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**Datasheet for the decision  
of 31 October 2006**

**Case Number:** T 0092/04 - 3.3.09

**Application Number:** 98946435.9

**Publication Number:** 1019449

**IPC:** C08J 9/14

**Language of the proceedings:** EN

**Title of invention:**  
Process for rigid polyurethane foams

**Patentee:**  
HUNTSMAN INTERNATIONAL LLC

**Opponent:**  
Honeywell International, Inc.

**Headword:**

-

**Relevant legal provisions:**  
EPC Art. 54(3)

**Keyword:**  
"Novelty (yes)"

**Decisions cited:**

-

**Catchword:**

-



Case Number: T 0092/04 - 3.3.09

**DECISION**  
of the Technical Board of Appeal 3.3.09  
of 31 October 2006

**Appellant:** Honeywell International, Inc.  
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**Representative:** Hucker, Charlotte Jane  
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**Decision under appeal:** Decision of the Opposition Division of the  
European Patent Office orally announced  
4 November 2003 and posted 19 November 2003  
rejecting the opposition filed against European  
patent No. 1019449 pursuant to Article 102(2)  
EPC.

**Composition of the Board:**

**Chairman:** P. Kitzmantel  
**Members:** W. Ehrenreich  
W. Sekretaruk

## Summary of Facts and Submissions

- I. Mention of the grant of European patent No. 1 019 449 in respect of European patent application No. 98 946 435.9 in the name of *Huntsman International LLC*, filed as International application No. PCT/EP 98/05437 on 27 August 1998 in the name of Imperial Chemical Industries PLC, was announced on 26 September 2001. The patent, entitled "*Process for rigid polyurethane foams*", was granted with ten claims, Claim 1 reading as follows:

"1. Process for preparing rigid polyurethane or urethane-modified polyisocyanurate foams comprising the step of reacting an organic polyisocyanate with a polyfunctional isocyanate-reactive component in the presence of water and a physical blowing agent mixture containing 1,1,1,3,3-pentafluoropropane and isopentane and/or n-pentane **characterised in that** the mole ratio 1,1,1,3,3-pentafluoropropane/iso- and/or n-pentane is between 1/99 and 40/60."

Claims 2 to 7 were, either directly or indirectly, dependent on Claim 1. Claim 8 was directed to a rigid foam obtainable by the method according to Claims 1 to 7 and Claims 9 and 10 were concerned with a polyfunctional isocyanate-reactive composition comprising a polyfunctional isocyanate-reactive component, water and the physical blowing agent mixture in molar ratios as defined in Claims 1 and 2, respectively.

- II. Notice of opposition based on the grounds of Article 100(a) EPC was filed on 24 June 2002 by *Honeywell International INC*.

The Opponent requested revocation of the patent in its entirety because in its view the disclosure of document

D1 WO 97/38045,

constituting prior art under Article 54(3) EPC, anticipated the claimed invention. Further documents representing passages from the following textbooks:

D2 G. Woods, The ICI Polyurethanes Book, ed. by J. Wiley & Sons (1990), pages 46 to 48, 55 to 59, 60 to 62 and 130 to 132

D3 K.C.Frisch and J.H. Saunders, Plastic, part II, ed. by Marcel Dekker (1973), pages 461 to 462

D4 W.F. Gum et al., Reaction Polymers, ed by Hanser Publishers (1992), pages 370, 548 to 550 and 552

were cited by the Opponent after the expiry of the opposition period with the letters dated 4 September 2003 (D2) and 30 October 2003 (D3, D4).

III. With the letter dated 19 September 2003, the Patent Proprietor submitted two sets of claims as bases for auxiliary requests 1 and 2 and enclosed pages 88 and 89 of the textbook "The ICI Polyurethanes Book (1990)" - hereinafter D5.

IV. With its decision, orally announced on 4 November 2003 and issued in writing on 19 November 2003, the Opposition Division rejected the opposition.

In its decision the Opposition Division held that D1, concerned with the preparation of flexible and rigid polyurethane (PU) foams using an azeotrope-like blowing

agent mixture of 1,1,1,3,3-pentafluoropropane (commercial name: HFC-245fa) with *inter alia* n- or isopentane, did not disclose the preparation of a rigid PU foam in the presence of water and the above blowing agent mixture in the claimed molar ratio. The use of water as co-blowing agent was only disclosed for the preparation of flexible foams. Its use in combination with the HFC-245fa / n- and/or isopentane mixture in the claimed molar ratio for the preparation of rigid PU foams required multiple selections from the disclosure in D1, which document was thus not novelty-destroying. The documents D2 to D5 were not admitted into the opposition proceedings; they were held to have no significance for the decision of the Opposition Division.

V. Notice of appeal was filed by the Opponent (hereinafter the Appellant) on 19 January 2004. The Statement of the Grounds of Appeal, wherein the Appellant maintained its objection as to lack of novelty over D1, was submitted on 26 March 2004. The further document

D6 A. Cunningham et al. "Recent Advance in the Development of Rigid Polyurethane Foams" presented at the PU World Congress 1987

was submitted.

VI. In a communication dated 14 September 2006 the Board indicated that the issue of novelty over D1 would be the only point of discussion in the oral proceedings scheduled for 31 October 2006. In its opinion, the documents D2 to D6 should be admitted into the proceedings in order to consider whether D1 implicitly

disclosed the preparation of rigid PU foams with the claimed physical blowing agent mixture in the presence of water as co-blowing agent.

The Board further stated that in the absence of specific requests submitted so far by the Respondent/Patent Proprietor it was assumed that dismissal of the appeal was requested.

- VII. With the letter dated 21 September 2006, received at the EPO by fax on the same day, the Respondent indicated that the Board obviously had not received its submissions dated 27 September 2004. A copy of these submissions, consisting of a letter bearing the date of 27 September 2004 and two sets of claims as bases for auxiliary requests 1 and 2 as enclosures, was submitted with the above fax. A confirmation copy of the correspondence dated 27 September 2004 was filed with the letter dated 18 October 2006.
- VIII. With its letter dated 26 October 2006 the Appellant submitted new experimental data (Exhibit I) as well as pages 536 to 538 of the textbook "Reaction Polymers" (1992) - D7 and requested that these additional pieces of evidence be admitted into the proceedings in response to the Respondent's submissions of 27 September 2004, of which it had been made aware for the first time only by the fax dated 21 September 2006.
- IX. The arguments of the Appellant provided orally and in written form with respect to the main request can be summarized as follows:

D1, pertaining to the preparation of flexible and rigid PU foams, disclosed the use of water as a potential additional blowing agent in a general way. This was evident from the passages bridging pages 6/7 and pages 9/10, where water was generally indicated as an optional other ingredient which chemically reacts with the isocyanate to produce carbon dioxide. This disclosure had therefore to be seen in context with both flexible and rigid foams.

That it was common knowledge to prepare rigid PU foams in the presence of water as a co-blowing agent was confirmed by D2 to D4 and D6. A skilled person, interpreting D1 in the context of this general common knowledge, would therefore seriously contemplate the use of water as co-blowing agent, together with the claimed HFC-245fa/n- and/or isopentane mixture, for the preparation of rigid PU foams.

Conversion of the weight-% ranges of the ratio HFC-245fa to n-/isopentane disclosed at the pages 3/4 of D1 into mole-% ranges showed a partial overlap in a range exceeding 60 mole-% pentane with the molar ratios of the corresponding blowing agent mixture according to Claim 1 of the patent.

It was further evident from Figure 1 in Exhibit I taken with the Tables 2 to 4 therein - showing increasing thermal conductivity values (corresponding to better insulation properties) of rigid PU foams blown with decreasing molar amounts of HFC-245fa in the presence of water - that, across the HFC-245fa / isopentane molar ratio range required by Claim 1 of the patent in suit, the thermal insulation properties of the foams obtained with less (better insulating) HFC-245fa were

not "comparably" good (as contended by the Respondent) with regard to those foams obtained with higher amounts of the thermally more conductive (and therefore worse insulating) isopentane.

Rather, in accordance with the expectations of a skilled practitioner, these data showed that an increase of the amount of isopentane at the expense of HFC-245fa led to a gradual worsening of the insulating properties at all test temperatures.

The claimed HFC-245fa/pentane molar ratio, where pentane was present in a molar excess of from 60 to 99 mole-% did not therefore cause an unexpected and surprising benefit over the prior art and was therefore not the result of a purposive selection.

X. The arguments of the Respondent can be summarized as follows:

The main features of the invention were

- the preparation of a rigid PU or polyisocyanurate foam
- in the presence of water and
- with a HFC-245fa/iso- and/or n-pentane blowing agent mixture in the molar ratio range 1:99 to 40:60, i.e. using a molar excess of the cheaper pentane.

Such a combination of features was not directly and unambiguously disclosed in D1.

Although it was incontestable in the light of the available evidence that water might be used as co-blowing agent in the preparation of rigid PU foams, it



was not an indispensable ingredient according to the general disclosure in D1 and even explicitly left out from the rigid foam formulation described in the example 3.

There was furthermore only a partial overlap between the narrow HFC-245fa/pentane molar range according to the patent in suit and the broad range described in D1, with no overlap for the preferred ranges. In this context the passage in D1 at page 3, lines 11 to 13 had also to be taken into account. It indicated that the hydrocarbon [i.e. blowing agent] was only present as a minor component making the composition non-flammable. This was a clear statement which would induce a skilled person to work in the preferred and non-overlapping range of D1 and not in the range as claimed using an excess of pentane over HFC-245fa.

Furthermore, the figures 1 and 2 in the patent specification, and the figure in Exhibit I provided by the Appellant itself, indeed clearly showed the unexpected benefit contested by the Appellant.

By drawing a straight line in the HFC-245fa versus thermal conductivity plots according to the above figures between the points marking the highest (at 0 % HFC-245fa) and the lowest (at 100 % HFC-245fa) thermal conductivity, it could be observed that within the claimed HFC-245fa/pentane molar range the measured loss in thermal conductivity deviated considerably from the expected loss along this line. This confirmed the Patentee's stance that the proposed partial replacement of HFC-245fa by cheaper pentane led to an unexpectedly small impairment of the insulation capacity of the resulting foam. This was particularly conspicuous from

table 4 of the Appellant's Exhibit I, according to which a reduction of the HFC-245fa content from 55 mole-% to 35 mole-% with a concomitant increase of the amount of isopentane caused only very minor changes of the thermal conductivity.

This evidence from the Appellant itself supported the comparison data in Table 1 of the patent in suit, which evidence showed that comparative foam C (according to US-A 5 562 857) using a very large excess of HFC-245fa over isopentane had a thermal insulation performance comparable to "inventive" foam B using even a small excess of isopentane over HFC-245fa.

It was thus established that the claimed subject-matter resulted from a purposive selection of the blowing agent mixture in both qualitative and quantitative aspects.

- XI. The Appellant requested that the decision under appeal be set aside and that the patent be revoked.
  
- XII. The Respondent requested that the appeal be dismissed, or that the decision under appeal be set aside and the patent be maintained on the basis of auxiliary requests 1 or 2, filed with the letter dated 18 October 2006.

## Reasons for the Decision

1. The appeal is admissible.
2. *Novelty of the subject-matter according to the main request.*

### 2.1 The claimed subject-matter

The process of Claim 1, relating to the preparation of PU and polyisocyanurate foams from the usual reaction system polyisocyanate/isocyanate reactive component, defines the following essential elements:

- (a) the resulting foams are rigid;
- (b) the physical blowing agent mixture contains 1,1,1,3,3-pentafluoropropane (HFC-245fa)/n- and/or isopentane in a molar ratio of from 1/99 to 40/60, the preferred range according to Claim 2 being from 10/90 to 40/60;
- (c) water is used as co-blowing agent.

### 2.2 The disclosure in D1 and its comparison with the disclosure in the patent in suit

D1, which constitutes prior art according to Article 54(3) EPC, also pertains to the preparation of PU foams. The following features are disclosed in D1:

- (a) The resulting foams can be either rigid or flexible (page 1, lines 7 to 9);

(b) the azeotrope-like blowing agent mixture, which is composed of HFC-245fa and at least one hydrocarbon selected *inter alia* from n-pentane or isopentane, is characterized at page 3, line 22 to page 4, line 5 by the following ratios in weight-%:

- (i) HFC-245fa/n-pentane: 30/70 to 95/5,  
preferred: 65/35 to 95/5;
- (ii) HFC-245fa/isopentane 30/70 to 95/5,  
preferred: 55/45 to 95/5.

These weight-% ratios can be converted into the following mole-% ratios:

- (i) HFC-245fa/n-pentane: 19/81 to 91/9,  
preferred: 50/50 to 91/9;
- (ii) HFC-245fa/isopentane: 19/81 to 91/9,  
preferred: 39/61 to 91/9.

When comparing these ranges with the corresponding molar ratios HFC-245fa/n-/isopentane according to the claimed invention:

- (i) Claim 1: 1/99 to 40/60
- (ii) Claim 2: 10/90 to 40/60 (preferred)

the following overlapping areas can be determined:

- (i) HFC-245fa/n-pentane: broadest range: overlap between 19-40/81-60; preferred range: no overlap;

- (ii) HFC-245fa/isopentane: broadest range:  
overlap between 19-40/81-60; preferred range:  
very small overlap between 39-40/61-60.

The above figures show that, in its broadest aspect, the HFC-245fa/n-/isopentane blowing agent mixtures of the claimed invention overlap with those of D1 only in a narrow area where higher amounts of 60 to 81 mole-% pentane are used, whereas the area covered by D1 outside the claimed invention, i.e. using amounts of less than 60 down to 9 mole-% pentane is by far larger.

For the preferred ranges virtually no overlap is observed.

From these figures it is clear that the tendency in D1 is to blow the foams with considerably smaller amounts of pentane compared to the claimed invention. This is confirmed by the passage at page 3 of D1 indicating that the hydrocarbon is present as a minor component (emphasis by the Board);

- (c) water is generally indicated in D1 as an *optional other ingredient* or co-blowing agent (page 7, lines 9 to 11; page 9, line 31 to page 10, line 2). However, a blowing agent formulation including water and a specific HFC-245fa/hydrocarbon blowing agent mixture for the preparation of either flexible or rigid PU foams is not within D1's disclosure. In particular, example 3 (cf. especially Table VIII), which, as uncontested by the parties, describes the preparation of rigid

foams, exclusively uses HFC-245fa/isopentane in various weight ratios as blowing agent formulation.

Thus, according to D1's disclosure taken as a whole, water is simply to be considered as one of a number of possible further ingredients, such as flame retardants, colorants and other blowing agents (cf. page 7, lines 9 to 11), which may or may not be added to the foam formulation.

The argument of the Appellant with respect to D2 to D4 and D6, that it was common knowledge to blow rigid foams optionally in the presence of water, does not change the situation. From the general disclosure in the above documents that the use of water as co-blowing agent is a known option it cannot automatically be inferred that this measure is in any case to be applied to the preparation of rigid foams in combination with a specific HFC-245fa/pentane blowing agent mixture constituting one of several variants in D1.

### 2.3 Assessment of novelty

It follows, that in order to arrive at the claimed invention, the following selections from the disclosure in D1 are to be made:

- (a) the preparation of rigid foams, the choice being flexible or rigid foams;
- (b) the selection of a specific range for the HFC-245fa/n- or isopentane molar ratio, overlapping with the respective claimed range - this specific

range not only is considerably smaller than the non-overlapping range but, because of its higher hydrocarbon content, is also not preferred.

- (c) the use of water in addition to the blowing agent mixture (b) - such use not being found in the examples and not being preferred.

These necessary selections from D1 cannot be considered to represent a direct and unambiguous disclosure of the claimed invention. The Board therefore concludes that D1 does not anticipate the novelty of the claimed subject-matter.

The Appellant argued that D1 nevertheless deprived the claimed invention of novelty because the selections to be made did not fulfil the criteria for a selection to be new. While the above-mentioned facts and arguments already make clear that the "selections" made concern only a relatively minor, non-preferred area of the physical blowing agent, and while furthermore the only relevant concrete information in D1 (Table VIII) is not to be considered as "close" to the claimed invention as it does not use water as a co-blowing agent, it is also apparent that the alleged effect of the claimed "selection" is indeed achieved, i.e. that in that respect this "selection" can be considered as "purposive".

This is established by the Respondent's analysis of the information contained in Appellant's Exhibit I, according to which the use of the blowing agent mixture containing a molar excess of the thermally higher conductive n- or isopentane as claimed results in rigid

foams with better insulating properties than those which the skilled person would expect on the basis of a strictly linear interpolation of the thermal conductivities of the two blowing agents HFC-245fa and pentane (cf. section X above).

The subject-matter of the main request is therefore novel over D1. It is therefore not necessary to discuss the auxiliary requests 1 and 2 or D7, which was cited only in context with these requests.

## **Order**

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

The appeal is dismissed.

The Registrar

The Chairman

D. Sauter

P. Kitzmantel