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File No.: T 0408/92 - 3.3.3  
Application No.: 87 109 405.8  
Publication No.: 0 254 890  
Classification: C08J 9/14  
Title of invention: Polyether silicone copolymers with mixed hydroxy  
alkoxy capping for stabilizing high solid content,  
molded, flexible urethane foam

**DECISION**  
of 16 November 1993

Applicant: Union Carbide Corporation

Proprietor of the patent: -

Opponent: -

Headword:

EPC: Art. 56

Keyword: "Inventive step - (yes)"

Headnote  
Catchwords



Case Number: T 0402/92 - 3.3.3

**D E C I S I O N**  
of the Technical Board of Appeal 3.3.3  
of 16 November 1993

**Appellant:** Union Carbide Corporation  
39 Old Ridgebury Road  
Danbury  
Connecticut 06817 (US)

**Representative:** Wuesthoff, Franz, Dr.-Ing.  
Wuesthoff & Wuesthoff  
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Schweigerstrasse 2  
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**Decision under appeal:** Decision of the Examining Division of the European  
Patent Office dated 11 December 1991 refusing  
European patent application No. 87 109 405.8  
pursuant to Article 97(1) EPC.

**Composition of the Board:**

**Chairman:** C. Gérardin  
**Members:** R. Lunzer  
F. Benussi

### Summary of Facts and Submissions

- I. European patent application No. 87 109 405.8, publication No. 254 890, was filed on 30 June 1987, having a priority date of 30 June 1986 derived from US Application No. 88 0295.
- II. In response to the first action by the Examining Division issued on 9 July 1991, the Appellant filed a letter dated 11 November 1991, which included detailed argument by way of reply to the objection of lack of inventive step, and two amended sets of claims, a set of Claims 1 to 8 for the designated Contracting States other than Austria (set A), and a set of Claims 1 to 7 for Austria (set B). The amendments made by the Appellant to the main claims of these two sets were purely of a clarifying nature, and did not affect the scope of their subject-matter.
- III. By its written decision given on 11 December 1991, the Examining Division refused the application, holding that although novel, it lacked any inventive step having regard to the combined teachings of:
- (1) DE-C-3 508 292 and
  - (2) BE-A-676 149.

The single independent Claim 1 of set A is in the following form:

"A polyurethane foam surfactant which comprises: one or more polydialkylsiloxane-polyoxyalkylene copolymer(s) wherein the polydialkylsiloxane backbone contains no more than 10 silicon atoms and the backbone is substituted with an average of at least 0.5 polyoxyalkylene substituents wherein

- (a) 5 to 95 percent by weight of the pendants on the copolymer have the formula



- (b) 95 to 5 percent by weight of the pendants on the copolymer have the formula



wherein R is an alkylene group of 1 to 4 carbons linked to the silicon atom, R' is an oxyalkylene group of 1 to 4 carbons, R'' is a second oxyalkylene group of 1 to 4 carbons which is different from R', a + b is 1 to 15, and X is -OR<sup>3</sup> or -OCR<sup>3</sup> where



R<sup>3</sup> is a monovalent alkyl group of 1 to 4 carbons; and c + d is 1 to 10."

The single independent Claim 1 of set B is drafted as a process claim for making moulded, flexible polyurethane foams of improved breathability characterised by the use of a foam stabiliser as defined in the main claim of set A.

IV. An appeal against that decision was lodged on 10 February 1992, the appeal fee was paid on the same day, and the Grounds of Appeal were filed on 9 April 1992. In the Statement of Grounds of Appeal, the Appellant argued that the refusal of the application after one single communication and without granting the Appellant's representative an interview amounted to a = substantial procedural violation, giving rise to a right to the reimbursement of the appeal fees pursuant to

Rule 67 EPC. That request was withdrawn by a letter dated 8 November 1993.

As to the substantive matters, the Appellant emphasised the differences in structure and properties between the surfactants as defined in the application in suit and the compounds described in documents (1) and (2). As demonstrated in an affidavit, even a combination of the essential features of these citations, i.e. mixed end groups according to document (1) and a relatively low number of silicon atoms according to document (2), would not lead to a product having the desired properties.

- V. The Appellant requested that the decision under appeal be set aside, and a patent granted on the basis of the claims filed on 11 November 1991, the description still to be amended.

#### Reasons for the decision

1. The appeal is admissible.

2. *Admissibility of amendments*

The Examining Division raised no objection to the amendments proposed by the Appellant, which had been made in response to objections previously raised by it on the ground of lack of clarity under Article 84 EPC. These amendments are of a purely clarifying nature, and are substantially as suggested by the Examining Division. The Board is satisfied that they are permissible for the purposes of Article 123(2) EPC.

3. *Novelty*

Novelty was acknowledged by the Examining Division, and as will appear later, that finding was justified because each of the cited documents mentioned in paragraph III above lacks at least one feature which is essential to the invention as claimed.

4. *Closest prior art*

The application in suit concerns polyether silicone copolymers with mixed hydroxy alkoxy capping for stabilising high solid content, moulded, flexible urethane foam. Such compounds are known from document (1) which the Board, like the Examining Division, regards as the closest prior art. This citation describes polysiloxane polyether block copolymers which are used for the stabilisation of flexible polyurethane foams. According to their general formula, these products contain at least 32 siloxane units, and according to the examples more than 60. The polyoxyalkylene side units are partly hydroxy terminated, and partly alkyl or acyl capped (see the claims). From the data in Tables 1 to 3 it appears that such mixed copolymers ensure high stability against shear collapse, but that breathability cannot be regarded as entirely satisfactory.

5. *Problem and its solution*

In view of this shortcoming of the stabilisers disclosed in the prior art, the problem underlying the application in suit may be seen in the provision of surfactants which improve the breathability of polyurethane foams, without impairing their stability.

According to the application in suit, this problem is solved by polysiloxane polyoxyalkylene copolymer compositions, i.e. either by blends of hydroxy terminated and alkyl capped polyoxyalkylene copolymers, or by mixed hydroxy terminated and alkyl capped polyoxyalkylene copolymers, wherein the polydialkylsiloxane backbone contains no more than 10 silicon atoms.

In view of the experimental data in Tables 3 to 9 of the application in suit, which show that such compositions provide both a high degree of foam stabilisation and foam breathability, the Board is satisfied that the above-defined technical problem is effectively solved.

6. *Inventive Step*

6.1 It remains to be decided whether this solution involves an inventive step having regard to the teachings of documents (1) and (2).

6.2 The comparative experiments reported in Tables 1 to 3 of document (1), which illustrate the influence of the end groups of the polyoxyalkylene side units on stability and breathability of polyurethane foams, would not suggest to the skilled worker that these properties are capable of being controlled or influenced by restricting the number of siloxane units.

The comparison between surfactants (i) containing only methyl capped polyoxyalkylene units (stabilisers A, F and K), (ii) containing only hydroxy terminated polyoxyalkylene units (stabilisers B, G and L), and (iii) containing a combination of both types of side chains (stabilisers C, H and M), shows that the best results as far as breathability is concerned are obtained with stabilisers (i), but that at the same time

the foam stability deteriorates. A similar loss of foam stability is shown by the surfactant identified as D in Table 1 of document (1), which is stated to be in accordance with Example 1, substance C, formula III of DE-C-1 694 366, which surfactant contains polyoxyalkylene units capped with an n-butyl group. Document (1), Table 1 likewise refers to another comparative surfactant E, said to be made in accordance with US-A-3 402 192, which is a commercially available product identified by the trade mark "DC 190" of Dow Corning Corporation. Although its composition is no more closely specified, it seems in view of the structural formulae (1) to (4) and the definitions of G, A, and n mentioned in Claim 1 that the compound actually used for comparative purposes must have been a polyoxyalkylene siloxane branch copolymer having a large number of silicon atoms in the polydialkylsiloxane backbone, and the polyoxyalkylene substituents capped with a radical selected from -OR', -OOCR', and -OCCOR'. Regarding such a surfactant, Table 1 of document (1) shows again that breathability is achieved only with a loss of foam stability.

It is thus evident that an improvement in terms of breathability can only be obtained at the expense of stability, and that therefore the teaching of document (1) cannot provide a solution to the above-identified technical problem.

6.3 The structural features of the polyether polyoxyalkylene copolymers mentioned in document (2), whereby polyurethane foams of great stability can be produced (page 1 to page 2, paragraph 2), do not correspond to the solution claimed at present.

Like the Examining Division and the Appellant, the Board relies on the compounds exemplified on page 8 of this

citation, rather than on the general formulae (1) and (2) given on pages 5 and 6. From these examples it appears that the products regarded as particularly useful contain between 12 and 25 silicon atoms in combination with polyoxyalkylene units capped with a lower alkyl group. Even if this could be regarded at first sight as an incentive for the skilled man to consider shorter polysiloxane blocks, a mere combination of this feature with the stabilisers described in document (1) would not lead to success.

As demonstrated by the Appellant in the affidavit filed together with the Statement of Grounds of Appeal, depending upon their number of silicon atoms, copolymers having both hydroxy terminated and methyl capped polyoxyalkylene units have an entirely different activity. By using a surfactant with 14 silicon atoms, thus within the terms of document (2), in combination with the polyurethane formulation 2 according to page 34 of the original application, one obtains a foam which shrinks severely, failing the Foam Breathability Test described at pages 32/33, and thus a product which is commercially unacceptable. This result must be regarded as surprising since optimal results are obtained in the application in suit with surfactants having less than 10 silicon atoms, but otherwise identical.

It follows that the claimed subject-matter goes beyond the mere combination of the teachings of documents (1) and (2), and that, in particular, the presence of polydialkylsiloxane blocks with less than 10 silicon atoms in the copolymer must be regarded as an inventive feature.

6.4 For these reasons, the first alternative covered by Claim 1, i.e. the "mixed hydroxy terminated and alkyl capped polyalkylene copolymers", involves an inventive

step. The same applies to the second alternative, the "blends of hydroxy terminated and alkyl capped polyoxyalkylene copolymers", since such blends are not envisaged in the two documents considered above.


- 7. Claim 1 of set A being allowable, the same applies to dependent Claims 2 to 6, which are directed to preferred polyurethane foam surfactants according to Claim 1, as well as to Claims 7 and 8, which concern a process for making moulded, flexible polyurethane foams utilising the surfactant of Claims 1 to 6, and whose inventiveness is supported by that of the main claim.
- 8. Similar considerations apply to the claims according to set B, since they are drafted as process claims using foam stabilisers defined by the combination of features recited in set A.

**Order**

**For these reasons, it is decided that:**

- 1. The decision under appeal is set aside.
- 2. The case is remitted to the Examining Division with the order that a patent be granted on the basis of the claims referred to in paragraphs II and III above, subject to appropriate adaptation of the description.

The Registrar:

  
 E. Gorgmaier

The Chairman:

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 C. Gérardin