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D E C I S I O N
of 23 July 1997

Case Number: T 0307/94 - 3.3.3

Application Number: 84301252.7

Publication Number: 0117748

IPC: C08L 59/02

Language of the proceedings: EN

Title of invention:

Polyoxymethylene/polyurethane compositions containing polycarbodiimide

Patentee:

E.I. DU PONT DE NEMOURS AND COMPANY

Opponent:

BASF Aktiengesellschaft, Ludwigshafen
Degussa AG, Frankfurt - Zweigniederlassung Wolfgang-
HOECHST Aktiengesellschaft Zentrale Patentabteilung

Headword:

-

Relevant legal provisions:

EPC Art. 56

Keyword:

"Inventive step (yes) - technical problem - insight to technical effect lying closer to the claimed subject-matter than the relevant state of the art yet which directly contradicts the teaching of this art"

Decisions cited:

T 0192/82

Catchword:

-



Case Number: T 0307/94 - 3.3.3

D E C I S I O N
of the Technical Board of Appeal 3.3.3
of 23 July 1997

Appellant:
(Proprietor of the patent) E.I. DU PONT DE NEMOURS AND COMPANY
1007 Market Street
Wilmington
Delaware 19898 (US)

Representative:
Jones, Alan John
CARPMAELS & RANSFORD
43, Bloomsbury Square
London, WC1A 2RA (GB)

Respondent:
(Opponent 01) BASF Aktiengesellschaft, Ludwigshafen
- Patentabteilung - C6-
Carl-Bosch-Strasse 38
D-67056 Ludwigshafen (DE)

Opponent 02:
Degussa AG, Frankfurt
- Zweigniederlassung Wolfgang -
Postfach 13 45
D-63403 Hanau (DE)

Opponent 03:
HOECHST Aktiengesellschaft
Zentrale Patentabteilung
Postfach 80 03 20
D-65903 Frankfurt (DE)

Decision under appeal: Decision of the Opposition Division of the
European Patent Office dated 16 November 1993,
issued in writing on 16 February 1994 revoking
European patent No. 0 117 748 pursuant to
Article 102(1) EPC.

Composition of the Board:

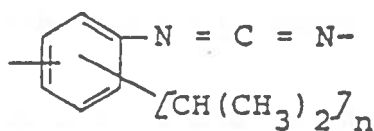
Chairman: C. Gérardin
Members: R. Young
J. A. Stephens-Ofner

Summary of Facts and Submissions

I. The mention of the grant of European patent No. 0 117 748, on the basis of twenty claims, in respect of European patent application No. 84 301 252.7, filed on 27 February 1984 and claiming United States priorities of 25 February 1983 (US 469759) and 21 February 1984 (US 579912) was announced on 5 September 1990 (Bulletin 90/36). Claim 1 reads as follows:

"A thermoplastic polyoxymethylene composition consisting essentially of

- (a) 5-40 weight percent of at least one thermoplastic polyurethane, which polyurethane has a soft segment glass transition temperature of lower than 0°C,
- (b) 0.05-1.0 weight percent of at least one hindered polycarbodiimide having a molecular weight of about 1000 and containing units of the formula



where n has an average value of about 3, and

- (c) a complementary amount of at least one polyoxymethylene polymer, which polyoxymethylene polymer has a weight average molecular weight of from 20,000 to 100,000."

Dependent Claims 2 to 12 are directed to elaborations of the composition of Claim 1.

Independent Claim 13 is directed to a method for improving the resistance to discoloration and decomposition of a thermoplastic composition consisting essentially of the first and last components as defined in Claim 1, comprising the step of incorporating into the polyoxymethylene composition 0.05-1.0 weight percent of a hindered polycarbodiimide as defined in Claim 1, above.

Dependent Claims 14 to 16 are directed to elaborations of the method according to Claim 13.

Independent Claim 17 is directed to shaped articles made from the composition according to any one of Claims 1 to 12.

Independent Claim 18 is directed to a method of preparing the shaped articles according to Claim 17 selected from compression moulding, injection moulding, extrusion, blow moulding, rotational moulding, melt spinning, thermoforming and stamping.

Dependent Claims 19 and 20 are directed to elaborations of the method according to Claim 18.

II. Notices of Opposition were filed on 28 May 1991 (Opponent I); on 4 June 1991 (Opponent II) and on 5 June 1991 (Opponent III), in each case on the ground of lack of inventive step. The oppositions were supported inter alia by the documents

D1: GB-A-993 600; and

D3: DE-C-1 193 240.

III. By a decision which was given at the end of Oral Proceedings held on 16 November 1993 and issued in writing on 16 February 1994, the Opposition Division revoked the patent.

According to the decision, the closest state of the art was D3, since it disclosed polyoxymethylene/polyurethane (POM/PU) blends in combination with stabilisers, and the technical problem could be regarded as improving the stability of POM/PU blends at high temperatures and hold-up times. Document D1 disclosed the stabilisation of POM by the addition of polycarbodiimides (PCDI), and furthermore made it clear that adding PU to mixtures of POM and PCDI prevented degradation at high temperatures. This was a clear hint to use a mixture of all three of the claimed components rather than just two of them. Although the relevant PCDI was only generically disclosed in D1, all the members of the relevant range had to be regarded, in the absence of evidence to the contrary, as suitable stabilisers. Thus, the claimed subject-matter was prima facie obvious. The alleged effect, of an unexpected improvement in yellowness index for a POM/PU blend compared with the individual components, had been calculated in terms of an absolute difference in yellowing, which failed to take account of the increase in yellowing brought about by the addition of PCDI itself. Consequently, the difference of yellowness index should have been referred back to the individual components without the addition of PCDI. If this were done, it was evident that no surprising result had been demonstrated. Consequently, the claimed subject-matter did not involve an inventive step.

IV. On 11 April 1994, a Notice of Appeal against the above decision was filed, together with payment of the prescribed fee.

In the Statement of Grounds of Appeal filed on 16 June 1994, the Appellant (Patentee) argued, in essence, as follows:

- (i) The disclosure of D1 pointed away from the solution of the stated problem, because it stated that, at the relevant temperatures of 180°C to 220°C, PCDis not only had no significance in the stabilisation of polymers, but they even increased the decomposition after a certain time.
- (ii) The use of PU in D1 was only as a stabiliser and it would not have been obvious to increase the amount of PU to the higher quantities claimed.
- (iii) D1 failed to disclose the claimed PCDI. The conclusion that all the PCDis in D1 had to be regarded as suitable stabilisers was contradicted by the disclosure of D1 itself, which showed that the most relevant PCDI (D) was in fact the worst stabiliser at the relevant temperature. Consequently, the claimed subject-matter was not prima facie obvious.
- (iv) As regards the reduction in the degree of yellowing, the Appellant's calculations had not been shown to be wrong, and it was not clear, therefore, why the alternative method, which was not valid because it involved measuring percentages of percentages, had been accepted instead in the decision under appeal.

The Statement of Grounds of Appeal was accompanied by a graph to show that the actual improvement in yellowing index was considerably greater than the predicted one.

V. The arguments of the Respondents may be summarised as follows:

- (i) It was clear from D1 that PCDI in combination with PU formed an ideal stabiliser for POM at the relevant temperatures of 180° to 220°C and hold-up times of 20 minutes. By analogy with the amount of PCDI stabiliser added, which was up to 5%, D1 must be taken as disclosing a similar amount of PU, thus falling within the terms of Claim 1 of the patent in suit. It would in any case have been obvious for the skilled person to increase the amount of PU to further increase the stability of the blend.
- (ii) The examples in the patent in suit were carried out at 188°C and for 15 minutes, which was on the one hand within the range of conditions covered by D1 which would have been expected to provide thermal stability, and on the other hand below the preferred range of temperatures in the patent in suit which might have provided a distinction from D1.
- (iii) Although it was true that D1 gave poor results of PCDI (D), the conditions under which the measurements were made according to D1 (2 h at 220°C) were drastic compared with those exemplified in the patent in suit. In any case, the amount of PU taught to be added according to D1 had to be regarded as falling within the claimed range, and the onus was therefore on the Appellant to show that there was selection in the choice of PCDI.

- (iv) The results of heat aging at 100°C/64 days in D1 were on the other hand excellent, and the presence of a large number of corresponding such examples in the patent in suit showed that this aspect was significant also.

- (v) For the assessment of an effect, the relevant standard was not the eye of the beholder but the measurements obtained by the person skilled in the art. Furthermore, the person skilled in the art would expect a deterioration of the yellowing index even at short hold-up times, and consequently, the question of whether the effect was surprising could only be answered by considering a relative, i.e. percentage difference in the index. On this basis, the yellowing index increased less steeply with addition of PCDI for PU and for POM than without it, which was what would have been expected. With a POM/PU blend this reduction in steepness also corresponded to the expectation.

- (vi) In view of the obviousness of the claimed compositions, for the reasons given, the mere presence of an additional effect not mentioned in the state of the art (stability during long hold-up times) could not render them inventive (T192/82, OJ EPO 1984, 415).

VI. The Appellant filed, with a submission received on 19 June 1997, three sets of claims forming, respectively, a first, second and third auxiliary request.

- VII. Oral proceedings were held before the Board on 23 July 1997. They were attended by the Appellant, and Respondents I and II. Respondent III, although duly summoned, did not attend the oral proceedings (letter of 9 June 1997).
- VIII. The Appellant requested that the decision under appeal be set aside and that the patent be maintained, as main request, as granted, or in the alternative, on the basis of the claims submitted as auxiliary request 1, 2 or 3 on 19 June 1997.

The Respondents requested that the appeal be dismissed.

Reasons for the Decision

1. The appeal is admissible.
2. *The patent in suit (main request); the technical problem*

The patent in suit is concerned with a thermoplastic polyoxymethylene (POM) composition containing 5-40 weight percent of at least one thermoplastic polyurethane (PU) having a soft segment glass transition temperature of lower than 0°C, the POM polymer having a weight average molecular weight of from 20,000 to 100,000 and being present in a complementary amount (Claim 1). Such a composition may have extraordinary toughness and/or impact resistance (page 2, lines 15 to 17).

- 2.1 Such a composition is, furthermore, admittedly known from D3, which was considered in the decision under appeal and by the parties to be the closest state of the art.

2.1.1 Document D3 is concerned with the modification of high molecular weight PU masses with high molecular weight POM and vice versa, to provide masses which are repeatedly thermoplastically deformable into shaped articles (column 1, lines 10 to 14). The masses contain (a) high molecular PU based on polyhydroxyl compounds (molecular weight 500 to 4 000), polyisocyanates and chain extenders, and (b) high molecular POM, in a ratio of 5:95 to 95:5 weight percent (column 1, lines 23 to 30).

2.1.2 It is known, in the thermoplastic processing of POM, to trap the formaldehyde that is to a greater or lesser extent released, with the aid of urethanes, whereby N-methylol groups are formed, which convert to N-methylene compounds, and thus to arrive at a stabilisation of the POM. Higher molecular PUs cannot, however, be utilised for this purpose, since they would become cross-linked and cease to be plastically deformable. It is surprising that no such cross-linking occurs with above compositions, even though formaldehyde is produced in sufficient quantities to bring about such cross-linking (column 1, line 31 to column 2, line 22).

2.1.3 The thermoplastically deformable masses can be processed by shaping under pressure, at elevated temperatures, in the region of 180 to 220°C, for periods of 1 to 40 minutes. They are susceptible to the application of typical thermoplastic processing methods, such as injection moulding, extrusion, or welding into shaped or flat objects, or into coatings (column 4, lines 59 to 68).

2.1.4 Thermal stabilisers, anti-oxidants or fillers may be added to the compositions (column 5, lines 24 to 26).

2.1.5 According to Example 1, a POM derived from trioxan (250 pbw) and 1,3 dioxolane (2.5 pbw) is mixed, in various proportions comprised between 30:70 and 90:10 weight percent, with a PU derived from reaction of a polyester of adipic acid and ethylene glycol with diphenylmethane-4,4'-diisocyanate, on a mixing roll at a temperature of 170 to 180°C, with the addition of 1 wt% of a polyamide thermal stabiliser (polycaprolactam) and 0.5 wt% of a 2,6-di-tert-butylphenol as antioxidant. The resulting homogeneous mixture is formed under heat and pressure into a flat sheet having impact resistance, bending resistance, tear resistance, and hardness (column 5, line 30 to column 6, line 42).

2.2 According to the patent in suit, however, such compositions of POM and PU discolour and/or decompose under certain conditions, particularly when hold-up time is excessive during moulding, or other melt processing operations (page 2, lines 17 to 19). According to an uncontested submission of the Appellant during the oral proceedings before the Board, in this connection, a number of decomposition mechanisms operate. Whilst some of these do not result in discoloration, in particular yellowing, there are others which do.

2.3 The extent of this problem is illustrated by a set of comparative experiments submitted by the Appellant, to show the difference in discoloration, in terms of change of yellowness index, ΔYI , between a sample moulded with prior hold-up of the resin melt in the moulding barrel, and that of a similar sample moulded without such hold-up, the hold-up time being 20 minutes at a melt temperature of 212 to 215°C or 215 to 228°C. The results, which concern samples of POM, PU and POM/PU blends respectively, and were originally filed, in the form of an Affidavit, during

the pre-grant examination proceedings (submission filed on 28 November 1989), were extensively cited in both the opposition proceedings and in the subsequent appeal.

In particular, a submission of Respondent I, filed on 23 December 1994, which contains a tabular representation of certain of the Appellant's results, formed the basis of discussions at the oral proceedings before the Board. In the table, YI_E represents the yellowness index of a sample injection moulded with hold-up, and YI_0 that of a sample moulded without hold-up (submission, page 6). The yellowness index is a positive number indicative of the degree of yellowness in a sample, larger numbers corresponding to greater discoloration. The table is reproduced below:

Test Nr.	Zusammensetzung Gew.-%		PCDI Gew.-%	Yellowness Index YI			ΔYI in % des Wertes ohne Zusatz von PCDI
	PU	POM		YI_0 vor Verarb.	YI_E nach Verarb.	ΔYI	
1	100	-	0	17,9	27,0	9,1	100
2	100	-	0,1	18,2	25,2	7,0	77
3	100	-	0,3	21,0	25,7	5,7	63
4	-	100	0	3,3	4,6	1,3	100
5	-	100	0,1	5,3	6,5	1,2	92
6	-	100	0,3	11,4	13,2	1,8	139
7	10	90	0	10,1	53,4	43,3	100
8	10	90	0,1	10,2	36,1	25,9	60
9	10	90	0,3	12,9	32,4	19,5	45

2.3.1 It is evident from the table that, whilst the yellowness index without hold-up, YI_0 , of POM/PU lies, at 10.1, as would be expected, between that of PU (17.9) and POM (3.3), the yellowness index with hold-up, YI_E , of POM/PU, at 53.4 is much higher than that of either of the components PU (27.0) or POM (4,6) alone.

- 2.3.2 Furthermore, the ΔYI value exhibited by a POM/PU blend having 10 wt% PU, at 43.3 is at least four times as great as the corresponding ΔYI values for either of the separate components PU, at 9.1 or POM, at 1.3 (Test No. 7 vs. Test Nos. 1 and 4).
- 2.3.2 Consequently, it is evident that, under the relevant conditions of high temperature hold-up, the POM/PU blend is disproportionately more prone to discoloration (yellowing) as a result of thermal degradation than either of its components separately.
- 2.3.3 Whilst the Respondent I mentioned at the oral proceedings that comparative experiments done by them did not confirm the above results, none of these experiments was submitted to the Board. Nor was any other reason given why the Board should not accept the Appellant's results, which the Board therefore accepts as true.
- 2.3.4 The argument of the same Respondent, that the relevant measure is not the eye of the holder but the measurements made by the skilled person (section V(v), above), is beside the point, because the relevant effect forming the basis of the problem addressed by the patent in suit is one of discoloration, which is indeed a quality significant to the human eye. Consequently, a relevant measure of such discoloration in terms of yellowness would have to reflect the absolute extent of yellowness, in order to enable a change in such yellowness to be ascertained. This, in the Board's view, is adequately expressed by the relevant yellowness indices YI_e and YI_o , and the difference in their values, ΔYI .

- 2.3.5 In summary, it is evident that the problem of discoloration (yellowing) of a POM/PU blend as referred to in the patent in suit is of far greater magnitude than that experienced with either of the components POM or PU alone. In other words, the presence of POM and PU together in a blend results in a profound discoloration as a result of thermal degradation.
- 2.3.6 It is the extent of this thermal degradation-induced discoloration which forms the basis of the technical problem addressed by the patent in suit.
- 2.4 Such a problem is nowhere referred to, however, in D3. On the contrary, D3 specifically states that the thermoplastic masses can be shaped under pressure at elevated temperatures of around 180 to 220°C for 1 to 40 minutes (column 4, lines 59 to 64), and does not refer to any concomitant disadvantages. Indeed, it even refers to the stabilising effect of the high molecular PU (column 1, line 31 to column 2, line 22). Consequently, the effect forming the basis of the technical problem referred to in the patent in suit is not derivable directly from the disclosure of D3 alone.
- 2.5 It was, however, in this connection, clear from the submissions of the Appellant at the oral proceedings, that the occurrence of substantial hold-up times in the moulding of such compositions was, although undesirable, nevertheless in practice unavoidable. Consequently, it was conceded, the technical problem addressed by the patent in suit would inevitably become apparent to the skilled person operating according to the teaching of D3, and in particular applying shaping under pressure at elevated temperatures of around 180 to 220°C for 1 to 40 minutes (column 4, lines 59 to 64).

- 2.6 In the light of this consideration, the technical problem arising from D3 may be seen as being the improvement of the resistance to discoloration, in particular yellowing, through thermal degradation, of POM/PU blends with long hold-up times at temperatures in the range 180° to 230°C, without adversely affecting the other important technical properties, such as toughness and impact strength (patent in suit, page 4, lines 10 to 12).
- 2.7 The solution proposed according to Claim 1 of the patent in suit is to add to the blend 0.5 to 1.0 wt% of at least one hindered PCDI having a molecular weight of about 1 000 and containing units of the formula stated in Claim 1.
- 2.8 It can be seen from the large number of examples and comparisons in the patent in suit with a 10-15 minute hold-up at 188°C, that whereas 0.1 wt% of added PCDI gives a significant reduction in discoloration of POM/PU compositions, even increased quantities of conventional polyamide stabiliser and phenolic antioxidant do not show any reduction in discoloration (Examples 1 to 12; Tables I and II). Furthermore, the impact toughness (Izod) is not adversely affected by the addition of PCDI (Example 15).
- 2.9 Additional evidence of the effect that added PCDI has on the discoloration of POM, PU and POM/PU blends is also available from the comparative data supplied by the Appellant and presented in the Table submitted by the Respondent (section 2.3, above). In particular, it is evident from these comparative data, that the addition, to the POM/PU blend, of PCDI at a level of 0.1 or 0.3 wt% results in a reduction in the value of ΔYI , which falls from 43.3 without addition of PCDI through 25.9 (at 0.1 wt% PCDI) to 19.5 (at 0.3 wt%

PCDI) by up to twenty units (Test Nos. 7, 8 and 9). These numbers of units are at least three times greater than the corresponding Δ YI values obtained for the addition of the same quantities of PCDI to the component PU alone (9.1, 7.0 and 5.7; Test Nos. 1, 2, 3, respectively), and at least ten times the values obtained for the component POM alone (1.3, 1.2 and 1.8; Test Nos. 4, 5, 6, respectively). In the latter case, furthermore, the Δ YI contrastingly shows an **increase** (corresponding to a greater degree of yellowing), when PCDI is added at the 0.3 wt% level to the component POM alone (Test Nos. 5, 6).

- 2.10 The criticism of Respondent II, that an effect had not been demonstrated in the patent in suit for processing temperatures in the range of 200 to 230°C (section V(ii), above) is not justified, since the additional comparative data of the Appellant involve processing temperatures of up to 228°C, which is well within the preferred range referred to (section 2.9, above).
- 2.11 The argument of Respondent I, that the Δ YI value is an inappropriate measure, because it is not calculated as a percentage compared with the Δ YI value obtained without addition of PCDI (section V(v), above), is irrelevant to an appreciation of the extent of the problem, because this arises before any PCDI has been added (section 2.3, etc., above).
- 2.12 In this connection, the percentage referred to by the Respondents is derived by always setting the value of Δ YI without added PCDI to 100% (section 2.3, above; Table, last column, Tests 1, 4 and 7, respectively). The effect of this on the results obtained when PCDI is added, therefore, is to factor out of the

calculation the greater extent of the problem experienced with POM/PU blends, which in turn deprives the measure of its relevance to the the technical problem (sections 2.3.5, 2.3.6, above).

2.13 Consequently, the percentage value of ΔYI canvassed by the Respondents is an inappropriate measure.

2.14 In the light of the above, the experimental data provided by the Appellant render it credible that the claimed measures provide an effective solution of the stated problem.

3. *Novelty*

The novelty of the claimed subject-matter was not disputed by the parties. Nor does the Board see any reason of its own to do so. Consequently, the subject-matter claimed in the patent in suit is held to be novel.

4. *Inventive step*

In order to assess the question of inventive step it is necessary to consider whether the skilled person, faced with the stated problem of discoloration (yellowing) under conditions of high temperature and long hold-up times would have expected a significant amelioration to be obtained from the addition of PCDI in the relevant quantities.

4.1 There is no suggestion in D3 itself to do this, because there is no mention of discoloration in any connection, let alone that of high temperature moulding. Nor does D3 refer to the addition of PCDI. On the contrary, only the addition of conventional thermal stabilisers, such as polyamide and phenolic antioxidants is referred to. The addition of such

stabilisers has been shown, however, in the examples of the patent in suit, to be ineffectual in reducing discoloration, even at hold-up times as short as 10 or 15 minutes, compared with the addition of PCDI (patent in suit, Table I, Examples 1 to 4 vs. Examples 5, 6; Table II, Examples 7, 11 vs. Examples 8 to 10 and 12).

In other words, the teaching of D3 does not offer a hint to the solution of the technical problem.

- 4.2 The remaining document cited in the appeal, D1, relates to POM polymer compositions having a high thermal stability and specifically concerns the provision of additional thermal stability.
- 4.2.1 According to D1, high molecular weight POMs which have been stabilised in the end groups may be additionally stabilised with mono- or polycarbodiimides, if desired together with polyamides or polyurethanes and thiuram sulphides. These stabilisers are mixed with high molecular weight acylated or alkylated POMs or their copolymers, and the mixtures thereby obtained are subjected in known manner to thermoplastic deformation at temperatures of 190 to 220°C (page 1, lines 6, 7 and 16 to 21).
- 4.2.2 The technical advance cannot be detected by the usual test methods for thermal stability at temperatures of 180 to 220°C. Under such conditions, carbodiimides not only have no significance in the stabilisation of polymers but they even increase the decomposition of POMs after a certain time, e.g. after 20 minutes heating time (page 1, lines 36 to 40).

- 4.2.3 The method of stabilising high molecular weight POMs by addition of carbodiimides is, however, ensured even after the use of such high temperatures, owing to the fact that such temperatures are rarely and at the most only briefly employed for thermoplastic working up of the material (page 2, lines 3 to 7).
- 4.2.4 The use of mono- or PCDIs together with polyamides or PUs as stabilisers of POM is also very advantageous, since this provides a practically ideal stabilising system. Polyamides or PUs prevent degradation at relatively high working up temperatures, whereas carbodiimides act as age resistors over prolonged periods under the conditions occurring in practice. The stabiliser mixtures thus complement each other in their range of action (page 2, lines 21 to 27).
- 4.2.5 The following may be used as PUs: PUs of hexamethylene diisocyanate and butane-1,4-diol, hexanediol or N-methyldiethanolamine (page 2, lines 37, 38).
- 4.2.6 Particularly advantageous mono- or PCDIs may be prepared from sterically obstructed mono- or polyisocyanates with the aid of heat and catalysts, since they are stable, practically non-volatile and compatible with POMs (page 3, lines 3 to 7). The POMs are mixed with 0.1 to 5 wt%, calculated on the POMs used, preferably 0.4 to 0.8 wt% of carbodiimides (page 4, lines 9 to 15).
- 4.2.7 It is particularly advantageous to use PCDIs of, for instance 1,3,5-triisopropylbenzene-2,4-diisocyanate (page 5, lines 6 to 9; Example 1, mixture 5).

4.2.8 According to Examples 5 to 7, read in conjunction with Example 1, a high molecular weight acetylated POM having an internal viscosity of 0.74 is compressed and granulated at 200°C with 0.5 wt% of one of three different PCDI stabilisers, e.g. carbodiimide (D), which is derived from 1,3,5-triisopropylbenzene-2,4-diisocyanate, and then injection moulded. Whereas the moulded samples showed no discoloration and negligible loss of weight after being aged in a hot air oven at 100°C for 64 days (0.78 % in the case of PCDI (D)), a similar test involving heating the same composition for only 2 h at the higher temperature of 220°C resulted a weight loss of 27% (page 8, lines 9 to 15).

4.3 Thus, whilst D1 mentions PCDIs as thermal stabilisers for temperatures in the lower range of 100° to 140°C (page 2, lines 9 to 20), it makes it equally clear that they have no stabilising effect at the relevant temperatures of 180 to 220°C. On the contrary, they are stated to have the opposite effect after relatively short heating times (sections 4.2.2, 4.2.8, above).

4.3.1 The suggestion of Respondent II, made at a late stage of the proceedings (submission filed on 19 June 1997) and repeated at the oral proceedings, according to which lack of thermal stability on the one hand and discoloration (yellowing) tendency on the other were independent parameters which should be considered separately, contradicted the assumption, which had been accepted throughout the proceedings, and on which the decision under appeal had been based, that the discoloration (yellowing) effect forming the basis of the technical problem was attributable to thermal decomposition processes and indicative, therefore, of a lack of thermal stability.

- 4.3.2 If accepted at face value, i.e. to mean that there is no relationship at all between lack of thermal stability and discoloration (yellowing) tendency, this suggestion would tend to destroy the whole of the Respondent's case based on D1, since the only reason for consulting this document in the first place is that its teaching of improved thermal stability could be of relevance to the stated problem of discoloration.
- 4.3.3 The suggestion in this form was not, however, supported by convincing evidence and is, in any case, contradicted not only by the general knowledge of the skilled person, but also by the disclosure of D1 itself. This uses discoloration as one measure of loss of thermal stability (page 7, Table 5; page 8, Table 6; references to "yellow discoloration").
- 4.3.4 To the extent that the suggestion merely implies that thermal degradation and yellowing tendency are not related in a linear way, it is irrelevant, because it does not put in question the validity of the assumption that the yellowing tendency forming the basis of the technical problem is attributable to thermal decomposition processes associated with high temperature hold-up times.
- 4.3.5 The situation in this connection is considered by the Board to have been adequately set out in the statement of the Appellant at the oral proceedings, which confirmed the generally understood position (section 4.3.3, above) and which was not further challenged (section 2.2, above).

- 4.3.6 In summary, whilst the skilled person would regard the disclosure of D1 of relevance to the stated problem, its teaching concerning the effects of PCDI at the relevant temperatures would constitute a strong disincentive against the utilisation PCDI as a solution to the stated problem.
- 4.4 The argument of Respondent I, that D1 taught that a combination of PCDI with PU as an "ideal stabilising system" fails to take account of the context of this statement. In particular, it ignores the preceding general remark concerning the ineffectiveness of PCDI at temperatures relevant to the technical problem (section 4.2.2, above), and the subsequent explanation that it acts to complement the range of action of the relatively high temperature stabiliser PU (section 4.2.4, above). Thus, when the document is read as a whole, there is no hint PCDI might be an effective solution of the stated problem.
- 4.5 The further argument of Respondent I, that the teaching of D1 alone could not establish a general prejudice against the use of PCDI is irrelevant, because the disincentive arising from the teaching of D1 is quite specific to the context of the stated problem.
- 4.6 The criticism of Respondent II, that this disincentive was the result of a test which was carried out, according to Examples 5 to 7 of D1, at temperatures substantially higher than the hold-up temperatures exemplified in the patent in suit, is not convincing in the light of the comparative tests filed by the Appellant, in which temperatures in excess of those reported in D1 were used, and similar results obtained (section 2.3, etc., above).

4.7 The argument of Respondent I, that D1 disclosed an amount of PU additive falling within the terms of Claim 1 of the patent in suit, is not supported by the disclosure of D1. Whilst the Respondent cited a range of 0.1 to 5 wt% (page 4, lines 9 to 15), this does not refer to PU but to the other additive PCDI. No such range is disclosed in relation to the amount of PU to be added. On the contrary, the greatest amount of PU disclosed as being added in D1 is 3 wt% (Example 4, runs 1 and 3), and according to the relevant Examples 5 to 7 is 0.6 wt%, based on POM.

4.8 The crucial argument of Respondent I, elaborated at the oral proceedings before the Board, that it would in any case have been an obvious measure for the skilled person to increase the amount of PU at least to the same level as the PCDI, so as to obtain, at the level of 5 wt% or above, something falling within the range covered by Claim 1 of the patent in suit, was based on the concept that PU was taught in D1 as a thermal stabiliser for POM and therefore the skilled person would expect, by increasing the relative amount of PU, correspondingly to increase the thermal stability of the mixture.

4.8.1 The argument fails to recognise, however, the fundamental difference in the nature of the compositions according to D1 on the one hand, in which PU is present in small amounts (section 4.7, above) as a thermal stabilising additive to POM, and those according to D3 on the other, in which PU is blended with POM in larger quantities to form an essentially binary mixture, providing special mechanical properties such as impact resistance (section 2.1.5, above). Whilst it might, in the Board's view, be obvious to vary the amount of PU additive within the general teaching of D1, there would be no justification for increasing the amount

of additive to such an extent that the character of the composition was changed completely, so as to have the different properties disclosed in D3. On the contrary, it would be the normal practice to seek a way of reducing the amount of such additive consistent with retaining its effect.

4.8.2 Furthermore, according to the patent in suit, the PU must have soft segments (Claim 1). The PUs disclosed in D1 do not, however, have such segments (sections 4.2.5 to 4.2.7, above). Consequently, even if, in spite of the lack of incentive to do so, the skilled person were for some reason nevertheless to increase the proportion of PU disclosed in D1 to the level claimed in the patent in suit, the result of doing so would still not be something corresponding to the composition according to Claim 1 of the patent in suit.

4.8.3 Finally, the concept, based on the teaching of D1, of increasing the proportion of PU to POM to increase the thermal stability flies in the face of the technical problem itself, since the latter arises when PU is blended with POM in such proportions (section 2.3.6, above).

4.8.3.1 In this connection, the much greater extent of the relevant thermal destabilisation (i.e. that leading to yellowing) only becomes evident once the stated problem has manifested itself (section 2.3.6, above).

4.8.3.2 Thus, the recognition of the technical problem represents an insight into a technical effect, lying closer to the claimed subject-matter than the relevant state of the art D1, yet which directly contradicts the teaching of this art.

- 4.8.3.3 Hence, the concept of Respondent I, based on the teaching of D1, is invalid in the light of the technical problem, and the associated argument, consequently, is unconvincing.
- 4.8.4 In summary, the teaching of D1 cannot assist the skilled person to the solution of the stated problem.
- 4.8.5 Thus, it is superfluous to consider which of the PCDIs disclosed in D1 might have been chosen by the skilled person, since it is evident from the above that he would not have been led to choose any of them.
- 4.8.6 The further argument of Respondent I, that the additional effect of thermal stabilisation could not make a contribution to inventive step, was based on decision T 0192/82 (section V(vi), above). This decision relates, however, only to additives having predictable effects. It is therefore not applicable in the present case.
- 4.8.7 On the contrary, the effect of enhanced relevant thermal stability during long hold-up times at high temperatures due to the presence of PCDI in the claimed compositions is central to the solution of the existing problem of discoloration, yet it is in no way predictable from the state of the art.
- 4.9 In summary, the subject-matter of Claim 1 of the patent in suit (main request) involves an inventive step. The subject-matter of the remaining dependent and independent claims, which all contain limitations corresponding to those in Claim 1, by the same token also involves an inventive step.

4.10 In view of the above, it is not necessary for the Board to consider the auxiliary requests of the Appellant.

Order

For these reasons it is decided that:

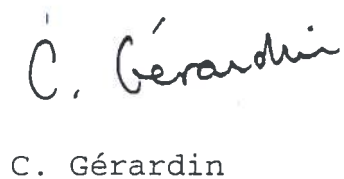
1. The decision under appeal is set aside.
2. The case is remitted to the Opposition Division with the order to maintain the patent as granted.

The Registrar:



E. Görgmaier

The Chairman:



C. Gérardin