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D E C I S I O N
of 7 January 2003

Case Number: T 1116/00 - 3.3.3

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Title of invention:
Process for preparing polyester

Patentee:
MITSUI CHEMICALS, INC.

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 56, 82, 84

Keyword:
"Clarity (yes)"
"Inventive step (yes)"

Decisions cited:
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-

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Case Number: T 1116/00 - 3.3.3

D E C I S I O N
of the Technical Board of Appeal 3.3.3
of 7 January 2003

Appellant: (Opponent)
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Decision under appeal: Decision of the Examining Division of the European Patent Office posted 20 June 2000 concerning maintenance of European patent No. 94 120 682.3 in amended form.

Composition of the Board:

Chairman: R. Young
Members: C. Idez
U. Tronser

Summary of Facts and Submissions

I. European patent application 94 120 682.3, filed on 27 December 1994, claiming a priority date of 28 December 1993 based on two JP applications (338681/93 and 338682/93) and published under number 0 661 326, was refused by a decision of the Examining Division dated 22 March 2000 and issued in writing on 20 June 2000. The decision was based on a set of claims 1 to 9, claims 1 to 4 of which read as follows:

"1. A process for preparing a polyester comprising:

[A] a liquid phase polycondensation step in which a dicarboxylic acid including terephthalic acid or its ester derivative and a diol including ethylene glycol or its ester derivative are subjected to polycondensation reaction in liquid phase and molten state under heating in the presence of a polycondensation catalyst to produce a polyester (a) having an intrinsic viscosity, as measured in o-chlorophenol, of 0.7 to 1.5 dl/g,

[C] a hot water treatment step in which the polyester (a) is contacted with hot water of 60 to 130°C for 5 minutes to 10 hours,

[D-1] a drying step in which the polyester (c-I) having passed the hot water treatment step is dried at a temperature of 110 to 150°C for 30 minutes to 6 hours, and

[D-2] a heat treatment step in which the polyester is heated at a temperature of 160 to 200°C for 1 to 10 hours until the acetaldehyde content of the polyester is not more than 10 ppm.

2. Process according to claim 1, wherein the polyester (a) obtained in the liquid phase polycondensation step [A] is subjected to

[B] a precrystallization step in which the polyester (a) is kept at a heat-up crystallisation temperature to 200°C for 1 minute to four hours, before being subjected to the next steps [C] to [D-2].

3. Process according to claim 2, wherein step [D-2] is carried out before step [C] [D-2] is a heat treatment in which the polyester (b) having passed the precrystallization step is heated at a temperature of 160 to 200°C for 1 to 10 hours, wherein (i) the intrinsic viscosity of the polyester does not substantially increase in steps [B] and [D-2].

4. Process according to claim 3, wherein step [D-1] is omitted."

Claims 5 to 9 were dependent claims.

II. According to the decision, which noted, in view of clarity (Article 84 EPC) and scope of the claims, that

(i) the wording "comprises" in the claims did not exclude solid phase polymerization; and

(ii) Claim 3 was not clear as to the difference between step "B" and step "D-2",

the subject-matter of claim 1, whilst being novel, did not involve an inventive step, in particular in view of a combination of the disclosures of:

D5: US-A-4 609 721; and

D1: EP-A-0 389 948.

Compared with D5, the closest state of the art, and which disclosed a process having the step sequence A, B, D-1 and D-2 or steps A, D-1, and D-2, the objective technical problem, which was solved by adding water treatments step C after polymerization step A, was to provide polyesters with a decreased generation of acetaldehyde during moulding.

Such an objective technical problem was, however, explicitly addressed in D1. Consequently, a person skilled in the art starting from D5 had a strong indication to consider the teaching in D1, in which a polyethylene terephthalate (PET), prepared by a multistep polymerization comprising (a) a liquid phase polymerization according to step A over the process according to the application in suit, followed by (b) a solid phase polymerization, is subjected to a water treatment according to relevant step C. Since, furthermore the teaching of D1 was that exactly and solely the water treatment step solved the above technical problem, it was an obvious solution to take this step out of the context of the process according to D1. It was of no consequence that Example 35 in D1 showed that the factor of increase of the relative acetaldehyde content during moulding was 9, since it was clear that it would be still higher without the water treatment. Furthermore, a person skilled in the art would introduce the water treatment step of D1 in the process of D5 either after the polymerization step, after the crystallization step or after the drying step D-2. Since all three possibilities were apparently suitable to solve the above technical problem, a non-arbitrary selection of process steps could not be acknowledged. Therefore the above technical problem was

solved in an non-inventive way starting from D5 and using the teaching of D1.

Nor would the result have been different following the objective technical problems starting from D1 as closest prior art, of providing a simplified process in view of time and costs for the preparation of polyesters with similar properties to those in D1, which was addressed on page 2, lines 16 to 20 of the application in suit. The process according to D1 encompassed steps A (liquid state polymerization), solid state polymerization and the water treatment. If a person skilled in the art wanted to reduce costs or time of the process, he could not omit the water treatment step which was essential to provide polyesters with little generation of acetaldehyde during moulding. Consequently, the only step which could be simplified to solve the objective problem was the solid state polymerization step. Thus, a person skilled in the art would replace the solid state polymerization according to D1 by the drying steps and crystallization steps according to D5.

Thus, the claimed subject-matter did not involve an inventive step according to Article 56 EPC.

III. On 11 August 2000, the Appellant (Applicant) filed a Notice of Appeal against the above decision, the prescribed fee being paid on the same day.

The Statement of Grounds of Appeal, filed on 30 October 2000 was accompanied by experimental data in which Example 2 according to the application in suit, having a process step sequence: A→C→D-1→D-2 was compared with a variant in which step C was shifted to become the final step, giving a step sequence: A→D-1→D-2→C, as to inherent acetaldehyde content prior to moulding and also the amount of acetaldehyde formed

during moulding of the PET formed by the two respective process step sequences.

The arguments of the Appellant may be summarized as follows:

(i) The decision under appeal had wrongly applied the problem and solution approach, because it had started with the relevant problem and worked back to a compatible state of the art. Whilst both D1 and D5 belonged to a technical field quite similar to the application in suit, D5 disclosed more features in common with the claimed subject-matter than D1 and alone qualified, therefore, as closest state of the art.

(ii) Claim 1 according to the application in suit differed from the disclosure of D5 in that it included a hot water treatment step (C) in between the liquid phase polycondensation step (A) and steps D-1 and D-2. The objective problem arising in view of the process according to D5 was thus to provide a process for manufacturing polyesters having a low inherent acetaldehyde content and generating less acetaldehyde upon moulding. That the solution, of inserting a water treatment step (C) between the liquid phase polycondensation (A) and steps D-1 and D-2 was effective was shown by Example 1 and comparative Example 1 of the application in suit, according to which the water treatment step (C) reduced the concentration of the acetaldehyde generated upon moulding the polyester chips into a stepped square plate by one half, the same being true for the acetaldehyde content in a preform produced from the chips.

(iii) It was questionable whether the skilled person would have consulted D1 in his efforts to solve the objective problem starting from D5, since D1 clearly related to a process which necessarily included a solid phase polymerization step contrary to D5. Even if the skilled person would have consulted D1, however, he would not have had any incentive to disregard the whole teaching of D1 except the water treatment step and to insert the latter between the liquid phase condensation step (A) and the drying step D-1, as required by claim 1 of the application in suit, because:

- according to D1 the water treatment step was always the last step;

- it belonged to the general knowledge of the skilled person that the amount of oligomers in PET was reduced by both the polycondensation step (A) and the water treatment step (C), which both contributed to the solution provided by D1; and

- as demonstrated by the experimental data the order of the steps was a crucial feature in the process according to claim 1 of the application in suit, which demonstrated that the inherent acetaldehyde content prior to moulding and also the amount of acetaldehyde formed during moulding can be further decreased by a process according to claim 1 as compared with a process wherein the water treatment step (C) is the final step prior to moulding.

(iv) Even if one would start, incorrectly in the Appellant's view, from D1, it was unrealistic to disregard the whole teaching of D1 except for the water treatment step, more particularly because this was not the only step which could be simplified in the process according to D1. On the contrary, the liquid phase polycondensation step could be simplified.

Hence, it required inventive activity by the skilled person to arrive at the process according to the application in suit.

IV. Following the issue, by the Board, on 19 July 2002, of a communication in which doubts were expressed as to the clarity, in the sense of Article 84 EPC, and as to the unity, in the sense of Article 82 EPC, of the claimed subject-matter, in particular as between claims 1 and 3, the Appellant filed, on 4 October 2002, an amended set of claims 1 to 7, the wording of which reads as follows:

"1. A process for preparing a polyester comprising:

[A] a liquid phase polycondensation step in which a dicarboxylic acid including terephthalic acid or its ester derivative and a diol including ethylene glycol or its ester derivative are subjected to polycondensation reaction in liquid phase and molten state under heating in the presence of a polycondensation catalyst to produce a polyester (a) having an intrinsic viscosity, as measured in o-chlorophenol, of 0.7 to 1.5 dl/g,

[C] a hot water treatment step in which the polyester (a) is contacted with hot water of 60 to 130°C for 5 minutes to 10 hours,

[D-1] a drying step in which the polyester (c-1) having passed the hot water treatment step is dried at a temperature of 110 to 150°C for 30 minutes to 6 hours, and

[D-2] a heat treatment step in which the polyester (c-1) having passed the drying step is heated at a temperature of 160 to 200°C for 1 to 10 hours until the acetaldehyde content of the polyester is not more than 10 ppm, wherein the intrinsic viscosity of the polyester does not substantially increase in step [D-2].

2. Process according to claim 1, wherein the polyester (a) obtained in the liquid phase polycondensation step [A] is subjected to

[B] a precrystallization step in which the polyester (a) is kept at a heat-up crystallization temperature to 200°C for 1 minute to four hours, before being subjected to the next steps [C] to [D-2], wherein the intrinsic viscosity of the polyester does not substantially increase in steps [B] and [D-2].

3. Process according to any one of the preceding claims, wherein the liquid phase polycondensation step [A] is carried out until the polyester (a) has an intrinsic viscosity, as measured in o-chlorophenol of 0.8 to 1.2 dl/g.

4. Process according to any one of the preceding claims, wherein the liquid phase polycondensation step [A] consists of an esterification reaction step [A-1] and a polycondensation step [A-2], which comprises three or more stages.

5. Process according to claim 4, wherein the polyester obtained after the polycondensation reaction of the second stage in the polycondensation reaction step [A-2] has an intrinsic viscosity of 0.4 to 0.7 dl/g.

6. Process according to claim 2, wherein the polyester is precrystallized to a crystallinity of 20 to 50% in the precrystallizing step [B].

7. Process according to any one of the preceding claims, wherein the resultant polyester (d-2) has an acetaldehyde content of not more than 5 ppm."

V. The Appellant requested that the decision under appeal be set aside, and a patent be granted on the basis of claims 1 to 7 filed on 4 October 2002.

Reasons for the Decision

1. The appeal is admissible.

2. *Amendments*

Claim 1 is supported by original claim 1 in combination with page 18, lines 3 to 8, 16 to 19 and 24 of the application as originally filed.

Claim 2 is supported by original claim 2 in conjunction with page 5, lines 12 to 13.

Claims 3, 4 and 5 are identical with the correspondingly numbered claims as originally filed.

Claims 6 and 7 find their support in original claims 6 and 8, respectively.

It thus follows that the requirements of Article 123(2) EPC are complied with by all the claims.

3. *Unity of invention*

The doubts referred to concerning unity of invention have been removed by the deletion of claims 3 and 4 underlying the decision under appeal. Consequently the present claims meet the requirements of Article 82 EPC.

4. *Clarity*

The deletion of previous claims 3 and 4, referred to above met the objection of lack of clarity insofar as this concerned the relationship of the subject-matter of these claims to that of claim 1.

The further objection, that the claims did not exclude the use of solid phase polycondensation, also mentioned in the communication of the Board (cf. section II, above) has been removed by the restriction inserted in claim 1 that the intrinsic viscosity of the polyester does not substantially increase in step D-2 and in claim 2 to the effect that it does not substantially increase in steps B and D-2.

Consequently the subject-matter of claims 1 to 7 meets the requirements of clarity of Article 84 EPC.

5. *Novelty*

The novelty of the subject-matter of claim 1 has been acknowledged in the decision under appeal and the Board sees no reason to take a different view. Consequently the claimed subject-matter is held to be novel.

6. *Inventive step*

The application in suit relates to a process for obtaining PET having a low content of acetaldehyde and a low generation of acetaldehyde during the moulding of articles such as containers for beverages, whilst avoiding the need for a solid state polymerization step (page 1, lines 5 to 22; page 3, lines 5 to 13). Such a process is, however, known from D5 which in the Board's view represents the closest state of the art.

6.1 According to D5, there is disclosed, as admitted by Appellant, such a process including steps A, D-1 and D-2 according to claim 1 in the application in suit. There is, however, no mention of the use of a water treatment as defined in step C of the application in suit.

6.2 Compared with this state of the art, the technical problem objectively arising is seen as being the provision of PET having a low content of acetaldehyde and generating less acetaldehyde during moulding.

6.3 The solution proposed according to claim 1 of the application in suit is to carry out a hot water treatment step in which the polyester from step A is contacted with hot water of 60 to 130°C for 5 minutes to 10 hours.

6.4 It is evident from Example 1 and comparative Example 1 of the application in suit, that the water treatment leads to a low amount of acetaldehyde in the PET pellets used as moulding material and to a lower generation of acetaldehyde during the moulding process.

Moreover, the further examples submitted by the Appellant with the Statement of Grounds of Appeal additionally show that the point in the sequence of

steps of the process at which the water treatment is carried out (ie after step A and before the steps D-1 and D-2) is crucial for obtaining a lower generation of acetaldehyde during the moulding step (cf. section III, above).

Thus, it is plausible that the claimed measure provides an effective solution of the technical problem objectively arising.

6.5 There is no hint in D5 as to the provision such a water treatment step for any reason, let alone that of solving the relevant technical problem.

6.6 Document D1 also deals with the problem of reducing the acetaldehyde content of PET polymers and lowering the generation of acetaldehyde during the moulding process. Whilst D1 generally refers to a process for the treatment of PET which comprises bringing a PET having an intrinsic viscosity of at least 0.50 dl/g and a density of at least 1.38 into contact with water kept at a temperature of from 1 to 150°C for a period of time of a least 1 minute, it is clear from the disclosure of D1 that the manufacturing process of the PET subjected to the water treatment encompasses a solid state polymerization step (D1, page 4, line 42 to page 5, line 6; page 6, line 11; page 7, lines 2 to 31) and that therefore D1 teaches the skilled person to carry out the water treatment after the solid state polymerization step. Thus, at least for this reason, starting from D5, which expressly aims to avoid the use of a solid state polymerization, the skilled person would not look for a solution of the technical problem in a document such as D1, in which solid state polymerization is an essential part of the process disclosed therein.

Even if it were considered that D1 generally teaches,

independently of the manufacturing process of the PET, the use of a water treatment in order to reduce the content and the generation of acetaldehyde, it would, however, give no indication to carry out this treatment after the polycondensation step in the liquid phase and before the steps D-1 and D-2 as defined in claim 1 of the application in suit. The examples submitted with the Statement of Grounds of Appeal show that this time is critical in order to solve the technical problem.

Thus, even the combination of D5 and D1 would not lead to the solution of the technical problem.

6.7 It follows from the above, that the solution of the technical problem does not arise in an obvious way from the relevant state of the art. In other words, the subject-matter of claim 1 and by the same token that of claims 2 to 7, involves an inventive step within the meaning of Article 56 EPC.

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 grant a patent on the basis of claims 1 to 7 filed with the submission dated 4 October 2002, and a description yet to be adapted.

The Registrar: The Chairman:

E. Görgmaier R. Young