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**D E C I S I O N**  
of 1 March 1995

**Case Number:** T 0540/92 - 3.3.3

**Application Number:** 86102195.4

**Publication Number:** 0192260

**IPC:** C08G61/12

**Language of the proceedings:** EN

**Title of invention:**  
Ordered polyetherketones

**Patentee:**  
E. I. DU PONT DE NEMOURS AND COMPANY

**Opponent:**  
BASF Aktiengesellschaft, Ludwigshafen  
HOECHST Aktiengesellschaft Zentrale Patentableitung

**Headword:**  
-

**Relevant legal provisions:**  
EPC Art. 54, 56

**Keyword:**  
"Novelty (yes) - prior generic disclosure - no implicit  
combination of features"  
"Inventive step (yes) - no pointer - skilled person - time  
factor - commercial success"

**Decisions cited:**  
-

**Catchword:**  
-



Case Number: T 0540/92 - 3.3.3

**D E C I S I O N**  
of the Technical Board of Appeal 3.3.3  
of 1 March 1995

**Appellant:**  
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**Decision under appeal:** Decision of the Opposition Division of the  
European Patent Office dated 6 February 1992,  
posted on 7 April 1992 revoking European patent  
No. 0192260 pursuant to Article 102(1) EPC.

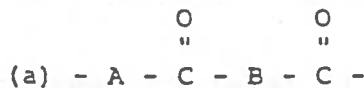
**Composition of the Board:**

**Chairman:** C. Gérardin  
**Members:** W. Kaltenegger  
S. Perryman

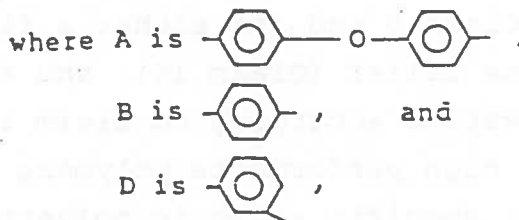
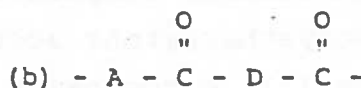
### Summary of Facts and Submissions

I. The mention of the grant of the patent No. 192 260 in respect of European patent application No. 86 102 195.4 filed on 21 February 1986 and claiming the priorities of 22 February 1985 and 2 August 1985 from two earlier applications in the United States, was published on 12 July 1989 on the basis of 16 claims, Claim 1 reading as follows:

"An ordered copolyetherketone consisting essentially of the two repeat units represented by the formulas



and



where said (a) and (b) units occur at a ratio in the range of 80:20 to 25:75 characterised in that said (a) and (b) units occur either in alternating order or in blocks to such an extent that at least one of the following provisos is fulfilled:

(i)  $\Delta H$  is at least 5 J/g greater than the  $\Delta H$  of a copolyetherketone of the same gross composition wherein the repeat units occur in random sequence,  $\Delta H$  being the heat of fusion,

(ii)  $\Delta T$  is at least 5°C less than the  $\Delta T$  of a copolyetherketone of the same gross composition wherein the repeat units occur in random sequence,  $\Delta T$  being the

difference between the melting point and the temperature of onset of crystallization, and

(iii)  $T_m$  is at least 5°C greater than the  $T_m$  of a copolyetherketone of the same gross composition wherein the repeat units occur in random sequence,  $T_m$  being the melting point."

Claims 2 to 6 are dependent claims directed to preferred copolyetherketones according to Claim 1.

Claims 7 to 12 concern a process as well as particular embodiments thereof for preparing a copolyetherketone according to any of Claims 1 to 5.

Claims 13 to 16 refer to respectively a shaped article obtained by extruding, compression molding or injection molding a copolyetherketone according to Claim 1 or Claim 5 (Claim 13), a composite structure consisting essentially of (a) a copolyetherketone according to Claim 1 or Claim 5 and (b) either a fibrous substrate or a particulate filler (Claim 14), and a blend of a copolyetherketone according to Claim 1 or Claim 5 and one or more high performance polymers (Claim 15), in particular a specific aromatic polyetherimide (Claim 16).

II. On 5 April 1990 and 12 April 1990 respectively Opponents 1 and 2 filed Notices of Opposition against the grant of the patent and requested revocation thereof in its entirety for lack of novelty and inventive step under Article 100(a) EPC. These objections, which were emphasized and elaborated in several later submissions as well as during oral proceedings, were based essentially on the following documents:

- (1) DE-A-1 905 652 = (2) US-A-3 516 966,
- (3) US-A-3 637 592 (continuation-in-part of (2)),

- (6) L. Mandelkern, Crystallization of Polymers, McGraw Hill, 1964, pages 106 to 110,
- (7) D. C. Allport and W. H. Janes, Block Copolymers, Applied Science Publishers, 1973, pages 385 to 391,
- (8) J. K. Kenny, Properties of Block Versus Random Copolymers, Polymer Engineering and Science, July 1968, Volume 8, No. 3, pages 216 to 225, and
- (13) EP-A1-0 033 394.

During oral proceedings held on 6 February 1992 the Patentee filed a graph to show that the copolyetherketones according to the patent in suit crystallized faster than the known polymers.

III. By a decision of 6 February 1992, with written reasons posted on 7 April 1992, the Opposition Division revoked the patent on the ground of lack of inventive step.

- (i) In that decision novelty over the teaching of document (1) was first acknowledged, since there was no evidence that the difference in reactivity of terephthalic acid and isophthaloyl chloride towards diphenyl ether, which was not disputed as such, would lead inevitably to an ordered copolyetherketone within the terms of the patent in suit.
- (ii) The graph submitted by the Patentee during oral proceedings did not provide adequate evidence that the claimed copolyetherketones crystallized faster than the prior art polymers, since (1) no explanation of the experimental procedure followed to determine the crystallization rates was given, (2) there was no direct comparison with a corresponding random copolyetherketone as disclosed in the prior art, and (3) the most relevant part of the graph was only an extrapolation of the other available data. It

followed that crystallization rates could not be taken into consideration to evaluate inventive step and that the problem underlying the patent in suit reduced to the provision of copolyetherketones fulfilling one or more of the provisos (i) to (iii) of Claim 1, thus having a higher degree of crystallinity.

- (iii) Since document (7) taught that the melting point of block copolymers was higher than that of the corresponding random copolymers, which for a skilled person meant a higher degree of crystallinity, an ordered sequence of the copolymer was regarded as obvious.
- (iv) Furthermore, it was emphasised that fully compatible blends of copolyetherketones and aromatic polyetherimides were described in document (13); the miscibility of these polymers could not therefore be regarded as surprising.

IV. On 9 June 1992 the Appellant (Patentee) filed a Notice of Appeal against that decision and paid the prescribed fee at the same time. In the Statement of Grounds of Appeal filed on 13 August 1992 the Appellant concentrated on the issues discussed in the decision under appeal.

- (i) Although novelty was acknowledged, a repetition of Example 1 of document (3) showed that the known copolyetherketone was not an ordered polymer within the terms of the patent in suit.
- (ii) A graph representation of the crystallization rates of an ordered copolymer and a known random copolymer was submitted (Appendix II) and information about the method used for the determination of crystallinity was provided. Thanks to their higher crystallization rates the

ordered copolyetherketones could be used for injection molding purposes.

- (iii) Furthermore, the comparative data in Table I, page 6 showed that the copolyetherketones within the terms of the patent in suit had an increased melt stability, which was not to be expected.
- (iv) A proper formulation of the technical problem underlying the patent in suit should thus take these two particular advantages into account. Such effects could not be predicted on the basis of the documents considered in the decision; in particular, the interpretation of document (7) regarding the melting point of block copolymers could not be accepted.
- (v) The fact that 16 years elapsed between the first publication of one of the documents (1) to (3) and the priority date of the patent in suit was evidence that the solution to that problem was not obvious. Similarly, the commercial success of the ordered copolyetherketones was further evidence of the presence of an inventive step.

V. In its written statements filed on 27 February 1993 and 3 September 1993 as well as during oral proceedings held on 1 March 1995 Respondent 1 (Opponent 1) objected against the definition of the technical problem on this new basis. Such a reformulation was not justified in view of the content of the original application which made neither reference to higher crystallization rates (cf. statement filed on 3 September 1993, point 4), nor to improved melt stability (oral proceedings).

In substance, Respondent 1 relied additionally on documents (6) and (8), which had played a minor role during the opposition procedure, to support its previous interpretation of document (7) regarding the difference

between the physical properties of random and block copolymers, and referred to following new citations:

- (18) "Block and graft copolymers: a review" by M. Matzner, Ind. Chim. Belg., (1973), 1104-1118,
- (19) US-A-3 767 620, and
- (20) US-E-28 252.

Document (20) described aromatic copolyetherketones based on para-phenylene groups, which could additionally comprise diphenyl ether units as well as meta-phenylene groups and even have a block structure. Such a combination of features would be novelty destroying. In the same respect, the objection of lack of novelty based on Example 1 of document (3) was maintained.

Document (20) furthermore taught that the crystallization characteristics, in particular the rate of crystallization, of aromatic copolyetherketones comprising para-phenylene groups, oxygen atoms and carbonyl groups could be adjusted by replacing some of the para-phenylene groups by ortho-phenylene groups; a skilled person would self-evidently expect a similar advantage by introducing meta-phenylene groups in the main polymer chain. The higher crystallization rate put forward by the Appellant could thus no longer be regarded as surprising.

- VI. Besides submitting an additional plot of crystallization rates for several ordered copolyetherketones with various terephthalic/isophthalic ratios, the Appellant pointed out in its later statements filed on 21 July 1993 and 13 December 1993 that the copolyetherketones disclosed in document (20) belonged to a broad class of polymers whose general definition was different from that of the present copolymers and which, moreover, were not ordered; such a teaching could thus not affect



novelty or render obvious the present structure, let alone suggest a suitability for injection molding purposes. As to document (19), it was clearly irrelevant, since the presence of flaws and impurities in random copolymers could not be related to the crystalline properties of ordered polymers.

VII. Respondent 2 (Opponent 2), which did not take an active part in the appeal procedure, was duly summoned to oral proceedings. By letter received on 23 December 1994 it informed the EPO that it would not attend these oral proceedings.

VIII. The Appellant requested that the decision under appeal be set aside and that the patent be maintained as granted.

Respondent 1 requested that the appeal be dismissed.

Respondent 2 requested that a decision be issued on the basis of the parties' written submissions.

#### Reasons for the Decision

1. The appeal complies with Articles 106 to 108 and Rule 64 EPC and is admissible.

##### *Procedural matters*

2. As noted above (point V), Respondent 1 relied on new documents (documents (18) to (20)) in its statements filed on 27 February 1993 and 3 September 1993 to support objections of lack of novelty and inventive step on the basis of arguments not presented before. The Board has duly examined these late-filed citations, which were obviously produced well after the nine-month time limit for filing a Notice of Opposition pursuant to

Article 99(1) EPC, in order to determine their relevance, namely their evidential weight compared with that of the documents submitted in due time.

This examination revealed that document (18) was not sufficiently relevant to be taken into consideration, so that no reference to this citation will be made hereinafter (Article 114(2) EPC). As far as documents (19) and (20) are concerned, in view of the detailed comments provided by the Appellant in relation to both the issues of novelty and inventive step (cf. statement filed on 13 December 1993, page 4, paragraph 2 to page 5, paragraph 3), the Board has decided to admit them into the procedure.

*Novelty*

3. The objection of implicit lack of novelty with respect to Example 1 of document (3), originally raised by Respondent 2, but maintained by Respondent 1 during oral proceedings, which is based on the difference in reactivity towards diphenyl ether between terephthalic acid and isophthaloyl chloride, cannot be accepted.

Together with the Statement of Grounds of Appeal the Appellant submitted the experimental evidence that polymers prepared according to that example do not have the same crystallization behaviour as ordered copolyetherketones and are therefore different entities. In particular, it appears from the Affidavit (page 4, Table) that the copolyetherketone obtained by following the procedure described in Example 1 of document (3) has a lower peak melting temperature ( $T_m$ ) and a higher crystallization rate value ( $dT$ ), thus a longer crystallization time, than the ordered copolyetherketone according to Example 6 of the patent in suit; this

result is fully in line with provisos (ii) and (iii) of Claim 1.

In the absence of experimental counter-evidence submitted by Respondent 1, the Board relies on the results of the Appellant's test report and concludes that this particular teaching of document (3) is not novelty destroying.

4. The issue of novelty has also been raised on the basis of the disclosure of document (20).

4.1 According to the broadest teaching of that citation, a dihalogenobenzenoid compound having the formula  $X-Ar-Y-Ar'-X'$ , wherein Ar and Ar' are each a phenylene group, X and X' are each a halogen atom, Y is  $SO_2$ , SO, CO or a group  $Y'-A-Y''$  in which Y' and Y'' are each  $SO_2$ , SO or CO and A is a bivalent aromatic radical having both valencies linked to carbon atoms, is caused to react, alone or together with another dihalogenobenzenoid compound, in a polar liquid under anhydrous conditions and at a temperature between 150 and 350°C with a substantially equivalent amount of an alkali metal hydroxide by the displacement of alkali metal halide (Claim 1 in combination with column 2, lines 57 to 59). According to a more specific definition of the dihalogenobenzenoid compound,  $Y'-A-Y''$  may be a terephthaloyl group (column 2, lines 18 to 46, in particular lines 26 to 34).

4.2 Although the group  $SO_2$  and CO are regarded as equivalent for the definition of the dihalogenobenzenoid compound, in practice the corresponding polymers are very different entities and emphasis is clearly put on polymer containing the sulphonyl unit.

According to the passage dealing specifically with polyarylketones (column 6, lines 21 to 70) referred to by Respondent 1, the all-para polyketone having repeating units of the formula  $-(p\text{-phenylene})\text{-CO}\text{-}(p\text{-phenylene})\text{-O-}$  may be modified by incorporation of the corresponding ortho-phenylene group. This may be achieved by partial isomerisation into the para configuration of an all-ortho polyketone or by copolymerization of a mixture of appropriate monomers as in Example 23, where equivalent amounts of potassium salts of 4-(4-chlorobenzoyl)phenol and 2-(4-chlorobenzoyl)phenol are used. It is clear that neither the general definition of the polyketones, nor the copolymer specifically exemplified correspond to the claimed copolyetherketones.

Furthermore, even if any dihalogenobenzenoid compound or mixture thereof may be used (column 1, lines 64 to 67), as pointed out by Respondent 1, which would comprise the meta configuration, preference is given to ortho and para configurations; there is thus no reason to extend to isophthalic units the teaching of the citation and thereby assume that the known polyketones contain D units within the terms of the patent in suit.

- 4.3 Regarding the structure, it is specified that polyketones containing both the para and the ortho configurations may be random copolymers (column 6, line 71 to column 7, line 12) or block copolymers (column 7, lines 55 to 65). In fact, whatever their structure, the crystallinity of these copolymers cannot be regarded as satisfactory, since in both cases the copolymers "as made" must be first subjected to a treatment, such as annealing or nucleation, in order to achieve a degree of crystallinity enabling a reasonable processability. This shortcoming is evidence that the known polyketones, in particular those having a block

structure and 50 to 80% of p-phenylene units, would not fulfil the provisos (i) to (iii) required in the patent in suit.

From a more general standpoint, Respondent 1 failed to provide evidence that the aromatic polymers obtainable by the process according to Claim 1 of document (20) would inevitably fulfil these provisos. It follows that the latter must be regarded as further distinguishing features over the prior art.

4.4 It is not disputed that all the compositional and structural features of the ordered copolyetherketones as claimed are mentioned individually in document (20) or at least encompassed within that disclosure. For the reason given above, however, there is no reason to assume that the known aromatic polyketones could have in addition to a block structure both diphenyl ether units and a combination of p-phenylene and m-phenylene units. There can thus be no question of an implicit disclosure of the claimed subject-matter.

4.5 In conclusion, document (20) must be regarded at most as a generic disclosure of aromatic polyethers which does not describe, either explicitly or implicitly, ordered copolyetherketones within the terms of the patent in suit, so that novelty is acknowledged.

*Inventive step*

5. The patent in suit concerns ordered copolyetherketones consisting essentially of diphenyl ether units, p-phenylene units and m-phenylene units. Copolyetherketones based on the same repeat units are known from documents (1) to (3) which, in view of their identification in point II above, can be regarded as a single disclosure representing the closest state of the

art. As acknowledged in the introductory section of the patent specification (page 2, lines 10 to 23 and lines 35 to 44), these copolymers, which contain moieties derived from terephthalic acid T and isophthalic acid I in T:I ratios varying from 95:5 to 70:30 (documents (1) and (2), Claim 1), are random copolymers, i.e. copolymers in which the terephthaloyl and isophthaloyl units are randomly dispersed along the backbone of the polymer chain. In spite of a good processability these copolymers turned out to be of limited utility because of their moderate melt stability and their poor propensity to crystallize, whereby injection molding applications could not be envisaged.

In the light of these shortcomings the technical problem underlying the patent in suit may thus be seen in the provision of copolyetherketones (a) having comparable melting points and, thereby, comparable processability, (b) having improved melt stability, and (c) having higher rates of crystallization compatible with injection molding applications.

According to the patent in suit this problem is to be solved by ordered copolyetherketones, i.e. copolymers in which the terephthaloyl and isophthaloyl units occur either in alternating units or in blocks, having thermal characteristics which fulfil at least one of the provisos (i) to (iii) specified in Claim 1.

6. This definition of the technical problem has been objected to by Respondent 1 on the grounds that there is no mention of crystallization rates in the application as filed (statement filed on 27 February 1993, point 1; statement filed on 3 September 1993, point 4), nor any reference to melt stability (oral proceedings) and that, consequently, such subject-matter extends beyond the application as filed.

The first objection cannot be accepted in view of following passages in the original application: page 2, lines 31 to 35; page 4, lines 4 to 10; page 7, lines 29 to 34 and page 11, lines 29 to 33, which explicitly refer to the crystallization behaviour of ordered copolyetherketones and to the advantage of high crystallization rates for injection molding purposes. Moreover, from the decision under appeal (Reasons for the decision, point 6) as well as from the minutes of the oral proceedings before the Opposition Division (points 3.1, 3.2, and 3.4) it clearly appears that the higher crystallization rates were already considered for the definition of the technical problem, but that eventually the latter had to be reformulated on a less ambitious basis only because of the lack of evidence that the more ambitious problem was actually solved.

From a more general standpoint the technical problem as originally formulated must be assumed to be based on the state of the art known to the Applicant at the filing date of the application. It is self-evident that this problem may have to be defined in other terms according to the documents cited in the search report or subsequently by the Opponents as well as according to the experimental evidence which may be provided. This applies in particular to melt stability, for which the Appellant provided comparative data which will be evaluated hereinbelow. Such new aspects of the technical problem cannot be regarded as the addition of subject-matter extending beyond the content of the application filed.

For these reasons, there can be no question of an offense against Article 123(2) EPC.

7. The experimental test reports submitted by the Appellant on 13 August 1992 and 21 July 1993 provide evidence that the above defined technical problem is effectively solved.

7.1 From the first statement (page 6, Table I; page 7, Table II and Appendix I) it appears that ordered copolyetherketones with a T/I ratio of 70:30 have a dramatically increased melt stability, whilst having a melting point similar to that of a random copolymer with the same composition. Further, the figure in Annex II to that statement shows that the peak time for an ordered copolyetherketone having a T/I ratio of 70:30 to crystallize is about 6 seconds, which means that complete crystallization can be achieved within 12 to 15 seconds; such figures indicate that the polymer would be suitable for injection molding applications. By contrast, the peak time for a random copolyetherketone with the same composition is about 40 to 50 seconds, thus less appropriate for injection molding purposes. This experimental evidence has been completed with an additional plot of crystallization rates for a set of ordered copolyetherketones with different T/I ratios, which was filed together with the second statement. In the case of the 80:20 and 70:30 ratios the crystallization rates are too fast for direct measurement of the minimum peak times, so that these minima have to be determined by extrapolation on the basis of the shape of the curves established for the 60:40 and 50:50 ratios. As pointed out by the Appellant, this is not objectionable since it is common practice, when a reaction or physical change occurs so fast that it cannot be measured, to extrapolate the unmeasurable portion of the curve on the basis of the general shape of the curve.



In addition to these data the Appellant has provided detailed information of the experimental procedure followed to determine the crystallization rates (statement filed on 13 August 1992, page 10, paragraph 3 to page 11, paragraph 2; Appendix II, point 2: Determination of the crystallization rate of the copolyetherketones). This overcomes the objection raised by the Opposition Division during oral proceedings concerning the absence of the indication of the method used to determine this parameter (decision under appeal, point 7)).

7.2 During the oral proceedings the conclusiveness of the data provided by the Appellant regarding the improvement of melt stability allegedly demonstrated in Table 1 of the Statement of Grounds of Appeal has been questioned in view of the fact that the test report does not indicate the method of measurement used by the Appellant, nor define the "melt index stability" mentioned therein. These deficiencies have not been disputed by the Appellant.

However, a proper interpretation of the diagram in Appendix II in annex to the Statement of Grounds of Appeal provides an indirect comparison of the melt stability of random and ordered copolyetherketones. As specified by the Appellant (Appendix II, page 3, paragraph 3), by contrast to ordered copolyetherketones the right hand side of the curve corresponding to random copolymers cannot be measured because of cross-linking reactions. This clearly shows that ordered copolyetherketones have an improved melt stability and that, consequently, this aspect of the technical problem is also solved.

- 7.3 Since all the examples in the patent in suit show that ordered copolyetherketones have melting points ensuring an easy processability, the above-defined technical problem in its three aspects (a), (b) and (c) must be regarded as effectively solved. Moreover, as made clear by the Appellant during oral proceedings, any of the provisos (i) to (iii) is to be regarded as a condition sufficient to solve that problem, in particular to ensure injection molding processability.
8. It remains to be decided whether the claimed subject-matter involves an inventive step with regard to the teaching of the known documents.
- 8.1 The starting point of the random copolyetherketones described in documents (1) to (3) is the polyetherketone derived from terephthalic acid only, which is a highly crystalline product with a high melting point, therefore difficult to process. In particular, it appears that the polyetherketone based on terephthalic acid only, which possesses desirable characteristics for high quality electrical insulation, cannot be melt fabricated because of that high crystalline melting point which requires extrusion temperatures of 420°C or more; such temperatures not only cause degradation and decomposition of the polymer, which affects the physical properties thereof, but also prevent carrying out extrusion on a continuous basis (document (2), column 4, lines 35 to 56). According to the main teaching of this citation, these shortcomings can be overcome by introducing 5 to 30 mol percent of units derived from isophthalic acid, which lowers the crystalline melting point and extrusion temperature of the polymer, whereby melt processing can be performed without degradation and

decomposition (column 4, lines 56 to 61). The above amount of isophthalic acid, which corresponds to ratios T:I between 95:5 and 70:30, is thus guided by practical considerations, since copolyetherketones with lower T:I ratios would crystallize only with difficulty.

The T:I ratios disclosed in document (2) must thus be regarded as critical in that they express a compromise between antagonistic requirements, namely the necessity for the polymer to be melt processable, which is achieved by lowering the amount of terephthalic acid, while still being able to crystallize, which is achieved by keeping that amount high. This means that any improvement of one of these properties can only be obtained at the expense of the other. There would thus be no incentive for a skilled person facing the above defined problem to consider a copolyetherketone having a general definition outside the scope of this citation.

It is doubtful in fact whether the crystalline properties referred to in documents (1) to (3) are at all comparable to the properties achieved in the patent in suit. It may be that document (3) specifies that "sufficient crystallinity for good dimensional stability has been developed in copolyketone film structures having a T:I ratio of 70:30 in continuous runs by contacting the film structure for less than 5 sec. with a drum heated at 275°C" (column 3, lines 15 to 19). However, as pointed out by the Appellant in the Statement of Grounds of Appeal (page 9, paragraph 1), it has not been investigated anywhere in this citation as to how high the achieved crystallinity is after 5 seconds; this is an essential parameter to consider in the case of injection molding applications, since the crystallinity achieved should be near to the maximum achievable in order to avoid subsequent postcrystallization or change of appearance of the

molded article. In the absence in document (3) of any reference to injection molding, there is no reason to assume that the level required by that technique could be achieved by what is disclosed in this citation.

For these reasons, it must be concluded that documents (1) to (3) cannot lead a person skilled in the art to the claimed subject-matter.

8.2 Document (19) is concerned with the improvement of melt stability of copolyetherketones prepared by Friedel-Crafts synthesis from diphenyl ether and terephthaloyl and isophthaloyl halides, which tend to degrade and undergo decomposition during attempts to extrude them (column 1, lines 14 to 28). Following the teaching of this citation, the polyketone is treated with a chemical reducing agent in an acidic environment in order to lower the number of 9-phenylenexanthidrol end-groups which have been found to be the major factor in the poor melt stability of the polymer (Claim 1; column 1, lines 44 to 52; column 2, lines 3 to 10). These groups are formed by side reaction of the acid chloride in the ortho position to the ether group followed by crystallization, whereby further chain extension is inhibited; there is no dispute between the parties about this interpretation (statements filed by Respondent 1 on 27 February 1993, point 3, and on 3 September 1993, point 3; statements filed by the Appellant on 21 July 1993, point 3, and on 13 December 1993, page 3, paragraphs 2 and 3).

As pointed out by the Appellant in its last statement, such ortho addition should not be affected by the type of polymer prepared, i.e. whether a random copolymer or an ordered copolymer is prepared, since the mechanism of chain formation should be the same in both cases; in particular, nothing in document (19) suggests that a

better selectivity could be expected in the case of the preparation of ordered copolyetherketones. There would thus be no incentive for a skilled person to depart from the random structure and thereby consider an ordered structure within the terms of the patent in suit.

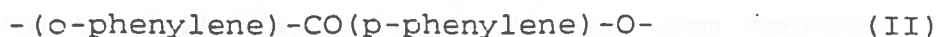
Even if, for the sake of argument, one assumed that the melt stability achievable by the reducing post treatment of random copolyetherketones according to the disclosure of document (19) corresponded to the level aimed at in the patent in suit, this would at most represent an alternative proposition to the solution as presently claimed, without teaching the skilled person how to solve the other aspects of the technical problem.

8.3 Document (20) concentrates on the features influencing the crystallinity of copolyetherketones.

The first is the composition of the polyketone, which is said to be responsible for the crystallisation characteristics, in particular for the degree of crystallinity, the rate of crystallization and the melting point, and thereby for the physical properties of the polymer. In the case of the all-para polyketone having the repeating unit



which is a highly crystalline and rather intractable material, the tendency to crystallize and the melting point may be reduced by introducing the repeating unit



(column 2, lines 21 to 51 and lines 61 to 70).

The second feature is the structure of the polyketone, since the same repeating units (I) and (II) can be present in the form of a random copolymer or a block copolymer. Both types of copolymers may be crystalline as well as amorphous and a difference in properties, which are described in the same terms, is not apparent (column 7, lines 55 to 65). Moreover, nowhere in the citation is there a relationship between crystallinity and structure; even the passage referred to by Respondent 1 during oral proceedings that "crystalline random copolymers ... generally have lower melting points than the block copolymers of the same composition" (column 7, lines 48 to 50) does not provide an incentive to consider a block structure rather than a random structure, for the copolymers mentioned there do not comprise terephthaloyl units together with meta configuration, and therefore differ from the claimed copolyetherketones by both their composition and their structure.

For the purpose of the present decision this is a minor point, since document (20) does not teach how to control each of the above crystallization characteristics individually, but only suggests an influence on these characteristics in general. The possibility of adjusting the degree of crystallinity, the rate of crystallization and the melting point can thus only be interpreted as the possibility of modifying these three parameters simultaneously. An adjustment of the crystalline characteristics as required according to the definition of the technical problem underlying the patent in suit, in particular an increase of the rate of crystallization without modification of crystallinity and melting point as demonstrated by the Appellant, is not envisaged in the citation.

It is thus evident that the approach followed in document (20), which regards higher crystallinity as a prerequisite for higher rates of crystallization, cannot lead a skilled person to the teaching of the patent in suit.

- 8.4 As far as documents (6) to (8) are concerned, the polymers considered there are too far from the claimed copolyetherketones to provide any useful guidance for the solution of the technical problem. On the one hand, the ordered copolymers specifically mentioned in these citations - namely ethylene-carbon monoxide copolymers, various polyester block copolymers and addition block copolymers in document (6) (page 107, paragraph 2 to page 108, paragraph 1); polyester block copolymers, ethylene-propylene block copolymers and polyurethanes in document (7) (page 387, paragraphs 1 to 3); various polyester block copolymers, polyamide block copolymers and polysiloxane block copolymers as well as polycarbonate-polyether block copolymers and addition block copolymers in document (8) (page 216, right hand column, paragraph 2 to page 224, right hand column, paragraph 5) - are very different from a composition point of view. On the other hand, the molecular weight of these blocks, as evidenced by reference to long crystalline blocks and phase separation in document (7) (page 385, last paragraph) and to long chains having commonly molecular weights of several thousands in document (8) (page 217, left hand column, paragraph 2; page 222, Table VI), is much higher than in the copolyetherketones according to the patent in suit, which comprise comparatively few units (cf. Example 7, blocks 4/3).

More specifically, Respondent 1 failed to demonstrate how the teaching of such general citations could be relevant for the solution of the technical problem, in particular more relevant than that of document (20) which at least mentions copolyetherketones. As specified in the final paragraph of document (8), "in a study of the properties of block copolymers, it is necessary to pay particular attention to the dependence of the properties on composition, structure, sequence of blocks, length and number of blocks." Such a statement, in the Board's view, clearly means that the improvement in physical properties achievable by a given arrangement of the units of a copolymer is far from being predictable and must thus be regarded as a warning against any kind of generalization.

8.5 In addition to the fact that the claimed subject-matter is not obvious to a person skilled in the art having regard to the documents relied upon by the Respondents, whether considered in isolation or in combination, following further aspects should be taken into account.

8.5.1 The first is the time factor, i.e. the 16 years which elapsed between the date of publication of document (1), i.e. 1969, and the priority date of the patent in suit, i.e. 1985. This is considerable in a field as active as aromatic polyetherketones as evidenced by the large number of documents cited by the Respondents. In particular, the fact that such a long time was necessary to provide a general solution to various shortcomings which were well known, but had always been considered in isolation - poor melt stability in document (19) and inadequate crystalline characteristics in document (20) - in order to make copolyetherketones suitable for injection molding purposes, speaks for the inventiveness of that solution.



The argument presented by Respondent 1 during oral proceedings that, in the absence of a need for such polymers, a lapse of time of 16 years could not be regarded as a sign of inventive step, cannot be accepted for it is based on a passive definition of the person skilled in the art. In the Board's view, on the contrary, it belongs to the routine activities of a skilled person to improve the preparation, to optimize the properties and to extend the field of application of known products, in particular to adjust the properties of these products to the specific requirements of the various processing techniques. In the present case, thus, the adjustment of the physical properties of the known random copolyetherketones in order to ensure suitability for injection moulding purposes must be regarded as part of the normal task of a skilled person. The extensive studies reported in documents (6) to (8) about the correlation between structure and properties of copolymers are themselves a reflection of that permanent concern of the skilled person.

- 8.5.2 A second element supporting the above conclusion is the commercial success of the thermoplastic sheets sold under the trademark Declar, which are used extensively in interior components of passenger aircrafts. These sheets are prepared by hot lamination of a polyvinyl fluoride film to a copolyetherketone sheet; because ordered copolyetherketones have a lower glass transition temperature than the corresponding random copolymers, such lamination can be successfully performed without risk of polyvinyl fluoride decomposition. This specific application is thus based on a significant, unexpected superiority of ordered copolyetherketones over random copolyetherketones, which by contrast have remained of limited utility and have not been commercialized successfully (Statement of Grounds of Appeal, Table II and points 2.4 and 2.5).

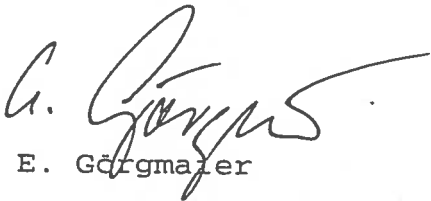
- 8.6 For these various reasons, the Board concludes that the subject-matter as defined in Claim 1 of the patent in suit involves an inventive step.
9. Claim 1 being allowable, the same applies to dependent Claims 2 to 6, which are directed to preferred copolyetherketones according to Claim 1, further to Claim 7 to 12, which deal with a process for the preparation of a copolyetherketone according to Claim 1, as well as Claims 13 to 16, which concern specific applications of the copolyetherketones according to Claim 1, and whose inventiveness is supported by that of the main claim. In particular, the inventiveness of the blends of ordered copolyetherketones and aromatic polyetherimides according to Claim 16 is not related to the miscibility of these polymers over the entire compositional range, which according to document (13) should be a property of polyketones in general (Claim 8; page 2, lines 27 to 34; page 19, lines 7 to 17), but to the suitability of such blends for injection molding applications, as shown in Example 9 of the patent in suit; this ability was not to be expected in the light of the various embodiments illustrated in document (13), wherein the blend of polyketones and polyetherimides (Examples 1 to 3) as well as the individual polymers themselves (control A and B) are always compression molded, which obviously requires much lower rates of crystallization.

Order

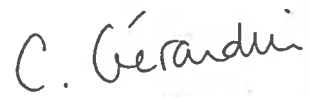
For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The patent is maintained as granted.

The Registrar:

  
E. Görgmaier

The Chairman:

  
C. Gérardin