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**Datasheet for the decision
of 26 February 2010**

Case Number: T 0368/07 - 3.3.09

Application Number: 00906213.4

Publication Number: 1141101

IPC: C08J 9/12

Language of the proceedings: EN

Title of invention:

Process for the preparation of flexible polyurethane foams

Patent Proprietor:

Shell Internationale Research Maatschappij B.V.

Opponent:

Bayer MaterialScience AG

Headword:

-

Relevant legal provisions:

EPC Art. 56

Relevant legal provisions (EPC 1973):

-

Keyword:

"Granted claims - inventive step (yes)"

Decisions cited:

-

Catchword:

-



Case Number: T 0368/07 - 3.3.09

D E C I S I O N
of the Technical Board of Appeal 3.3.09
of 26 February 2010

Appellant: Shell Internationale Research Maatschappij B.V.
(Patent Proprietor) Carel von Bylandtlaan 30
NL-2596 HR Den Haag (NL)

Representative: -

Respondent: Bayer MaterialScience AG
(Opponent) Patents and Licensing
D-51368 Leverkusen (DE)

Representative: -

Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 20 December 2006
revoking European patent No. 1141101 pursuant
to Article 102(1) EPC.

Composition of the Board:

Chairman: N. Perakis
Members: J. Jardón Álvarez
M.-B. Tardo-Dino

Summary of Facts and Submissions

I. Mention of the grant of European patent No 1 141 101 in respect of European patent application No 00906213.4 in the name of SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V., which had been filed as International application No PCT/EP00/00399 on 18 January 2000 and published as WO-A 00/043443 on 27 July 2000, was announced on 4 June 2003 (Bulletin 2003/23). The patent entitled "Process for the preparation of flexible polyurethane foams" was granted with three claims. The sole independent Claim reads as follows:

"1. Process for the preparation of flexible polyurethane foams comprising the steps of
(a) bringing together a polyol component, a polyisocyanate component, a blowing agent comprising liquid carbon dioxide, a suitable catalyst and optionally ancillary chemicals at sufficient pressure to maintain the carbon dioxide in a liquid state, and
(b) releasing the pressure and allowing the mixture obtained in step (a) to react into a flexible polyurethane foam,

wherein the polyol component comprises a polymer polyol consisting of at least one polyether polyol having an average nominal functionality of at least 2.5 with dispersed therein from 2 to 50 wt% based on total weight of polymer polyol of polymer particles, whereby the particle size of essentially none of these polymer particles exceeds 50 micron."

Claims 2 and 3 depend on claim 1.

II. A notice of opposition was filed against the patent by Bayer MaterialScience AG on 27 February 2004. The Opponent requested the revocation of the patent in its entirety, relying on article 100(a) EPC, namely that the claimed subject-matter lacked novelty; alternatively that it did not involve an inventive step.

During the opposition proceedings the following documents were cited:

D1: EP-B1-0 768 324

D2: Oertel G., Kunststoff-Handbuch, Band 7, "Polyurethane", Carl Hanser Verlag, 1993, pages 21-23 and 89-90

D3: WO-A-96/00644

D4: EP-B1-0 645 226

D5: Ullmann's encyclopaedia of industrial chemistry, VCH Verlagsgesellschaft 1992, ed. B. Elvers *et al.*, volume A20, pages 504-505

In the course of the opposition proceedings the patent proprietor filed five auxiliary sets of claims corresponding to auxiliary requests 1 to 5. Auxiliary request 1 was filed with a letter dated 17 August 2004 and auxiliary requests 2 to 5 with a letter dated 10 July 2006. At the oral proceedings held before the opposition division on 9 September 2006, the patent proprietor withdrew the auxiliary requests 3 to 5.

With the letter dated 10 July 2006 the patent proprietor filed also a technical report containing additional experimental data in order to illustrate the different clogging effect of the filtered and the non-filtered polymer polyol on the polyurethane foaming apparatus using liquid carbon dioxide as blowing agent.

III. Claim 1 of auxiliary request 1 reads as follows:

"1. Process for the preparation of flexible polyurethane foams comprising the steps of
(a) bringing together a polyol component, a polyisocyanate component, a blowing agent comprising liquid carbon dioxide, a suitable catalyst and optionally ancillary chemicals at sufficient pressure to maintain the carbon dioxide in a liquid state, and
(b) releasing the pressure and allowing the mixture obtained in step (a) to react into a flexible polyurethane foam,
wherein the polyol component comprises a **filtered** polymer polyol consisting of at least one polyether polyol having an average nominal functionality of at least 2.5 with dispersed therein from 2 to 50 wt% based on total weight of polymer polyol of polymer particles, whereby the particle size of essentially none of these polymer particles exceeds 50 micron."
[emphasis by the board in order to indicate the additional feature of this claim compared with the granted claim 1]

Claim 1 of auxiliary request 2 reads as follows:

"1. Process for the preparation of flexible polyurethane foams comprising the steps of
(a) bringing together a polyol component, a polyisocyanate component, a blowing agent comprising liquid carbon dioxide, a suitable catalyst and optionally ancillary chemicals at sufficient pressure to maintain the carbon dioxide in a liquid state, and

(b) releasing the pressure and allowing the mixture obtained in step (a) to react into a flexible polyurethane foam, wherein the polyol component comprises a polymer polyol consisting of at least one polyether polyol having an average nominal functionality of at least 2.5 with dispersed therein from 2 to 50 wt% based on total weight of polymer polyol of polymer particles, whereby the particle size of essentially none of these polymer particles exceeds 50 micron, **and wherein the polymer polyol used in step (a) is a polymer polyol that has been filtered in order to ensure that the polymer polyol is essentially free of polymer particles having a particle size above 50 micron.**"

[emphasis by the board in order to indicate the additional feature of this claim compared with the granted claim 1]

IV. By a decision orally announced at the oral proceedings held on 19 September 2006 and issued in writing on 20 December 2006 the opposition division revoked the patent. It considered that the subject-matter of claim 1 of the main and the second auxiliary request did not involve an inventive step in view of the obvious combination of D1 with D3, the latter been considered as the closest state of the art. The auxiliary request 1 was rejected for the reason that the subject-matter of claim 1 lacked clarity.

With regard to **claim 1 of the main request** the opposition division considered that its subject-matter differed from the disclosure of **D3** only in that a

polymer polyol was used, which did not contain polymer particles with a size exceeding 50 microns. The opposition division reasoned that the skilled person, starting from D3 and wishing to provide a process for preparing open-cell polyurethane foams with improved mechanical properties and processability, would in a first stage find in **D1** the hint to use in the process of D3 the polymer polyol of D1. Furthermore, in order to avoid clogging of the device used in D3 for the expansion of the reaction mixture, which had openings with a size of as low as 25 microns, he would in a second stage find it obvious to use polymer particles with a size of less than 25 microns. On this basis the opposition division concluded that the claimed subject-matter did not involve an inventive step.

With regard to **claim 1 of the second auxiliary request**, the opposition division reasoned that the additional feature of this request, namely the filtering of the polymer polyol, would be considered by the skilled person seeking to obtain polymer polyols whose particle size should not exceed 50 microns as an obvious technical measure.

With regard to **claim 1 of the first auxiliary request**, the opposition division reasoned that the additional feature of this request, namely the term "filtered", rendered the claim unclear. This was because it left the reader in doubt as to the meaning of this technical feature, especially as there was no explicit link to the maximum particle size of 50 μm .

V. The patent proprietor appealed the decision of the opposition division on 14 February 2007 and paid the

appeal fee on the same day. The statement setting out the grounds of appeal was submitted on 27 April 2007. It was accompanied by three sets of claims corresponding to three new auxiliary requests.

The appellant refuted the conclusions of the opposition division on the issue of inventive step. It considered D1 and not D3 to represent the closest state of the art on the basis of the similarity of the technical problem to be solved and of the common technical features. It argued that the technical problem to be solved should be reformulated and consist in the provision of a process for the manufacture of polyurethane foams with improved processability expressed in terms of cell-opening character. According to the technical explanations of the appellant the improved cell-opening character corresponded to a maximum amount of open cells in relation to that of closed cells which guaranteed constant foam properties in the course of time.

The appellant filed also a technical report which should demonstrate that the technical problem was solved by using in the process of polyurethane foam manufacture a polymer polyol with polymer particles having a size which did not exceed 50 microns. The appellant argued that the skilled person would not find any hint towards the claimed solution in the state of the art and held that the claimed process involved an inventive step.

VI. In its reply dated 13 September 2007, the respondent (opponent) defended the decision of the opposition division and argued that the claimed subject-matter lacked an inventive step in view of the obvious

combination of D1 with D3. Its essential argument was that the skilled person would find it obvious to use polymer polyol exempted of coarse particles in order to avoid clogging of the foam producing apparatus which would necessitate stopping the foam production. This was clearly shown in the technical report filed by the appellant.

- VII. Oral proceedings were held before the board on 26 February 2010. At the oral proceedings the debate concerned essentially the reformulation of the technical problem and the relevance and sufficiency of the additional experimental evidence filed by the appellant together with the statement setting out the grounds of appeal.
- VIII. The appellant requested that the decision under appeal be set aside and that the patent be maintained as granted as a main request or, alternatively on the basis of the set of claims 1-3 of the first or second auxiliary request or on the basis of the set of claims 1 and 2 of the third auxiliary request, all filed with the grounds of appeal.
- IX. The respondent requested that the appeal be dismissed.
- X. The arguments put forward by the appellant in its written submissions and at the oral proceedings can be summarized as follows:
- D1 should be considered to represent the closest state of the art for two reasons. The first was that D1 intended to provide flexible polyurethane foams with improved mechanical strength, weight load

bearing capabilities, cell-opening character and shrinkage resistance; under this aspect it solved that same technical problem as the opposed patent. The second reason was that D1 by disclosing a process for the manufacture of flexible polyurethane foams using a polymer polyol involved the same starting materials as the process of the opposed patent and thus had the most technical features in common with the claimed process when compared with the other cited documents of the state of the art.

- D3, which was considered by the respondent and the opposition division to represent the closest state of the art, was more remote than D1 since it related to a problem different from those disclosed in the opposed patent, namely the controllability of the expansion after pressure release (top of page 2).
- The technical difference between the claimed subject-matter and the disclosure of D1 concerned the combination of a specific polymer particles size with a specific blowing agent. With regard to the polymer particles size, D1 admittedly disclosed that it was very small but that their size distribution was broad because the polymer was produced following a continuous process (page 2, lines 16-18 in combination with page 3, lines 20-21).
- The technical problem should be reformulated in view of D1 and should concern a process which provides flexible polyurethane foams with improved processability in terms of cell-opening character when liquid carbon dioxide was the blowing agent. The meaning of the term "processability" disclosed in the opposed patent (paragraph [0004]) would be understood by the person skilled in the art in the way explained by the appellant in its statement

setting out the ground of appeal. This term related to a constant ratio of open to closed cells and did not vary in the course of time contrary to the unfounded allegations of the respondent.

- The technical problem was solved by the combined features of liquid carbon dioxide as blowing agent and of a polymer polyol with a particle size not exceeding 50 microns.
- The additional technical evidence filed with the technical report accompanying the statement setting out the grounds of appeal demonstrated that the technical problem was solved. This fact could not be contested on the basis that in this evidence water was used as blowing agent instead of carbon dioxide used in the claimed process. This evidence actually showed that there was a trend in polyurethane foams cell-opening, namely that the lower the relative amount of large polymer particles the better the cell-opening. This trend was independent of the nature of the blowing agent(s), the latter having an impact only on the way blowing took place. With regard to this evidence, what was relevant was not the absolute measured values (the ratio of closed to open cells in the foam was related to the porosity of the foam which was the property measured). On the contrary, what was relevant was the relation between these values resulting from the comparison of the porosity of foams having polymer particles with a size of at most 30 microns, ie within the claimed subject-matter, with the porosity of foams having polymer particles with a size greater than 30 microns which contained particles exceeding 50 microns, ie outside the claimed subject-matter.

- The claimed solution to the problem of improving processability was not obvious to the skilled person because the state of the art did not contain any hint in that direction. D1 did not suggest that the larger polymer polyol particles, specifically those having a particle size of more than 50 microns, should be removed in order to improve the processability of flexible polyurethane foams produced when liquid carbon dioxide was used as blowing agent.
- Though D1 disclosed that the polymer polyols should be free from agglomerates with no coarse particles and with a small average particle size, this disclosure related to the preparation of these polymer polyols and to the problematic of their storage stability (paragraphs [0016], [0017], [0031] and [0032]). It did not relate, implicitly or explicitly, to any problem resulting from their use in a process for the preparation of flexible polyurethane foams.
- The claimed process involved therefore an inventive step.

XI. The arguments put forward by the respondent in its written submissions and at the oral proceedings can be summarized as follows:

- The subject-matter of claim 1 of the main request lacked an inventive step in view of the obvious combination of D3, considered as the closest state of the art, with D1. The skilled person starting from D3 and aiming at improving the hardness, mechanical strength and loading properties of the polyurethane foams would consider it obvious to use the polymer polyols of D1. Furthermore, aiming at

reducing the risk of clogging the foaming device and of disrupting the preparation process he would consider it obvious to remove the coarser particles of these polymer polyols, specifically the particles with a size larger than 50 microns.

- Furthermore, the removal of those coarser particles would unavoidably lead to an improved processability of the polyurethane foams since the so manufactured polyurethane foams would intrinsically have an improved cell-opening character.
- The subject-matter of the main request would lack an inventive step even if D1 was considered to represent the closest state of the art.
- The only distinguishing feature of the claimed subject-matter was the specific particles size of the polymer polyol. The blowing agent, be it water or liquid carbon dioxide, did not have an effect on the quality of the polyurethane foam, which was evaluated in terms of density which depended on the amount of the blowing agent used. In fact the type of blowing agent had only an effect on the device used to foam the polyurethane.
- The technical problem to be solved starting from D1 was also the filterability of the polymer polyols (paragraphs [0003] and [0032]) the solution of which was provided by the control of the polymer particle size. This solution was obvious to the person skilled in the art in view of the commercially available foaming devices using liquid carbon dioxide as foaming agent, which had a mesh size ranging between 50 and 100 microns.
- If the reformulation of the problem was necessary in view of D1, this could not be so defined that it concerned the provision of a process for the

manufacture of flexible polyurethane foams with improved processability. The reason was that the term "processability" did not have a clear and unambiguous meaning in the light of the opposed patent specification; it could equally be interpreted as kinetic processability, which did not relate to any constant ratio of closed to open cells in the polyurethane foam.

- Was it to be understood in the way alleged by the patent proprietor and related to a maximum cell-opening in the polyurethane foam structure, the skilled person would find in D1 (see paragraph [0033]) the disclosure that the use of polymer polyols improved the foam processability. Hence, such an improvement could not constitute the technical problem to be solved.
- Furthermore, if the technical problem was to provide improved processability - in the sense alleged by the appellant - over the polymer polyols of D1, the appellant had not submitted any reliable technical evidence in support of the alleged improvement.
- The additional technical evidence filed by the appellant with the grounds of appeal was neither relevant nor sufficient. It was not relevant because it did not reflect the claimed subject-matter - water was used as blowing agent instead of the claimed liquid carbon dioxide. It was also not sufficient because it did not compare the processability in terms of cell-opening character of particles having a size greater than 50 microns with those having a size smaller than 50 microns.
- All in all the provided evidence simply tried to substantiate an additional effect (bonus effect) in relation to the main effect of avoiding clogging of

the foaming device which did not fall under the scope of the claimed subject-matter.

Reasons for the Decision

1. *Admissibility of the appeal*

The appeal is admissible.

2. *Inventive step of the main request (granted claims)*

2.1 The closest state of the art

- 2.1.1 The board concurs with the appellant that D1 should be considered to represent the closest state of the art. D1 (claims 1 and 12; paragraphs [0032], [0033], [0039]; examples 6-16) discloses a process for the preparation of polyurethanes and thus belongs to the technical field of the claimed subject-matter. Additionally, the process of D1 aims at solving the same technical problems (paragraph [0033]), namely to provide flexible polyurethane foams with improved rigidity, load bearing properties, open-cell character (which as set out below [point 2.2.2] is understood to relate to the foam processability) and shrinkage resistance. D1 further discloses that the polymer polyols are free from coarse particles responsible for sedimentation and filtration. Finally the process disclosed in D1, which comprises reacting a polymer polyol with a polyisocyanate in the presence of catalysts, blowing agents and other known additives, has the most features in common with the claimed process compared to the other opposed documents. Though liquid carbon dioxide is not used in the

experimental part of D1, it is disclosed to constitute one of the blowing agents to be used in such a preparation process (paragraph [0039]).

2.1.2 The document D3 is less relevant (page 1, lines 5-12; page 3, lines 9-22; page 4, lines 1-3). Although it belongs also to the technical field of polyurethane foam production it aims at solving a different technical problem, namely the production of uniform foams (page 2, lines 1-15 and page 4, lines 4-10). Furthermore it does not involve a polymer polyol in the preparation of the polyurethane foam.

2.1.3 The subject-matter of claim 1 of the main request differs from the process disclosed in D1 at least in that "the particle size of essentially none of the polymer particles exceeds 50 micron".

The board notes that the disclosure in D1 of particles size not exceeding 50 microns relates exclusively to **average particles size** (paragraphs [0018], [0020] and [0052]; claim 1; examples 6-16). D1 does not disclose any individual particles size. The claimed particles size of 50 microns cannot derive from the disclosure of D1 anyway. The reason is that this document does not disclose the particle size distribution which would allow the calculation of these values. The sole disclosure of D1 in this context (paragraph [0003] in combination with claim 1) is vague in the sense that it cites that the continuous process for the preparation of polymer polyols leads to polymer particles with a "broad" particle size distribution. Finally, the disclosure of the rating of the particle residue (page 8, lines 12-24) cannot be of any help because

such a rating is empirical - it is in fact based on visual inspection of a wetted glass wall.

2.2 The technical problem

2.2.1 The opposed patent, paragraph [0004], sets principally as technical problem to be solved the provision of a process for producing flexible polyurethane foams with "improved" hardness, with "improved" mechanical strength and load bearing properties and with **"improved" processability in terms of cell-opening**, while using liquid carbon dioxide as blowing agent. In paragraph [0006] the additional technical problem is extended to cover the provision of a process which also controls the filterability of the polymer polyols and thus avoids plugging of the small openings in the discharge device used for providing the liquid carbon dioxide.

2.2.2 In this context the board concurs with the appellant, who argued in the statement setting out the grounds of appeal (cf. page 3, first paragraph) that the term "processability" is construed by the person skilled in the art to relate to the open-cell character of the flexible polyurethane foams in the sense that it defines the stabilized ratio of closed to open cells in the polyurethane foam.

The board cannot concur on this point with the respondent, who contested the significance of the term "processability" for the first time at the oral proceedings before the board, without providing any contradicting technical evidence in support of its diverging interpretation.

2.2.3 In view of the considerations set out in the analysis of the closest state of the art (point 2.1.1 above), the board notes that the principal technical problems addressed in the opposed patent (hardness, mechanical strength and load bearing properties, as well as processability in terms of cell-opening of the polyurethane foams) have been equally addressed in D1 (paragraphs [0001] and [0033]). This document has further addressed the technical problem of filterability of the polymer polyols (paragraphs [0004] and [0032]) without making any particular relation to the supply of liquid carbon dioxide, which is however one of the possible blowing agents (paragraph [0039]).

2.2.4 Under these circumstances the board considers that the technical problem has to be reformulated. The board in view of the disclosure of the originally filed application can only acknowledge **an improvement** of the above mentioned properties on the basis of the available technical evidence. The relevant pieces of experimental evidence were those submitted before the opposition division (annex to the letter dated 10 July 2006) and before the board (annex to the statement setting out the grounds of appeal) which showed an improvement in processability and the prevention of clogging the device delivering the liquid carbon dioxide when this was used as blowing agent.

On this technical basis the board considers that the reformulated technical problem should be the provision of a process for the preparation of flexible polyurethane foams with **improved processability** while avoiding the clogging of the device delivering the

liquid carbon dioxide when this is used as blowing agent.

The board does not consider that an improvement concerning the hardness, the mechanical strength and the load bearing properties has ever been technically demonstrated. Consequently these aspects of the originally filed technical problem should be left out from the reformulation of the technical problem.

2.2.5 In this context the board does not concur with the respondent who argued on the basis of paragraph [0033] of D1, that it had already disclosed the improvement in processability. In the board's understanding this paragraph of D1 relates to the advantageous preparation of polyurethane foams when polymer polyols are used compared to polyurethane foam preparation without using polymer polyols.

2.2.6 The board acknowledges that the experimental reports submitted by the appellant both before the opposition division and the board provide the necessary technical evidence that the set technical problem is solved when polymer polyol particles size does not exceed 50 microns.

The respondent, who orally contested the reliability and sufficiency of the evidence submitted before the board for the first time at the oral proceedings before the board, did not file any concrete technical evidence in order to substantiate its allegation.

2.2.7 The board considers that the appellant's evidence is relevant because the exemplified polymer polyol

particles size falls within the scope of claim 1. According to this evidence, the polymer polyol contains 43 wt% of styrene-acrylonitrile particles dispersed in a polyether polyol with a nominal average functionality of 3.0. The polymer particles have been filtered using a filter mesh size of 30 microns which means that none of the particles has a size exceeding 30 microns and in consequence a size exceeding the barrier value of 50 microns set in the claimed subject-matter.

The appellant's evidence is also relevant despite the fact that the exemplified process is carried out using water and not carbon dioxide as blowing agent. In this point the board agrees with the appellant who reasoned that independently of the different blowing agent used, this evidence demonstrated that there was a trend in improving processability (measured as porosity) when the polymer particles size did not exceed 50 microns. Although a different absolute value would admittedly be obtained when using different blowing agents, it was not the absolute values that counted but the trend when modifying the particles size, which trend would be expected by the skilled person not to depend on the nature of the blowing agent. Furthermore, in the absence of any contradictory technical evidence the board accepts the argument of the appellant.

- 2.2.8 The board also considers the appellant's evidence to be sufficient. In the board's understanding this evidence shows that an advantageous effect in processability is obtained when excluding particles larger than 30 microns, the excluded particles comprising the particles with a size larger than 50 microns, ie those falling under the scope of D1 and excluded by the claimed subject-matter. The respondent's allegation on

this issue was not supported by any technical evidence contradicting the results of the appellant.

2.3 Obviousness

2.3.1 The question which remains to be answered is whether the skilled person starting from the disclosure of D1 and aiming at improving the processability of polyurethane foams expressed in terms of cell-opening while avoiding the clogging of the liquid carbon dioxide delivering device would find it obvious to control the size of the solid particles of the polymer polyols by removing those with a size exceeding 50 microns.

2.3.2 The board has reviewed the opposed documents and has not found in any of them any disclosure or any hint which would motivate the skilled person towards using a polymer particles size which does not exceed 50 microns in order to improve processability while avoiding clogging the liquid carbon dioxide delivering device. As already stated above (see point 2.1.3) the closest state of the art document D1 (paragraph [0032]) is the only document which deals with polymer polyols in the preparation of polyurethane foams, these polymer polyol particles being free from coarse particles and having a small **average** particle size. D1, however, does not define closer the meaning of "coarse" particles and does not disclose the **size distribution** of the small average particles. The only information it discloses is that the polymer particles, object of the invention of D1, are prepared by a continuous process (claim 1) and therefore have a broad particle size distribution (paragraph [0003]). Hence D1 does not disclose any

particular polymer polyol particles size and even less a particles size not exceeding 50 microns.

2.3.3 Under these circumstances the board concludes that the skilled person starting from D1 and seeking to improve the processability of the flexible polyurethane foams while avoiding clogging the liquid carbon dioxide delivering device would not find in this document the least indication that he would achieve his goal when the polymer particles size does not exceed 50 microns.

2.4 On the basis of the above considerations the board comes to the conclusion that the subject-matter of claim 1 of the main request (claim as granted) involves an inventive step. The subject-matter of claims 2 and 3 which corresponds to preferred embodiments of the subject-matter of claim 1 involves *mutatis mutandis* an inventive step.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The patent is maintained as granted.

The Registrar:

The Chairman:

G. Röhn

N. Perakis