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**D E C I S I O N**  
**of 23 August 2002**

**Case Number:** T 0764/01 - 3.2.5

**Application Number:** 95924245.4

**Publication Number:** 0767728

**IPC:** B29C 44/46

**Language of the proceedings:** EN

**Title of invention:**

Method and device for the production of foam using carbon dioxide dissolved under pressure

**Patentee:**

BAYER AG, et al

**Opponent 01:**

Foaming Technologies CarDio B.V.

**Headword:**

-

**Relevant legal provisions:**

EPC Art. 56, 83, 123

**Keyword:**

"Inventive step - yes (after amendment)"

"Examination of claims not under appeal - no (*reformatio in peius*)"

**Decisions cited:**

G 0009/92, G 0004/93, T 0856/92, T 0789/89

**Catchword:**

-



**Case Number:** T 0764/01 - 3.2.5

**D E C I S I O N**  
**of the Technical Board of Appeal 3.2.5**  
**of 23 August 2002**

**Appellant:** Bayer AG, et al  
(Proprietor of the patent) D-51368 Leverkusen (DE)

**Representative:** -

**Respondent:** Foaming Technologies CarDio B.V.  
(Opponent 01) Hoekenrode 6-8  
1102 BR Amsterdam (NL)

**Representative:** Ahme, Johannes, Dr.  
Uexküll & Stolberg Patentanwälte  
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**Decision under appeal:** Interlocutory decision of the Opposition Division  
of the European Patent Office posted 18 June 2001  
concerning maintenance of European patent  
No. 0 767 728 in amended form.

**Composition of the Board:**

**Chairman:** W. Moser  
**Members:** H. M. Schram  
W. Widmeier

## Summary of Facts and Submissions

I. The appellant (patent proprietor) lodged an appeal against the interlocutory decision of the Opposition Division maintaining European patent No. 0 767 728 in amended form.

In the decision under appeal, it was held that the grounds of opposition submitted by the respondent (opponent 01) and opponent 02, who withdrew his opposition during the opposition proceedings, under Article 100(a) EPC (lack of novelty and lack of inventive step) and Article 100(b) EPC (insufficiency of disclosure) did not prejudice the maintenance of the patent on the basis of the (amended) device claims according to the second auxiliary request. The Opposition Division held that the independent device claim according to the main request, i.e. claim 5 as granted, was not new and that the process claim 1 according to the first auxiliary request lacked an inventive step with respect to the documents

D1 US-A-3 108 976 and

D2 US-A-3 184 419

The Opposition Division further held that the objection under Article 100(b) EPC was rather a matter of clarity than of reproducibility, and did not decide on this matter.

II. The appellant requested that the decision under appeal be set aside and that the patent be maintained on the basis of claims 1 to 7 filed with his statement setting out the grounds of appeal on 25 October 2001.

The respondent requested on 4 March 2002 that the appeal be dismissed, without submitting observations in support of this request. Oral proceedings were requested on an auxiliary basis. On 6 May 2002 he withdrew his opposition.

III. The independent method claim 1 according to the sole request of the appellant reads as follows (amendments with respect to claim 1 as granted in bold):

"1. A process for the production of foams from at least two reactive components using carbon dioxide as expanding agent, comprising mixing at least one of the reactive components with carbon dioxide under pressure thereby producing a mixture containing liquid carbon dioxide, mixing the resultant mixture with the other reactive component to form a foamable reactive mixture **at a pressure in excess of the equilibrium pressure of dissolved carbon dioxide**, expanding the reactive mixture and curing the resultant foam product, characterized in that the foamable reactive mixture is expanded **by passing said reactive mixture through at least one fine-meshed screen** with subdivision into a large number of individual flows at shear rates of above 500/sec."

IV. In a communication dated 10 July 2002 the Board expressed its provisional opinion that the process claims 1 to 3 according to the sole request of the appellant appeared to meet the requirements of Articles 52, 56, 83, 84 and 123 EPC, and that neither the respondent nor the Board had the power to challenge the device claims 4 to 7 underlying the decision under appeal in view of the prohibition of *reformatio in peius*. The appellant was requested to file a

description in conformity with the claims according to the sole request. The Board stated that the respondent, after having withdrawn his opposition, ceased to be party to the present appeal proceedings in respect of the substantive issues (cf. decision T 789/89 [OJ EPO 1994, 482]), and that, since there were no other issues to be dealt with, the auxiliary request for oral proceedings filed by the respondent was no longer of any relevance and was therefore disregarded.

- V. The appellant filed an amended description on 23 July 2002, and requested the maintenance of the patent in amended form on the basis of this description, claims 1 to 7 filed on 25 October 2001 and the drawings of the patent specification.

### **Reason for the Decision**

1. *Scope of the appeal*

In substance, the device claims 4 to 7 correspond to the device claims 1 to 4, on the basis of which the Opposition Division has decided to maintain the patent in amended form. Due to the prohibition of *reformatio in peius* (cf. decisions G 9/92, G 4/93 [OJ EPO 1994, 875]), neither the respondent nor the Board may challenge these claims (cf. T 856/92, not published in the Official Journal of the EPO).

2. *Sufficiency of disclosure*

The respondent has inter alia raised the ground for opposition under Article 100(b) EPC. In particular, he has submitted that the patent specification did not

contain any information how the shear rate was calculated.

The shear rate is the gradient of the rate of flow transversely to the direction of flow. The Board agrees with the respondent that the velocity profile and hence the shear rate, depends *inter alia* on the size and shape of the cross-section of the channel. For various cross-sections, such as slits or perforated plates with circular openings, approximate formulae for the shear rate exist, which attempt to express the shear rate as a function of the parameter(s) that describe the cross-section, and of other parameters such as the length of the channel, the pressure difference through the opening and the viscosity of the fluid. However, flow rates, and thus shear rates, can be measured, so that the question which formula correctly calculates the shear rate, does not need to be answered.

In the description of the patent in suit, suitable ranges for the relevant process parameters for producing a foam with small and uniform bubbles are provided (cf. column 3, line 6, to column 5, line 18), namely: mesh-size of the fine-meshed screens, viscosity and shear stress of the reaction mixture, the required pressure of the reaction mixture prior to the passage through the screen and immediately prior to entering the screen. The pressure of the reaction mixture prior to the passage through the screen is dependent on the quantity of liquid carbon dioxide dissolved and must be in excess of the equilibrium pressure, so that the mixture is still homogeneous on entering the screen. By passing the reactive mixture through one or more fine-meshed screens, the foamable reactive mixture is subdivided into a large number of individual flows

having a shear rate of above 500/s, resulting in a homogeneous density of bubble nuclei, which upon expansion produces a homogeneous low-density foam free from large voids or bubbles.

In the description of the patent in suit it is noted (cf. column 4, line 53, to column 5, line 13) that it is advantageous to use several fine-meshed screens in tandem with a view of increasing the shear time. If the shear time is too short, i.e. less than the relaxation time associated with the formation of bubble nuclei, and this may happen when only one screen is used, the resulting foam may not be sufficiently homogeneous. The respondent objected to the fact that no definitions of shear time and relaxation time were given in the patent in suit. The Board is of the opinion that definitions of shear time and relaxation time are not required to perform the invention, since these parameters do neither appear in the claims, nor elsewhere in the patent in suit, apart from the passage cited above, which is an attempt to explain why the use of more than one screen is beneficial.

The Board thus has no doubt that the process is disclosed in a manner sufficiently clear and complete for it to be carried out by the person skilled in the art (cf. Articles 83 and 100(b) EPC).

3. *Allowability of the amendments and novelty*

Claims 1 to 3 according to the sole request of the appellant correspond to claims 1 to 3 according to the first auxiliary request submitted before the Opposition Division. The Opposition Division held that these claims met the requirements of Articles 54, 123(2)

and (3) EPC. The Board has duly examined this matter and has come to the same conclusion. Since novelty and allowability of the amendments were not challenged by the respondent, further substantiation of this matter is not considered necessary.

The amendments to the description, which were made with a view to bring the description into conformity with the new claims, also meet the requirements of Article 123(2) EPC. The claims according to the sole request are clear and supported by the description, so that the requirements of Article 84 EPC are also met.

4. *Inventive step*

4.1 The subject-matter of claims 1 to 3 relates to a process for the production of foams from at least two reactive components using carbon dioxide as expanding agent, comprising mixing at least one of the reactive components with carbon dioxide under pressure thereby producing a mixture containing liquid carbon dioxide, mixing the resultant mixture with the other reactive component to form a foamable reactive mixture at a pressure in excess of the equilibrium pressure of dissolved carbon dioxide, expanding the reactive mixture and curing the resultant foam product. Such a process is known from document D2 (cf. column 1, line 40, to column 2, line 6). This document, which can be considered as the closest prior art, does not disclose the use of a screen.

Liquid carbon dioxide has been used in the foaming art as an expanding agent for many decades (cf. document D2, which claims priority of an application filed in 1958), inter alia due to its environmental



acceptability. However, the release of carbon dioxide from a foamable reactive mixture has been found to be difficult to control, since, firstly, carbon dioxide vaporizes relatively suddenly so that a very large increase in volume takes place in the reaction mixture, and, secondly, the reaction mixture tends to inhibit release of the carbon dioxide, which can be from 3 to 6 bar below the equilibrium vapour pressure at the relevant temperature, so that a sudden explosive release of carbon dioxide occurs with the result that large voids or bubbles are enclosed within the foam (cf. column 1, line 42, to column 2, line 4, of the patent in suit).

The problem the invention as claimed in claims 1 to 3 seeks to solve can thus be formulated as providing a process which produces a foam with small and uniform bubbles.

The invention as claimed in claims 1 to 3 is based on the finding that a large number of microscopic bubble nuclei are produced when the reaction mixture is exposed during expansion to high shear rates of above 500/s. This is achieved by passing the reaction mixture containing liquid carbon dioxide through at least one fine-meshed screen, so that the flow is subdivided into a large number of individual flows, and thereby expanded.

- 4.2 Document D1 discloses a process whereby an inert gas and an organic liquid foam precursor are passed together through a frothing zone, see column 2, lines 29 to 32. The inert gas may be carbon dioxide, but is normally air (see the Examples and column 2, lines 12 to 16). Document D1 does hence neither

disclose that the inert gas is *mixed* with the reactive component before it enters the frothing zone, nor that it is initially mixed *with only one* reactive component and then with the other reactive component, i.e. a *two-step mixing process*. Document D1 also fails to disclose that the inert gas is in *liquid form*. Moreover, document D1 does not disclose the forming of a foamable reactive mixture *at a pressure in excess of the equilibrium pressure of dissolved carbon dioxide*.

The fine-mesh screens in the process known from document D1 are used to distribute the inert gas into the organic liquid foam precursor, whereby through the action of a large number of screens larger bubbles are divided into smaller ones. The process disclosed in document D1 is thus essentially a mechanical frothing process, although it is different from a conventional mechanical dispersion process, like, for example, beater and pump dispersion (cf. column 2, line 65, to column 3, line 9).

Summarizing, document D1 does not disclose that one of the reactive components is first mixed with carbon dioxide before the resultant "mixture containing liquid carbon dioxide" is mixed with the other reactive component to form a foamable reactive mixture, as required by claim 1. The expression "mixture containing liquid carbon dioxide" as used in claim 1 is defined in the patent in suit (cf. column 3, lines 10 to 13) as a homogeneous liquid under a pressure of at least 4 bar, wherefrom carbon dioxide is released after expansion to a pressure of less than at least 4 bar.

It follows from the above that document D1 is not at all relevant to assess inventive step of the invention

as claimed in claims 1 to 3. Document D1 does not disclose the preparation of a foamable reactive mixture in the sense of the invention as claimed in claims 1 to 3, whereby bubbles are formed by evaporation, it rather discloses the mechanical preparation of a froth, viz. a liquid foam. Hence the skilled person had no incentive to employ the fine-meshed screen known from document D1 in the process known from document D2.

- 4.3 The subject-matter of claim 1 thus involves an inventive step. Claims 2 and 3 are appendant to claim 1 and relate to preferred embodiments of the process of claim 1. These claims thus similarly involve an inventive step.
5. The patent can thus be maintained as requested by the appellant.

## Order

### For these reasons it is decided:

1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to maintain the patent on the basis of the following documents:

**Description:** page 2 with inserts 1 and 2 from column 2a and insert 3 from column 3b, and pages 3 to 5 filed on 23 July 2002

**Claims:** claims 1 to 7 filed on 25 October 2001

**Drawings:** pages 7 to 15 of the patent as granted

The Registrar:

The Chairman:

M. Dainese

W. Moser