous disclosure for the contested feature in claim 1.

Firstly, the board cannot see any contradiction between the cited passages. The disclosures on page 5, lines 24-25 and page 10, lines 30-31 are absolutely clear, the latter being broader than the former. This is, however, not a reason to consider them contradictory. In particular, page 10, lines 30-31 recites that "(t)he nucleating agent may comprise a perfluorinated alkene consisting at least 6 carbon atoms and may have a boiling point of 20-80°C". The skilled reader would understand from the two-fold use of the word "may" that the number of carbon atoms is not necessarily associated with the boiling point. In the board's view this passage discloses alternative definitions of the perfluorinated alkene. Thus, the nucleating agent may have (or may not have) a boiling point of 20-80°C. On the other hand, the passage on page 5 clearly discloses the combination of these two requirements.

Secondly, the board does not interpret the passage on page 10, lines 30-31, as being part of the description of figure 2, since the method relating to this figure is exhaustively dealt with in the previous, separate paragraph. On the contrary, this passage is part of an

independent, consecutive paragraph and relates to the general disclosure of the invention.

2.4 The board thus concludes that the skilled person would directly and unambiguously derive the contested feature of claim 1 of the main request from the application as filed.

3. Amendments (Article 123 EPC) - claim 1

3.1 Claim 1 of the main request differs from claim 1 as granted in that

- the alternative feature, in which the nucleating agent is emulsified with all of the polyol, has been deleted; and

- the wording "combining the emulsified nucleating agent with the remaining polyol" has been inserted.

3.2 No objections were raised by the respondent against these amendments. The board is also satisfied that the deletion of one alternative from granted claim 1 and the inserted wording, which implicitly derives from the whole content of the application as filed in a direct and unambiguous manner, fulfil the requirements of Article 123(2) and (3) EPC.

4. Novelty - claim 1

The respondent has never challenged the novelty of the method of claim 1. The board saw no reason to raise an objection on its own in this respect.

5. Inventive step - claim 1

5.1 The subject-matter of claim 1 relates to a method of producing a rigid polyurethane foam comprising preparing a polyol mixture containing a specific nucleating agent. A particular aspect of this reaction system is its stability (paragraph [0005] of the patent specification in combination with the "stable time" reported in table 1).

5.2 The closest prior art

5.2.1 The board concurs with the appellant that D1 should be considered to represent the closest state of the art. D1 discloses a process for preparing a polymeric foam using a blowing agent composition comprising a perfluorochemical compound dissolved or dispersed in a hydrofluoroether (claim 1). The perfluorochemical compound is preferably a perfluorinated alkene as required in claim 1 of the main request (passage bridging pages 5 and 6). In examples 2 and 3 of D1, a perfluorochemical compound, a hydrofluoroether and a co-blowing agent are emulsified in a polyol. The resulting polyol blend is reported to be stable for about 3 days. Thus D1 not only relates to a method of producing a rigid polyurethane foam, it also seeks to stabilise the emulsion of the polyol mixture.

5.2.2 D2 (column 1, lines 7-12; column 2, line 22 to column 3, line 16) is less relevant than D1 because it does not deal with the same technical problem. D2 is basically concerned with the improvement of the insulating properties of the rigid polyurethane foams and does not

identify any need to stabilise the emulsion of the polyol mixture.

5.2.3 According to D1 (examples 2 and 3) the method of producing a rigid polyurethane foam comprises:

- emulsifying the HFP dimer (a hexafluoropropene dimer, i.e. a perfluorinated alkene having 6 carbon atoms) in HFE-1 (perfluoropropyl methyl ether) and polyol 1832A/2 (a commercially available polyether polyol),
- wherein the HFP dimer is emulsified with the entire amount of polyol and
- reacting the polyol mixture with isocyanate.

Thus the method of claim 1 differs from the method of D1 only in that the perfuorinated alkene containing the nucleating agent, i.e. the HFP dimer of D1, is emulsified first with some of the polyol and subsequently combined with the remaining polyol.

5.2.4 The appellant argued that the claimed method differed from the method of D1 also in that it did not use HFE-1, which according to D1 (page 16, lines 8-9) provides the stability of the polyol emulsion. However, this argument of the appellant must fail in view of the "open" wording of claim 1: "(a) method … comprising preparing a polyol mixture comprising polyol and a nucleating agent ... said nucleating agent comprising a perfluorinated alkene … ", which does not exclude the presence of further ingredients in the claimed method such as the HFE-1 of D1.

5.2.5 The appellant also argued that the claimed method differed from the one disclosed in D1 since it allowed

its use on an industrial scale. Such a use typically required specific tank dimensions, and a specific homomixer capacity in view of the viscosity of the polyol and the density of the nucleating agent. According to the appellant the emulsification of the perfluorinated alkene containing nucleating agent in a smaller tank followed by its admixture with the remaining polyol in a larger tank made this industrial scale production feasible. However, this argument of the appellant can also not be accepted since the claimed method is not restricted as regards, for example, the apparatus dimensions, in order to render these alleged differences relevant.

5.3 The technical problem

5.3.1 The objective technical problem underlying the subject-matter of claim 1 in the light of the closest prior art D1 can only be seen in the provision of a method alternative to the method of D1.

5.3.2 As correctly pointed out by the respondent, the patent in suit does not contain any relevant technical evidence illustrating any advantage resulting from the emulsification of the nucleating agent comprising a perfluorinated alkene with part of the polyol mixture over the emulsification of the nucleating agent in the entire polyol as done in the closest prior art. In the only comparative example of the patent specification the nucleating agent is not emulsified at all (table 1 and paragraph [0034]). All other examples involve emulsification of the nucleating agent with some of the polyol mixture. Actually the application as filed and the patent as granted ascribe no importance as to

whether the nucleating agent is emulsified with some or all of the polyol.

5.3.3 The alleged improvement of the emulsion stability can also not derive from a comparison of the data in the patent in suit with the data of D1 since both documents disclose similar stability values. Thus, D1 (page 16, lines 5-6) discloses that the polyol emulsions of examples 2 and 3 were stable for about 3 days (no phase split observed) whereas the examples of the patent in suit (table 1) disclose a stability which ranges from 1 to 7 days (when the nucleating agent starts separating from polyol and sinks down).

5.3.4 Furthermore, the alleged improvement could also not be based on the appellant's additional technical evidence D10 which discloses not only polyol emulsions with a high stability but also emulsions with a stability of only 1 to 3 days (formulations 1-4).

5.3.5 Finally, the respondent's technical evidence D9a shows that the emulsification of the nucleating agent with some of the polyol does not improve the insulation properties of the resulting polyurethane foam, considered on the basis of the K-factor. Thus, the K-factor of example 2 (nucleating agent emulsified in all of the polyol) is 0.0181 kcal/m.h.°C compared to 0.0183 kcal/m.h.°C for example 6 (nucleating agent pre-emulsified in 25 wt% of the polyol). Considering that the slight variation lies within the typical error margin of ±2% (something not contested by the appellant), these data indicate that the emulsification with some of the polyol has no impact on the insulating properties of the polyurethane foam. D9a reports

similar results for example 4 (nucleating agent emulsified in all of the polyol; 0180 kcal/m.h.°C) and example 5 (nucleating agent emulsified in some of the polyol; 0.0181 kcal/m.h.°C).

5.3.6 At this juncture, it should be stated that the appellant objected to the admissibility of D9a during the written procedure. However, the objection was not pursued at the oral proceedings before the board after the respondent referred to the data of D9a. Furthermore, D9a was discussed by the opposition division in the appealed decision, which means that it had implicitly admitted this document into the proceedings. In fact, the appellant has never provided any argument as to why the opposition division was wrong in the implicit exercise of its discretionary power to allow the late-filed D9a into the proceedings. Under these circumstances, there was no need to pursue the issue.

5.3.7 In view of the above considerations the formulation of the objective technical problem as the provision of an alternative method to D1 is justified.

5.4 As a solution to this problem the patent proposes the emulsification of the nucleating agent comprising a perfluorinated alkene containing at least 6 carbon atoms in some of the polyol.

As can be seen from the examples in the patent in suit this problem is credibly solved by the method as claimed in claim 1.

5.5 Obviousness

The skilled person starting from the method of D1 (examples 2 and 3) and aiming at the provision of an alternative method for producing rigid polyurethane foams would consider the emulsification of the nucleating agent in some of the polyol as a trivial modification of the method of D1. Not only is the claimed emulsification a conventional step commonly known in the art when passing from a laboratory scale to an industrial scale method, in particular in view of the viscosity of the polyols and of the expensive stirring requirements of the apparatus. It reflects also common sense as explained by the respondent during the oral proceedings before the board. To illustrate this point, the respondent referred to the preparation of mayonnaise according to which the oil is introduced progressively and not at once. Hence, the method of claim 1 of the main request is obvious in view of the disclosure of D1.

6. In view of the above considerations the main request is not allowable.

First auxiliary request

7. Amendments - claim 1

The method of claim 1 of the first auxiliary request differs from that of claim 1 of the main request in the following additional feature:

"… , wherein emulsifying the nucleating agent comprises agitating with a homomixer at approximately 1000-6000 rpm".

This feature is disclosed as a general statement in the application as filed (page 7, lines 4-5) so that a person skilled in the art would clearly and unambiguously associate it with the other features of claim 1 of the main request. Furthermore, since this feature limits the scope of granted claim 1, the requirements of Articles 123(2) and (3) EPC are met. The respondent did not raise any objection in this context.

8. Novelty - claim 1

The considerations on novelty as set out for claim 1 of the main request apply *mutatis mutandis* to the first auxiliary request.

9. Inventive step - claim 1

9.1 What remains to be examined is whether the additional feature of claim 1, namely the emulsification of the perfluorinated alkene containing nucleating agent by agitation with a homomixer at a shear velocity of 1000

to 6000 rpm, is suitable to overcome the inventive step objection raised against the method of claim 1 of the main request.

9.2 For the assessment of the inventive step D1 is still considered to represent the closest prior art. Examples 2 and 3 of D1 disclose the use of a Pendraulic LD-50 high shear mixer at 6000 rpm for the preparation of the polyol mixture. Thus these examples anticipate also the emulsification of the nucleating agent by agitation with a mixer at the high shear conditions of claim 1 of the first auxiliary request.

9.3 The appellant asserted that D1 did not use a homomixer, so that the use of a homomixer constituted a technical difference of the claimed method over the method disclosed by D1. Even if one accepted this argument, there is no evidence on file which would show that the use of a homomixer leads to a technical effect which is significantly different from that using the Pendraulic LD-50 mixer of D1. In fact, examples 3 and 5 of the patent in suit - using a homomixer - show an emulsion stability of 2 and 3 days respectively, which is not different from the emulsion stability of about 3 days disclosed for the emulsions of examples 2 and 3 of D1. Thus the stability achieved by a homomixer is comparable to that achieved by the Pendraulic LD-50 high shear mixer of D1.

9.4 Under these conditions the technical problem in view of D1 still consists in the provision of an alternative method.

9.5 As regards the emulsification of the nucleating agent with some of the polyol the considerations as set out for claim 1 of the main request still apply.

Furthermore, a skilled person would consider the use of a homomixer as being an obvious alternative to the Pendraulic LD-50 mixer of D1, in particular because it is known that a homomixer is a high shear mixer (see D8). This fact was not disputed by the appellant. Consequently the additional feature cannot render the method of claim 1 of the first auxiliary request inventive over D1.

9.6 In view of the above considerations the first auxiliary request is not allowable.

Second auxiliary request

10. Claim 1

10.1 Amendments

10.1.1 The method of claim 1 of the second auxiliary request derives from the method of claim 1 of the main request with the additional feature:

"wherein 15-70 parts by weight of the total amount of the polyol in the polyol mixture is a toluenediamine-based polyol".

10.1.2 During the oral proceedings the respondent objected to the introduction of this feature into claim 1 under Article 100(c)/123(2) EPC. The respondent alleged that the passage on page 6, lines 8-13 of the application as

filed could not support the amendment. This passage disclosed the use of a polyaromatic polyol but not of a toluenediamine-based polyol, which is not polyaromatic.

10.1.3 The relevant passages on page 6 read as follows:

"It is preferred that the polyol mixture comprises a polyaromatic polyol, since this stabilizes the emulsified nucleating agent, thus improving the properties of the rigid polyurethane foams. The polyaromatic polyol may include, but is not limited to, a toluenendiamine-based polyol, a methylenediphenyl-diamine-based polyol, and a bisphenol-A-based polyol". Preferably, the polyaromatic polyol comprises the toluenediamine-based polyol only." (lines 8-13)

"In an embodiment of the present invention, the proportion of the polyaromatic polyol is 15-70 parts by weight per 100 parts by weight of the total polyol." (lines 16-17).

Even if one accepted the respondent's argument that toluenediamine-based polyols are monoaromatic and not polyaromatic, the skilled reader would understand from the above cited first passage that in the context of the application as filed a toluenediamine-based polyol is considered to be a "polyaromatic" polyol. The sentence starting with "The polyaromatic polyol may include …" clearly lists compounds which are considered to be polyaromatic polyols (in the sense of the invention). The next sentence emphasises that it is only toluenediamine-base polyol that is used as the polyaromatic polyol. This interpretation is also consistent with the examples of the patent (table 1,

footnote 1) which all comprise toluenediamine-base polyol (OH value: 350-550) as the sole polyol.

10.1.4 In view of these considerations the additional feature of claim 1 meets the requirements of Article 123(2) EPC. Moreover, since this feature limits the scope of granted claim 1 the subject-matter of claim 1 of the second auxiliary request fulfils also the requirements of Article 123(3) EPC.

10.2 Novelty

10.2.1 The respondent did not contest the novelty of the subject-matter of claim 1 of the second auxiliary request. The board is satisfied that the claimed method is not anticipated by any of the prior art documents cited by the respondent.

10.3 Inventive step

10.3.1 D1 (examples 2 and 3) is still considered to represent the closest state of the art. As set out previously, D1 relates to the stability of a reaction system used for the production of rigid polyurethane foam. This system contains a polyol (Polyol 1832 A/2), a polyisocyanate (Isocyanate 44 V-20) and an emulsified blowing agent composition comprising a perfluorochemical compound (HFP dimer),a hydrofluoroether (HFE-1) and a co-blowing agent (cyclopentane).

D1 (page 4, lines 19-21; examples 2 and 3 and comparative example C-1) discloses that the stability of the reaction system is due to the use of the hydrofluoroether (HFE-1) which increases the solubility

of the perfluorochemical compound (HFP dimer) in the co-blowing agent (cyclopentane). This is demonstrated in examples 2 and 3 which use HFE-1, resulting in a stability for the polyol blend of about 3 days, whereas the polyol blend of comparative example C-1, which does not contain HFE-1, has a stability of only a few hours.

The method of claim 1 of the second auxiliary request differs from that of D1 not only regarding the specific emulsification of the perfluorinated alkene containing the nucleating agent (see point 5.2.3 supra in relation to the main request) but also regarding the composition of the polyol mixture since it requires that 15-70 parts by weight of the total amount of the polyol in the polyol mixture is a toluenediamine-based polyol.

10.3.2 As already mentioned the patent in suit relates to the stability of the polyol mixture used in the production of rigid polyurethane foams. In this context it is explicitly stated in paragraph [0024] that a polyaromatic polyol (and in the patent in suit a toluenediamine-based polyol is considered to be a polyaromatic polyol, see point 10.1.3 above) stabilizes the emulsified nucleating agent.

The technical evidence in the patent in suit, in particular examples 1 and 2 of table 1, shows that the stability of the polyol emulsion comprising 60 parts by weight of a toluenediamine-based polyol is 7 and 6 days, respectively. Moreover, the additional experimental data submitted by the appellant (D10) show that the stability of the polyol emulsion comprising 15-70 parts by weight of a toluenediamine-based polyol ranges between 3 to 14 days.

10.3.3 In view of the above, the objective technical problem underlying the subject-matter of claim 1 of the second auxiliary request in the light of D1 can be seen in the provision of a method for the preparation of rigid polyurethane foams which involves the use of an emulsion which is at least as stable as that of the D1.

10.3.4 The data in the patent in suit and D10 clearly show that the presence of the toluenediamine-based polyol at the claimed amount contributes to the stability of the polyol mixture and that the emulsion stability is at least as good as in D1.

According to the disclosure of D1 the stability is due to the presence of HFE-1. The "open" claim language of present claim 1 still allows the presence of HFE-1 in the polyol mixture. However, as argued by the appellant, this would only further contribute to the stability of the polyol mixture, i.e. in addition to the stability effect provided by the toluenediamine-based polyol. This argument was not disputed by the respondent. Hence the board concludes that there is sufficient evidence that the technical problem has been successfully solved by the method of claim 1 characterized by the use of the specified amount of toluenediamine-based polyol.

10.3.5 The respondent argued that the problem was not solved over the whole claimed range in view of the emulsion stability value reported for formulation 4 of D10. This formulation contained 20% parts by weight of toluenediamine-based polyol of the total amount of the polyol in the polyol mixture and had a stability of only 3 days. However, the value is similar (not worse)

to the stability reported in D1 (around 3 days). In view of the fact that the objective technical problem is defined as the provision of a method for the preparation of rigid polyurethane foams which involves the use of an emulsion which is at least as stable as that of the D1, this example does not bring into doubt the conclusion that the set problem is indeed solved over the whole claimed range.

The respondent also contested the solution of the problem over the whole claimed range in view of formulations 7 and 8 of D10 which contained more than 70 parts by weight of toluenediamine-based polyol in the polyol mixture. As these formulations showed an improved emulsion stability, the respondent argued that the cut at 70% was arbitrary. The board disagrees with the respondent because paragraph [0025] of the patent in suit discloses that another technical reason for this limitation exists, namely the tendency of the resulting foam to become rather brittle.

10.3.6 With regard to the feature concerning the emulsification of the nucleating agent with some of the polyol, the conclusions set out above (see point 5.5 supra regarding the inventive step of the main request) apply to claim 1 of the second auxiliary request *mutatis mutandis*.

Consequently it remains to be answered whether the feature according to which 15-70 parts by weight of the total amount of polyol in the polyol mixture is a toluenediamine-based polyol is obvious to the skilled person in the art.

10.3.7 The board agrees with the appellant that a skilled person starting from D1 (examples 2 and 3) and looking for a method for the preparation of rigid polyurethane foams which involves the use of a polyol emulsion which is at least as stable as the emulsion of D1 would not find any motivation in the cited state of the art to use a polyol emulsion which comprises 15-70 parts by weight of a toluenediamine-based polyol.

This motivation would not be found in D4 since this document (abstract; column 1, lines 43-49; column 1, line 52 to column 2, line 11; column 2, lines 28-48) discloses the use of toluenediamine-based polyols in the production of low density, closed-cell, rigid foam polyurethanes exhibiting good physical properties for the purpose of reducing the overall consumption of isocyanate. D4 does not provide any stability data for the polyol emulsion. Therefore the skilled person would not find any hint towards the claimed solution in D4.

The same explanation applies to the very similar disclosure of D5 (abstract; column 1, line 41 to column 2, line 8; column 2, lines 24-44).

Regarding D6 (abstract; page 1, line 32 to page 3, line 3; example 4; table on page 10), it discloses the use of a toluenediamine-based polyol in the production of rigid foam polyurethanes since this reduces their thermal conductivity value and improves their thermal insulating properties. D6 does not provide any stability data for the polyol emulsion. Consequently the skilled person would not find the necessary hint in D6 to use a toluenediamine-based polyol in order to solve the set technical problem.

10.3.8 The respondent argued at the oral proceedings that the skilled person starting from D1 (example 1) would rather seek to improve the insulating properties of the polyurethane foam. He would then find in D6 the motivation to use toluenediamine-based polyols since this document disclosed that these polyols reduced the thermal conductivity value of the foam and improved its insulating properties. The result of the obvious combination of D6 with D1 would provide the improvement of the emulsion stability as a bonus effect.

The board cannot accept this argument because it is based on a technical problem, namely the improvement of the insulating properties of the foam, which is not the technical problem defined objectively in view of the state of the art closest to the claimed invention (see also T 1711/06, point 3.6.2 not published in the OJ EPO).

10.3.9 In view of the above considerations the board comes to the conclusion that the method of claim 1 of the second auxiliary request involves an inventive step.

10.4 Since this claim fulfils the requirements of the EPC, it is allowable.

11. Dependent claims 2 to 10

These claims correspond to specific embodiments of claim 1 and are therefore considered to be novel and to involve an inventive step.

12. Claim 15

12.1 Amendments

Independent claim 15 of the second auxiliary request relates to an emulsion suitable for use in a method of rigid polyurethane foam production and is based on claim 18 as granted (point I above) wherein the following further restriction has been added:

"wherein 15-70 parts by weight of the polyol mixture is a toluenediamine-based polyol".

For the reasons set out in relation to claim 1 of this request this amendment fulfils the requirements of Articles 123(2) and (3) EPC.

12.2 Novelty

The respondent did not contest the novelty of the subject-matter of this product claim. The board is also satisfied that none of the cited documents anticipates the claimed emulsion.

12.3 Inventive step

12.3.1 In the same way as for the subject-matter of claim 1, D1 has to be considered to represent the closest state of the art since it relates to the stability of the emulsion used in the preparation of the polyurethane foam. However, D1 does not disclose that the polyol emulsion contains 15-70 parts by weight of a toluenediamine-based polyol.

12.3.2 In analogy to the assessment of inventive step of the subject-matter of claim 1, the objective technical problem underlying the subject-matter of claim 15 in the light of D1 is to be seen in the provision of a polyol emulsion whose stability is at least as good as stability reported for the emulsion of D1.

Examples 1 and 2 of the patent in suit and formulations 4-6 of D10 demonstrate that the problem has been successfully solved by the use of 15-70 parts by weight of a toluenediamine-based polyol.

12.3.3 The skilled person starting from D1 (example 2) and looking for a polyol emulsion with similar or better stability would not find a hint in D1 itself or in any of the cited prior art documents to use 15-70 parts by weight of a toluenediamine-based polyol in the polyol mixture in replacement of or in addition to the hydrofluoroether HFE-1. As set out above in the context of inventive step of the subject-matter of claim 1 (point 10.3.7), D4 to D6, which disclose polyol emulsions containing a toluenediamine-based polyol, are not concerned with the stability of these emulsions. Consequently none of these documents can provide a hint regarding this property. Therefore the emulsion of claim 15 of the second auxiliary request is not obvious from the cited prior art.

12.4 In view of the above considerations claim 15 fulfils the requirements of the EPC and is allowable.

13. Claim 11

13.1 Amendments

Independent claim 11 of the second auxiliary request relates to a rigid polyurethane foam and is based on claim 14 as granted (point I above) including the following additional feature:

"wherein the polyurethane is made from a polyol mixture, 15-70 parts by weight of which is a toluenediamine-based polyol".

For the reasons set out in relation to claim 1 of this request this amendment fulfils the requirements of Articles 123(2) and (3) EPC.

13.2 Novelty

The respondent did not object to the novelty of the subject-matter of this claim and the board is satisfied that none of the cited pieces of prior art discloses the claimed foam.

13.3 Inventive step

13.3.1 The patent is suit relates also to rigid polyurethane foams having a relatively small closed cell size and having improved thermal insulation properties (see paragraph [0029]). These properties are assessed on the basis of the K-factor values. The respective values in examples 1 and 2 are 0.0143 and 0.0144 Kcal/m.h.°C (table 1).

13.3.2 D2 (example 1) is considered to represent the closest state of the art since it relates to a rigid polyurethane foam having a closed cell structure with an average closed cell size being in the range of 100-150 µm. D1 does not disclose the closed cell size and therefore is more remote from the claimed subject-matter than D2.

In example 1 of D2 the foam is prepared using a hydrocarbon (a perfluoroolefin) as the blowing agent and hexafluoropropene dimer as the co-blowing agent. This disclosure implies to the skilled reader that the foam will contain at least a trace of the hydrocarbon blowing agent and the co-blowing agent. Therefore the foam of claim 11 differs from the foam of D2 only in the polyol mixture, which according to the present claim must contain 15-70 parts by weight of a toluenediamine-based polyol.

13.3.3 A comparison of the polyurethane foams exemplified in the patent in suit with that of example 1 of D2 shows that the claimed foams have improved insulating properties in view of the lower value of the K-factor. The K-factor for examples 1 and 2 of the patent is 0.0143 and 0.0144 Kcal/m.h.°C, respectively. Example 1 of D2 does not disclose any K-value but an initial thermal conductivity of 22.3 mW/m(K). According to the respondent that value could be converted to a K-factor of 0.0192 Kcal/m.h.°C, which was not contested by the appellant.

The data provided in the additional experiments D10 cannot be taken into account in the assessment of the objective technical problem since the polyurethane

foams reported therein have an average cell size of 237-237 µm, which lies outside the claimed range. The appellant alleged during the oral proceedings that the cell size values in D10 were erroneous. However no evidence was filed with any corrected values, so that this argument does not alter the board's consideration of D10.

13.3.4 Consequently the objective technical problem in view of the disclosure of D2 (example 1) is to provide a rigid polyurethane foam with a relatively small cell size which has improved insulating properties.

The board is satisfied that the technical problem has been successfully solved by the features of claim 1, in particular the use of 15-70 parts by weight of a toluenediamine-based polyol.

13.3.5 The question which remains to be answered is whether the person skilled in the art starting from D2 (example 1) and seeking to improve the insulating properties of the rigid polyurethane foam would find in the state of the art the motivation to use a polyol mixture which comprises 15-70 parts by weight of a toluenediamine-based polyol in the preparation of the foam.

As pointed out by the respondent such a motivation is to be found in D6. This document discloses a process for making a polyurethane foam in which a polyol mixture including 30 to 80 pbws aromatic amine based polyol is used (claim 1). O-toluenediamine-based polyol is preferred (claim 2). It is evident from D6 that the use of toluenediamine-based polyol indeed improves the

thermal insulation properties. Reference is made to example 1 (a foam obtained without the use of toluenediamine-based polyol) and example 4 (50 parts by weight of a toluenediamine-based polyol is used in admixture with 50 parts by weight of another polyol). A clear reduction in the thermal conductivity value is observed for the foam of example 4 (22.7 mW/m(K)) over the foam of example 1 (24 mW/m(K)). Despite the fact that the absolute values of these examples are higher than the values of D2, D6 discloses a trend which would be perceived by the skilled person as a hint to use a polyol mixture with a toluenediamine-based polyol in the disclosed amounts in order to improve the insulating properties of the rigid polyurethane foam of D2. Thus the combination of D6 with D2 is obvious and leads to the claimed subject-matter without involving an inventive step.

13.4 In view of the above considerations claim 11 does not fulfil the requirements of the EPC and is not allowable.

14. Claim 13

The second auxiliary request contains a further independent claim directed to a polyurethane foam, namely claim 13, which was discussed at the oral proceedings before the board and was found to also lack an inventive step.

Given that the second auxiliary request is not in any event allowable because claim 11 is not allowable there is no need to elaborate on inventive step in relation to claim 13.

Third auxiliary request

15. Claims 1 to 11 of the third auxiliary request correspond to claims 1 to 10 and 15 of the second auxiliary request. All these claims were considered by the board to fulfil the requirements of the EPC. Consequently this request is allowable.

Amended description

16. During the oral proceedings the appellant amended the description of the patent in suit in order to bring it into conformity with the claims of the third auxiliary request. The finalised version of the amended description was not objected to by the respondent and the board is satisfied that it fulfils the requirements of the EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the opposition division with the order to maintain the patent as amended on the basis of:
   - claims 1 to 11 according to the third auxiliary request filed during the oral proceedings;
   - pages numbered 2, 2a, and 3 to 7 of the amended description as filed during the oral proceedings;
   - figure 1 as filed during the oral proceedings (being figure 2 as granted).

The Registrar: The Chairman:

M. Cañueto Carbajo W. Sieber