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**Datasheet for the decision
of 7 February 2007**

Case Number: T 0403/04 - 3.3.01

Application Number: 97914854.1

Publication Number: 0892782

IPC: C07D 201/12

Language of the proceedings: EN

Title of invention:

Process for depolymerizing polycaprolactam processing waste to form caprolactam

Patentee:

Honeywell International, Inc.

Opponent:

BASF Aktiengesellschaft, Ludwigshafen

Headword:

Polycaprolactam depolymerisation/HONEYWELL

Relevant legal provisions:

EPC Art. 100(a), 56

Keyword:

"Inventive step (yes) - non-obvious solution"

Decisions cited:

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Catchword:

-



Case Number: T 0403/04 - 3.3.01

DECISION
of the Technical Board of Appeal 3.3.01
of 7 February 2007

Appellant: Honeywell International, Inc.
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Representative: Gross, Stefan
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Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 11 February 2004
revoking European patent No. 0892782 pursuant
to Article 102(1) EPC.

Composition of the Board:

Chairman: A. J. Nuss
Members: C. M. Radke
D. S. Rogers

Summary of Facts and Submissions

- I. The Proprietor of the Patent lodged an appeal against the decision of the opposition division revoking the patent.
- II. The decision was based on the claims as granted (main request) and the claims of a first and a second auxiliary request, both filed during the oral proceedings before the opposition division.
- III. The opposition held that the subject-matter of the claims of the main request lacked novelty in view of example 1 of document (D6), that the subject-matter of the claims of the first auxiliary request was not based on an inventive step in view of document (D6) alone or in combination with (D1), and that claim 1 of the second auxiliary request was not clear.
- IV. During the oral proceedings before the Board, the Appellant made the claims filed with the letter dated 7 June 2004 a basis for his new Main Request and submitted three sets of claims as a basis for three auxiliary requests.

The only independent claim of the Main Request reads as follows:

"1. A continuous process for depolymerizing polycaprolactam waste, comprising no more than 10% by weight of non-polycaprolactam components with respect to polycaprolactam, to form caprolactam comprising the steps of:

a) feeding a melt of the polycaprolactam waste to a reactor in a continuous manner;
b) in the absence of added catalyst, contacting said polycaprolactam waste with superheated steam at a temperature of 250°C to 400°C and at a pressure within the range of 1.5 atm to 100 atm and less than the saturated vapor pressure of water at said temperature, wherein said contacting occurs countercurrently or crosscurrently with superheated steam, and wherein a caprolactam-containing vapor stream is formed."

V. *Inter alia*, the following documents were cited during the opposition and/or appeal proceedings:

(D1) US-A-3 182 055

(D2) US-A-3 939 153

(D3) US-A-4 605 762

(D6) EP-A-0 676 394.

VI. The Appellant submitted that document (D2) as the closest prior art did not teach hydrolysis under crosscurrent or countercurrent flow of polycaprolactam and superheated steam. He considered the problem to be solved as being to improve the yield of caprolactam and to keep the amount of undesirable by-products to a minimum. Document (D6), so he argued, only discloses countercurrent flow in the first step. He deemed that the person skilled in the art would not have combined the teaching of document (D2) with that of any of the documents (D1) and (D3) as these documents only

disclose hydrolysis of polycaprolactam in an aqueous solution. Moreover, document (D3) requires the products of the hydrolysis to be kept in the aqueous solution, contrary to the teaching of (D2) (see (D3), claim 1 and column 3, lines 17-19).

VII. The Respondent (the Opponent) considered the problem to be solved in the light of document (D2) was to provide an alternative process. He deemed that it was obvious to the skilled person to conduct the process disclosed in (D2) at the temperatures and pressure disclosed in example 1 of document (D6). Crosscurrent or countercurrent flow of the reactants, so he argued, were normal options to the skilled person, especially as document (D3) teaches hydrolysis under countercurrent flow of the polycaprolactam and the superheated steam.

VIII. The Appellant requested that the decision under appeal be set aside and that the patent be maintained on the basis of the claims of the Main Request or on the basis of the claims of any of the three auxiliary requests (see point IV above).

The Respondent requested that the appeal be dismissed.

Reasons for the Decision

1. The appeal is admissible.

Main Request

2. *Article 123 EPC*

The Respondent did not object to the amended claims under Article 123 EPC or under Article 100(c) EPC. Claim 1 has a basis in claim 1 as originally filed and page 11, lines 19-20, page 4, lines 28-30, page 5, lines 29-30 and page 12, lines 1-6, of the application as originally filed. Claims 2-9 have a basis in original claims 3-10.

All the amendments in the claims restrict the scope of protection compared with that of the claims as granted.

Hence, the Board is satisfied that the amendments do not contravene the requirements of Article 123 EPC.

3. *Novelty*

It was not disputed that the subject-matter of the claims is novel. The Board is satisfied that it differs from the disclosure of document (D2) or (D6) in that these documents do not disclose the contacting of the polycaprolactam melt with a countercurrent or crosscurrent flow of superheated steam.

4. *Inventive step*

4.1 *Closest prior art*

In accordance with the "problem-solution" approach consistently applied by the Boards of Appeal, it is necessary, as a first step, to establish the closest

state of the art which is normally a prior art document disclosing subject-matter conceived for the same purpose or aiming at the same objective as the claimed invention and having the most relevant technical features in common.

4.1.1 In the continuous process disclosed in document (D6) a multi-component polymeric waste material, in particular waste carpet material containing fibres of polycaprolactam and a backing material containing other polymers is used as a starting material (see claims 1 and claim 6 and column 1, lines 50-58). This process requires that the polycaprolactam is hydrolysed in the form of an aqueous solution (see steps (b) and (c) of claims 1 and 6).

4.1.2 Document (D2), however, discloses a continuous process for producing ϵ -caprolactam from waste or scrap polycaprolactam produced as an unavoidable by-product in the manufacture of nylon-6 moulded articles, i.e. a polycaprolactam containing no more than 10 % by weight of non-polycaprolactam components, by feeding a melt of the polycaprolactam to a reactor and contacting it with superheated steam, as required by the claims of the patent in suit (see claim 1, column 1, lines 7-12 and 62-68).

4.1.3 Hence, document (D2) is more closely related to the object of the present claims and has more features in common with said claims as compared to document (D6).

Consequently, document (D2) rather than (D6) represents the closest prior art.

4.2 The problem to be solved

As a second step it has to be determined which technical problem was to be solved in view of the closest prior art and if this problem was indeed solved over the whole breadth of the subject-matter claimed.

Starting from the disclosure of document (D2), the least ambitious problem to be solved by the claimed process is the provision of an alternative process for continuously depolymerising polycaprolactam to form caprolactam.

Examples 4 and 6 of the patent in suit show that this problem is indeed solved.

4.3 It remains to be decided whether or not the claimed solution to the technical problem defined above was obvious in view of the prior art cited taken as a whole.

The process disclosed in document (D2) as outlined in point 4.1.2 above involves cocurrent flow of steam with respect to the polycaprolactam to be hydrolysed (see column 2, lines 37-42). The question to be answered is whether or not the skilled person looking for an alternative to the process disclosed in document (D2) would be led by the prior art to modify said process by providing a countercurrent or crosscurrent flow of steam with respect to the polycaprolactam to be hydrolysed, as is required by the teaching of claim 1 of the Main Request.

4.3.1 Document (D6) discloses countercurrent flow only as an option in the first step, i.e. in the step in which the polycaprolactam is prehydrolysed and extracted into the aqueous phase (see column 6, line 32 to column 7, line 10).

Document (D3) discloses hydrolysis of polycaprolactam in aqueous solution in the presence of a countercurrent flow of steam (see claim 1, example 3 and the figure).

Both documents (D3) and (D6) teach that the hydrolysis products formed during the countercurrent steam treatment are recovered from the aqueous reaction mixture leaving the hydrolysis or prehydrolysis reactor. This means that both documents require that any caprolactam formed is to remain in the aqueous solution and, in order to avoid any loss of product, may not be distilled off (see (D3), column 3, lines 17-19; see also (D6), column 7, lines 24-29, which requires the steam to condense in the liquid reaction medium).

If under these circumstances the skilled person would have envisaged modifying the process disclosed in (D2) in accordance with the teaching of document (D3) or (D6), namely by providing a steam flow countercurrent to the polycaprolactam to be hydrolysed, he would, of necessity, also have adopted the conditions of the steam flow such that no caprolactam is distilled off, as required in documents (D3) and (D6).

When doing this he would not have ended up with the solution according to present claim 1 requiring that "a caprolactam-containing vapor stream is formed." (see claim 1; point IV above).

The combination of the teachings of document (D2) with that of (D3) or (D6) thus does not render the subject-matter of the present claims obvious.

4.3.2 Document (D1) discloses continuously introducing an aqueous solution containing the polycaprolactam and phosphoric acid into the depolymerisation zone, while passing steam from the bottom through this solution so that a caprolactam containing steam is formed (see claim 1 and column 2, lines 50-53 and column 3, lines 63-67). The steam flow thus is crosscurrent with respect to the flow of the polycaprolactam containing solution.

The phosphoric acid in document (D1) not only catalyzes depolymerisation but also serves to lower the viscosity of the polycaprolactam containing solution (see column 1, lines 34-35, and column 2, lines 50-53). A low viscosity of the solution is required as "... excessively high viscosities ... inhibit ... continuous operation." (see column 3, lines 43-48).

In contrast to document (D1), document (D2) teaches to hydrolyse a melt of the polycaprolactam which the person skilled in the art would consider to be more viscous than an aqueous solution.

Consequently, the skilled person would not have been inclined to apply the crosscurrent flow process disclosed in document (D1) to the viscous polycaprolactam melt which document (D2) seeks to depolymerise.

If the skilled person had consulted document (D1) when trying to solve the problem of finding an alternative process for continuously depolymerising polycaprolactam he would have also extracted from (D1) the teaching to hydrolyse the polycaprolactam in the form of an aqueous solution, preferably one containing phosphoric acid, in order to keep the viscosity of the reaction medium sufficiently low.

Consequently, for the skilled person to have combined the teachings of these two documents in such a way as to yield the process claimed in the patent in suit, namely one requiring the hydrolysis of a melt of polycaprolactam, would have required an inventive activity on his part.

- 4.3.3 Therefore, the subject-matter of the present independent claim 1 involves an inventive step. The same applies to the subject-matter of dependent claims 2-9 relating to preferred embodiments of the process of claim 1, so that the subject-matter of all of the claims of the Main Request is based on an inventive step in the sense of Article 56 EPC.

Auxiliary Requests

5. As the claims of the Main Request meet the requirement of the EPC, there is no need to deal with the auxiliary requests.

Remittal to the first instance

6. Although the Board has come to the conclusion that the Main Request is to be allowed, the description has still to be brought into conformity with the claims. Therefore, having regard to the fact that the function of the Boards of Appeal is primarily to give a judicial decision upon the correctness of the decision taken by the first instance, the Board exercises its discretion under Article 111(1) EPC to remit the case to the first instance in order to have the description adapted to the amended claims.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to maintain the patent with the following claims and a description to be adapted:

Claims Nos. 1-9 of the Main Request (former Auxiliary Request 1 submitted under cover of a letter dated 7 June 2004).

The Registrar:

The Chairman:

N. Maslin

A. J. Nuss