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**D E C I S I O N**  
of 22 September 2000

**Case Number:** T 0106/98 - 3.3.3

**Application Number:** 88300181.0

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**IPC:** C08G 63/60

**Language of the proceedings:** EN

**Title of invention:**  
Thermotropic aromatic copolyester

**Applicant:**  
HOECHST CELANESE CORPORATION

**Opponent:**  
-

**Headword:**  
-

**Relevant legal provisions:**  
EPC Art. 56

**Keyword:**  
"Inventive step - non-obvious combination of known features"

**Decisions cited:**  
-

**Catchword:**  
-



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Boards of Appeal

Chambres de recours

**Case Number:** T 0106/98 - 3.3.3

**D E C I S I O N**  
**of the Technical Board of Appeal 3.3.3**  
**of 22 September 2000**

**Appellant:** HOECHST CELANESE CORPORATION  
90 Morris Avenue  
Summit, NJ 07901 (US)

**Representative:** Jackson, Peter  
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**Decision under appeal:** Decision of the Examining Division of the  
European Patent Office posted 2 September 1997  
refusing European patent application  
No. 88 300 181.0 pursuant to Article 97(1) EPC.

**Composition of the Board:**

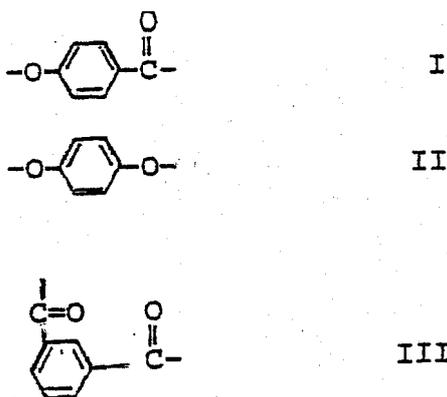
**Chairman:** C. Gérardin  
**Members:** P. Kitzmantel  
A. Lindqvist

## Summary of Facts and Submissions

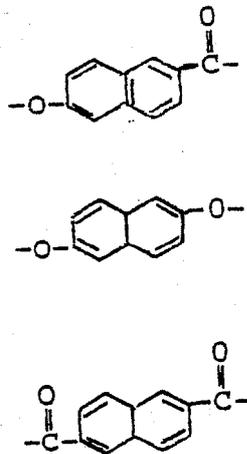
- I. This appeal, which was filed on 27 October 1997, lies against the decision of the Examining Division dated 02 September 1997, refusing European patent application No. 88 300 181.0 filed on 11 January 1988 in the name of IMPERIAL CHEMICAL INDUSTRIES PLC (now assigned to HOECHST CELANESE CORPORATION) and published under No. 0 275 164. The appeal fee was paid on 28 October 1997 and the Statement of Grounds of Appeal was filed on 30 December 1997.
- II. The decision under appeal was based on a set of 10 claims, independent Claims 1 and 10 submitted on 23 March 1995, dependent Claims 2 to 9 submitted on 11 January 1994.

Claims 1 and 10 read as follows:

"1. A melt processable aromatic copolyester comprising moieties I, II and III having the structural formulae



and at least one moiety IV selected from those of formula



wherein the polyester comprises more than 15 mole%, and less than 40 mole% of moieties I, more than 57.5 mole% and less than 84.75 [mole%] of moieties II and III taken together, the number of the moieties II being substantially equal to the number of moieties III and at least 0.25 mole% and less than 2.5 mole% of moieties IV."

"10. An injection moulded article formed from a melt processable aromatic copolyester as defined in any one of claims 1 to 9."

III. The decision under appeal held that the subject-matter of Claim 1 was novel but not inventive over the disclosure in document

D3: EP-A-0 102 612.

In the absence of convincing evidence for the existence of an unexpected technical effect caused by the substitution of isophthalic units for the terephthalic

units of the quaterpolymers disclosed in D3 derived from p-acetoxybenzoic acid, hydroquinone diacetate, dimethyl terephthalate and 2-acetoxynaphthalene-6-carboxylic acid, said substitution was, in the Opposition Division's view, an obvious alternative. The evidence contained in the Applicant's submission dated 17 July 1996 was not considered convincing because the failure reported therein to obtain mouldable products according to Experiments A (reworking of Example 5 of D3) and B (modification of Example 5 of D3 by using dimethyl isophthalate instead of dimethyl terephthalate) was considered to be due to inappropriate experimental conditions.

IV. The Board, in a letter dated 10 February 2000, raised an objection of obviousness on the basis of Example 2 of document

D5: US-A-4 370 466,

arguing that it was doubtful whether the marginal reduction in the quaterpolymers according to this example of the percentages of the units derived from p-hydroxy benzoic acid (hereinafter 4-HBA) and 2-hydroxy naphthalene-6-carboxylic acid (hereinafter 2,6-HNA), which would be necessary to meet the requirements of present Claim 1, involved an inventive step.

In a further communication dated 19 July 2000, issued in reaction to the Appellant's submission of 26 June 2000, the Board withdrew this objection and proposed amendments to Claim 1 made with a view to overcoming the obviousness objection made in the decision under appeal on the basis of document D3.

V. With its letter dated 12 September 2000 the Appellant submitted a set of 8 claims as its sole request.

In comparison with Claim 1 underlying the decision under appeal Claim 1 of this set has been amended in three respects:

- (i) The opening statement "A melt-processable aromatic copolyester comprising moieties I, II and III ..." has been amended to "A melt-processable aromatic copolyester which is capable of forming an anisotropic melt, the said copolyester comprising moieties I, II and III ...";
- (ii) the statement "wherein the copolyester comprises at least 15 mole % ... of moieties I ..." has been amended to "wherein the copolyester comprises at least 27 mole % ... of moieties I ..."; and
- (iii) the statement "... and less than 2.5 mole % of moieties IV" has been amended to "... and less than 2.0 mole % of moieties IV".

Claims 2 to 8 of this set correspond to Claims 3, 4 and 6 to 10 according to the decision under appeal with their numbers and appendances appropriately adjusted.

VI. The arguments of the Appellant may be summarized as follows:

- (i) The evidence in the application in suit demonstrated that the claimed copolyesters comprising small amounts of naphthylene moieties

IV had better processability than copolyesters consisting solely of the moieties I, II and III. In the Appellant's view, this effect was not suggested by the prior art.

- (ii) Document D3 was of no relevance for the assessment of inventive step, because its Example 5 did not comprise an enabling disclosure and did not, therefore, represent proper state of the art; this was confirmed by the evidence newly submitted with the Statement of Grounds of Appeal (Annex Q), which demonstrated that the minor deviations of the reaction conditions of the experiments submitted by the Appellant (then Opponent) on 17 July 1996 (Annex P) from those according to Example 5 of D3 had no influence on the failure of said experiments to get mouldable products.
  
- (iii) The subject-matter of the application in suit was also not obvious over D5, because this document did not contain any incentive to prepare polymers comprising a percentage of 2,6-HNA units below the value of 2.0 mole%. This conclusion resulted from the fact that the polymer according to Example 2 of D5, comprising 2.5 mole% of 2,6-HNA units, exhibited much lower initial tensile moduli than the polymers according to Examples 1, 3 and 4 of D5, comprising 5, 10 and 15 mole% of 2,6-HNA units.

VII. The Appellant requested that the decision under appeal be set aside and a patent be granted on the basis of the following version:

**Claims:** 1 to 8 filed with the submission dated 12 September 2000,

**Description:** pages 1 and 2 filed with the submission dated 12 September 2000, pages 3 and 3a filed with the submission dated 12 November 1992, and pages 4 to 24 as originally filed.

### Reasons for the Decision

1. The appeal is admissible.
2. *Amendments (Article 123(2) EPC)*

Claim 1 is essentially based on its original version; furthermore,

- with regard to the inserted passage "... aromatic copolyester which is capable of forming an anisotropic melt ..." on page 1, lines 2 to 4 of the description as filed,
- with regard to the lower limit of at least 27 mole % of moieties I on original Claim 2, and
- with regard to the upper limit of less than 2.0 mole % of moieties IV on original Claim 3.

Claims 2 and 4 to 7 correspond in substance to original Claims 3 and 7 to 10.

Claim 3 is based on original Claim 4 and on statements in the original description, i.e.

- with regard to the feature "... particular material having an inorganic portion to which organophilic chains are covalently or ionically bonded ..." on page 6, lines 10 to 12, and
- with regard to the feature "... and a settling volume of at least 10 ml when measured in a liquid in which the particulate material is compatible ..." on page 10, lines 9 to 16 ("compatible liquid") and 33 to 34 ("at least 10 ml").

Claim 8 is based on page 15, lines 16 to 18 ("high performance moulding powders") in combination with page 18, lines 16 to 18 (Example 3) and page 24, lines 12 to 14 (Example 6) of the original description.

The requirement of Article 123(2) EPC is therefore complied with by all claims.

3. *Article 84 EPC*

The claims are clear, sufficiently concise and supported by the description. The requirements of this article are therefore met.

4. *Novelty*

4.1 Document D3

This document relates to a process for producing an aromatic polyester capable of forming a thermotropic molten phase, which comprises polycondensing a raw material or raw material mixture selected from (a) an aromatic hydroxycarboxylic acid other than 2,6-HNA, or its derivative, (b) a mixture of an aromatic

dicarboxylic acid or its derivative and an aromatic diol or its derivative, (c) a mixture of (a) and (b) and (d) up to 20 mole%, based on the total amount of the entire raw materials, of 2,6-HNA or its derivative (Claim 1; page 2, lines 6 to 28; page 5, lines 28 to 32).

Among the raw materials, which may be used, are *inter alia*:

- 4-HBA (page 3, lines 16 to 31),
- hydroquinone (hereinafter HQ) (page 4, lines 6 to 15),
- terephthalic acid (hereinafter TA) and isophthalic acid (hereinafter IA) (page 3, line 32 to page 4, line 5).

According to Example 5 (page 9, lines 29 to 36) 0.19 mole of p-acetoxybenzoic acid (moiety I), 0.15 mole of hydrochinone diacetate (moiety II), 0.15 mole of dimethyl terephthalate (moiety III') and 0.01 mole of 2-acetoxynaphthalene-6-carboxylic acid (moiety IV) were reacted to yield a polymer having an intrinsic viscosity of 4.7 (designation of the moieties according to the application in suit). Under the assumption that the unit distribution in the polymer corresponds to the molar proportions of the monomers, this polymer comprises 38 mole% 4-HBA moieties I, 30 mole% HQ moieties II, 30 mole% TA moieties III' and 2 mole% 2,6-HNA moieties IV.

From that disclosure the subject-matter of Claim 1 of the application in suit is different (i) by the

presence of IA moieties III instead of the TA moieties III' according to Example 5 of D3 and (ii) by the use of 2,6-HNA in amounts of **less than** 2.0 mole%.

4.2 Document D5

Claim 1 of this document relates to fiber-forming melt-spinnable copolyesters that exhibit optical anisotropy in the melt consisting of at least 10 mole% of HQ units I (moieties II), at least about 10 mole% of IA units II (moieties III), from about 40 to 70 mole% of 4-HBA units III (moieties I) and from about 2.5 to 15 mole% of 2,6-HNA units IV (moieties IV) (designation of the moieties according to the application in suit).

Examples 1 to 4 of D5 describe aromatic copolyesters comprising different molar amounts of 4-HBA, HQ, IA and 2,6-HNA; the copolyester coming closest to those according to present Claim 1 is that according to Example 2 comprising 40 mole% 4-HBA, 28.75 mole% HQ, 28.75 mole% IA and 2.5 mole% 2,6-HNA.

From that disclosure the subject-matter of Claim 1 of the application in suit is different (i) by the lower molar amount of 4-HBA moieties I of less than 40 mole% and (ii) by the lower molar amount of 2,6-HNA moieties of less than 2.0 mole%.

4.3 The subject-matter of present Claim 1 is, thus, novel over each of D3 and D5.

4.4 The same conclusion applies a *fortiori* to the subject-matter of the dependent Claims 2 to 7 and of independent Claim 8 relating to an injection moulded article made from a polyester according to any one of

Claims 1 to 7.

5. *Inventive step*

5.1 Document D3

5.1.1 Problem and solution

The problem underlying the subject-matter of present Claim 1 with respect to D3 is the provision of further aromatic copolyesters having the ability to form anisotropic melts, which exhibit a good processability in the melt and provide a good combination of strength and stiffness (page 1, lines 5 to 17 of the application in suit).

In view of the experimental evidence in the application (cf. Examples 1 to 4 and 6) the Board is satisfied that this problem has effectively been solved by the subject-matter of present Claim 1.

5.1.2 Obviousness

With respect to the embodiment according to Example 5 of D3, which comes closest to the subject-matter of the application in suit, the issue of obviousness turns on the question whether the replacement in the copolyesters according to said example of the TA moieties by IA moieties and the reduction of the molar amount of the 2,6-HNA moieties from 2.0 mole% to less than 2.0 mole% involves an inventive step for the person skilled in the art wishing to solve the existing technical problem.

(i) In the Board's judgment, under the

circumstances, the use of isophthalic acid moieties III in lieu of the terephthalic acid moieties III' is not *prima facie* obvious and, in order to establish the existence of an inventive step, it is therefore not necessary to demonstrate that this change gives rise to a surprising effect.

- (ii) This conclusion is based on the fact that Claim 1 of the application in suit is not directed to any aromatic copolyester but (only) to those which are capable of forming an anisotropic melt. The formation of an anisotropic liquid crystal melt phase requires, however, linear, rigid chain structures, which are invariably disturbed by the introduction of kinking units, as those formed by IA.
  
- (iii) When it comes to the formation of anisotropic liquid crystal phases, one skilled in the art will not, therefore, put linear TA-units and kinking IA-units on a par, even though the use, for the preparation of certain thermotropic copolyesters, of IA as a comonomer in certain weight proportions and together with certain other comonomers was known. Thus, although IA is mentioned on page 3, line 32 to page 4, line 5 of D3 together with TA as one member of the group of dicarboxylic acids, this does not mean that these two acids are simply interchangeable monomers. On the contrary, the skilled person would not assume that the substitution of IA moieties for TA moieties in a certain thermotropic polyester would automatically lead to an analogous thermotropic polyester.

- (iv) In the Board's judgment, therefore, the replacement of dimethyl terephthalate by dimethyl isophthalate in the compositions according to Example 5 of D3 was not obvious, irrespective of the fact whether this example does or does not comprise an enabling disclosure.
  
- (v) In view of the unobviousness of the substitution of IA-units for TA-units, the question of obviousness or not of the further distinguishing feature, i.e. the minor amount of 2,6-HNA moieties, is of no consequence for this issue.
  
- (vi) The subject-matter of present Claim 1 is, thus, not obvious over the disclosure of document D3.

## 5.2 Document D5

This document is concerned with the provision of polyesters, which are structurally similar to those according to present Claim 1 and which are *inter alia* suitable for the preparation of high tenacity fibres (column 1, lines 11 to 12), a use which is also contemplated according to the application in suit (page 15, lines 16 to 18). D5 may, thus, be considered as an alternative starting point for the assessment of inventive step of the subject-matter of the application in suit.

As set out in point 3.2 *supra*, the difference between the polyesters according to this document and those according to the application in suit resides in the fact that the "inventive" polyesters comprise less moieties I and less moieties IV.

### 5.2.1 Problem and solution

The problem underlying the present subject-matter with respect to D5 is the provision of further aromatic copolyesters having good melt processability and an improved stiffness at elevated temperatures (page 1, lines 14 to 18; page 15, lines 18 to 20 of the original description).

In view of the experimental results contained in the application the Board is satisfied that this problem has effectively been solved.

On the one hand the good melt processability of the inventive compositions comprising 1 mole% 2,6-HNA is evidenced by their favourable "Spiral Flow Lengths" (cf. Example 3, page 18, line 9 to page 19, line 17 of the application), and on the other hand Table I (page 22 of the application) shows that these compositions (lines 5 and 7 of Table I) exhibit a much better stiffness retention at elevated temperatures ("Normalised DMA Stiffness at 180°C (Relative to 0°C)") than copolymers according to D5 which comprise 5 mole% 2,6-HNA (last line of Table I).

### 5.2.2 Obviousness

- (i) The issue of inventive step turns upon the question whether it is obvious to an expert seeking to solve the existing technical problem to simultaneously reduce in the copolyesters according to D5 the molar amounts of the 4-HBA (moieties I) and of the 2,6-HNA units (moieties IV).

- (ii) While there is a clear indication in D5 (column 1, lines 13 to 25) that aromatic copolyesters comprising 40 mole% or more of 4-HBA units have increasingly poorer melt processability, leading to the conclusion that this property can be improved by lowering the percentage of such units, there is no suggestion in this document of any advantage to be gained by lowering the percentage of 2,6-HNA units below the lower limit of 2.5 mole% according to its Claim 1.
  
- (iii) Rather analysis of the tensile properties of the copolyesters according to Examples 1 to 4 of D5 shows that the initial tensile modulus of the polymer according to Example 2, which has the lowest 2,6-HNA content (2.5 mole%), is lower than in the case of the other exemplified copolyesters comprising higher amounts of 2,6-HNA (column 4, line 42 to column 5, line 30 in conjunction with column 3, lines 56 to 61):

Example	4-HBA mole%	HQ mole%	IA mole%	2,6-HNA mole%	initial tens. modulus [dN/tex]	
					As-spun	Heat-Treated
2	40	28.75	28.75	2.5	173	288
1	65	15	15	5	206	370
3	65	12.5	12.5	10	350	376
4	65	10	10	15	329	309

- (iv) There is, thus, no incentive in D5 to investigate the feasibility of aromatic copolyesters comprising 2,6-HNA moieties in

amounts below 2.5 mole%, because on the basis of this information the skilled person would have assumed that the initial tensile moduli of such copolyesters would even be lower than that according to Example 2 of D5; this would be contrary to one of the explicit objectives of D5, i.e. to provide fibers having high initial moduli (cf. column 1, lines 11 and 12; column 3, lines 66 to 68).

(v) The subject-matter of present Claim 1 is, thus, not obvious over the disclosure of document D5.

5.3 The subject-matter of Claim 1 thus complies with the requirement of Article 56 EPC.

5.4 The same conclusion applies *a fortiori* to the subject-matter of dependent Claims 2 to 7 and to the subject-matter of Claim 8, which relates to an injection moulded article formed from a copolyester according to claims 1 to 7.

6. The claims and the amended description also meet the further requirements of the EPC, especially those of Article 84 EPC.

## 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 to grant a patent on the basis of the following version:

**Claims:** 1 to 8 filed with the submission dated  
12 September 2000,

**description:** pages 1 and 2 filed with the submission  
dated 12 September 2000,  
pages 3 and 3a filed with the submission  
dated 12 November 1992, and  
pages 4 to 24 as originally filed.

The Registrar

The Chairman:

E. Görgmaier

C. Gérardin