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Datasheet for the decision of 13 February 2020

Case Number: T 0020/17 - 3.3.03

Application Number: 08804922.6

Publication Number: 2195374

IPC: C08K3/04, C08K7/00

Language of the proceedings: EN

Title of invention:
HEAT-PROCESSABLE THERMALLY CONDUCTIVE POLYMER COMPOSITION

Patent Proprietor:
DSM IP Assets B.V.

Opponents:
Covestro Deutschland AG
SABIC Global Technologies B.V.
EMS-PATENT AG

Relevant legal provisions:
EPC Art. 56, 114(2)
RPBA Art. 12(4), 13(3)
RPBA 2020 Art. 15(4)-15(6), 25(2), 25(3)

Keyword:
Inventive step - (no) - main request, auxiliary requests 1-4
Auxiliary reuqest filed during oral proceedings - admitted- no - opponents not in position to address issues raised
Admittance of documents by opposition division - discretionary decision - taken according to correct principles

Decisions cited:
T 0640/91, T 0246/91, T 0039/93, T 0386/89

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Case Number: T 0020/17 - 3.3.03

D E C I S I O N
of Technical Board of Appeal 3.3.03
of 13 February 2020

Appellant: (Patent Proprietor)	DSM IP Assets B.V. Het Overloon 1 6411 TE Heerlen (NL)
Representative:	DSM Intellectual Property P.O. Box 4 6100 AA Echt (NL)
Respondent: (Opponent 1)	Covestro Deutschland AG Kaiser-Wilhelm-Allee 60 51373 Leverkussen (DE)
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Respondent: (Opponent 2)	SABIC Global Technologies B.V. Plasticslaan 1 4612 PX Bergen op Zoom (NL)
Respondent: (Opponent 3)	EMS-PATENT AG Via Innovativa 1 7013 Domat / Ems (CH)
Representative:	Pfenning, Meinig & Partner mbB Patent- und Rechtsanwälte Theresienhöhe 11a 80339 München (DE)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 8 November 2016**

revoking European patent No. 2195374 pursuant to Article 101(3)(b) EPC.

Composition of the Board:

Chairman	D. Semino
Members:	M. C. Gordon
	W. Ungler

Summary of Facts and Submissions

I. The appeal lies against the decision of the opposition division posted on 8 November 2016 revoking European patent number 2 195 374.

II. The patent was granted with a set of 14 claims, whereby claims 1 and 2 read as follows:

"1. Process for preparing a heat-processable thermally conductive polymer composition according to claim 6, comprising steps of

- melt mixing of a thermoplastic polymer, a thermally conductive filler and optionally one or more further components, thereby forming a mixed homogenous melt, and
- cooling the mixed homogenous melt thereby obtaining the polymer composition in a solid form,

wherein thermoplastic polymer is selected from polyamides, polyesters, polyarylene sulfides, polyarylene oxides, polysulfones, polyarylates, polyimides, poly(ether ketone)s, polyetherimides, polycarbonates, copolymers of said polymers among each other and/or with other polymers, including thermoplastic elastomers, and mixtures of said polymers and copolymers, and
wherein the thermally conductive filler comprises graphite powder comprising platelets having a thickness of less than 500 nm, and wherein the graphite powder has a BET specific surface area, determined by the method according to ASTM D3037, of at least 10 m^2 /g and a particle size distribution **characterized by** a D(v, 0.9) of at least 50 µm as determined by laser diffraction.

2. Process according to claim 1, wherein the graphite powder in the form of platelets having a thickness of less than 500 nm is present in an amount of 5 to 40 % by weight, relative to the total weight of the polymer composition."

Claims 3-5 were dependent on claim 1.

Claim 6 was an independent claim, directed to a polymer composition and read as follows:

"Heat-processable thermally conductive polymer composition comprising

(a) 30 to 95 % by weight of a thermoplastic polymer selected from polyamides, polyesters, polyarylene sulfides, polyarylene oxides, polysulfones, polyarylates, polyimides, poly(ether ketone)s, polyetherimides, polycarbonates, copolymers of said polymers among each other and/or with other polymers, including thermoplastic elastomers, and mixtures of said polymers and copolymers; and

(b) 5 to 40 % by weight of a graphite powder in the form of platelets having a thickness of less than 500 nm and wherein the graphite powder has a BET specific surface area, determined by the method according to ASTM D3037, of at least 10 m^2 /g and a particle size distribution characterized by a D(v, 0.9) of at least 50 µm as determined by laser diffraction;

wherein the weight percentages are relative to the total weight of the polymer composition."

Claims 7-13 were directed to preferred embodiments of the composition of claim 6.

Claim 14 was directed to the use of a composition as defined in claims 6-13.

III. Three notices of opposition against the patent were filed, invoking the grounds pursuant to Article 100(a) EPC (lack of novelty, lack of inventive step), Article 100(b) EPC and Article 100(c) EPC.

The following documents, *inter alia* were cited in support of the oppositions:

D1: US-A-6 685 855
D2: US 2002/0054995 A1
D3: KR 100705906 B1 (D3a: translation of claims and Table 1; D3b: complete translation)
D4: KR 100705905 B1 (D4a: translation of claims and Table 1; D4b complete translation)
D5: US 2003/0220432 A1
D8: TIMCAL Graphite & Carbon, "TIMREX® Graphite ENSACO™ Carbon Black Carbon additives for polymer compounds", 2004.

During the course of the opposition proceedings the patent proprietor submitted two experimental reports, designated D17 and D20 with letters of 7 January 2016 and 26 August 2016 respectively. Opponent 1 submitted *inter alia* with letter of 26 August 2016 an experimental report designated D21.

IV. The decision was based on amended sets of claims forming a main and four auxiliary requests.

Claim 1 of the main request differed from claim 1 as granted by specifying that the thermally conductive filler "comprises a graphite powder in the form of platelets" according to part of claim 2. Claim 5,

directed to a composition, was unamended compared to the corresponding claim 6 as granted.

The wording of the auxiliary requests underlying the decision is not relevant for the present decision.

D20 was admitted to the procedure. D17 was discussed in the decision together with D20, although no explicit finding with respect to admittance of D17 was given. Document D19 was not admitted to the procedure, as it would only become relevant if D8 were considered to represent the closest prior art, which was not the case.

The main request was found not to meet the requirements of Article 56 EPC. Any of D1, D2 or D5 could be considered as representing the closest prior art. These disclosed thermally conductive plastic compositions comprising one of the polymers as defined in claim 1 and an amount of graphite platelets in the claimed range.

The subject-matter claimed was distinguished from the closest prior art by the properties of the graphite, in particular the defined combination of BET surface area and particle size distribution.

The graphite of D2 satisfied the claimed requirements in respect of BET surface area. The value of particle size distribution - D(v, 0.9) was however not disclosed. Thus the examples in the patent could not be considered as representative of the teaching of D2. Nevertheless it was accepted that the data of the patent showed that the claimed compositions exhibited improved thermal conductivity for a given filler loading. The evidence of the patent indicated in

particular improvements as compared to a graphite TIMREX® KS44 which, as stated in the patent and shown in D8, had a particle size distribution in the required range but a BET specific surface area of 9 m^2/g and hence below that required.

Experimental reports D17 and D20 showed that the claimed graphites did not impair the processability of the compositions. However the patent contained no data which would provide a basis for reformulating the problem on this basis. The graphite used in D17 and D20 - "EcoPhit" - had a particle size far larger than the lower limit of the claim and differed greatly from that of the closest prior art - KS44. Thus the proffered comparison was not a fair one and not suitable to demonstrate any technical effect over the whole scope of the claims.

Although the patent proprietor had argued that improvements in the mechanical properties arose, there was no evidence for any such improvement at the same filler loading.

Thus the objective problem could be formulated only as the provision of thermoplastic compositions of improved thermal conductivity at the same loading of filler.

The problem was solved by the use of a thermally conductive graphite filler as defined in the claims, for example TIMREX® BNB90.

This material was however known as the filler of choice in thermally conductive compositions and was known to be clearly better than the KS grades at a given loading. This was shown by D8 on page 22. This particular filler as well as similar fillers of the

same class had been used as thermally conductive fillers in polypropylene (D8, page 22), ABS (D3, D4) and other polymers. Thus it was obvious to use said class of filler with other types of polymers known in the art, and as taught *inter alia* by D8.

Accordingly an inventive step was denied.

The auxiliary requests, insofar as held admissible, were also held not to meet the requirements of the EPC. The details of these findings are not relevant for the present decision.

Accordingly the patent was revoked.

V. The patent proprietor (appellant) filed an appeal against the decision.

In the statement of grounds of appeal the main request as considered by the opposition division was maintained and a first auxiliary request, in claim 1 of which the thermoplastic polymer was restricted to various polyamides was submitted.

A further experimental report was provided ("Enclosures 5.1-5.3").

VI. The opponents (respondents) replied to the appeal.

Objections to admittance of the auxiliary request and of the newly filed experimental data were raised. It was also disputed that the opposition division had correctly exercised its discretion in admitting D17 and D20 to the procedure.

Objections in respect of lack of sufficiency of disclosure and lack of inventive step were pursued in respect of the main request.

For the auxiliary request objections pursuant to added subject-matter, clarity and inventive step were raised.

VII. The Board issued a summons to oral proceedings and a communication.

VIII. With a letter of 3 December 2019, the appellant filed two "Enclosures" - numbered 3 and 4 each containing a "Declaration" and three further auxiliary requests designated auxiliary requests 1-3 were provided. The main request and the previously filed auxiliary request, which was redesignated auxiliary request 4, were filed again.

Claims 1 and 5 of auxiliary request 1 differed from claims 1 and 5 of the main request by restricting the polymer to polyamides and polycarbonates.

Claims 1 and 5 of auxiliary request 2 differed from auxiliary request 1 by specifying only polyamides.

Claims 1 and 5 of auxiliary request 3 were restricted to the same polyamides as listed in auxiliary request 1 as submitted with the statement of grounds of appeal (now auxiliary request 4) but additionally specified that these were "semicrystalline".

IX. A further document - designated A1 - was submitted by opponent 2 with letter of 18 December 2019.

X. Oral proceedings were held before the Board on 13 February 2020.

In the course of the oral proceedings the appellant submitted a further set of claims as auxiliary request 5 in which claims 1 and 5 restricted the polyamide to a single species, namely PA 4,6. Otherwise the claims were as claim 1 of the main request with consequential deletion of claim 8 (directed to polyamides and hence redundant).

XI. The arguments of the appellant, insofar as relevant for the decision, can be summarised as follows:

(a) Admittance of documents

D17, D20: There was no legal basis for excluding these documents from the procedure. The opposition division had correctly exercised its discretion in admitting said documents.

D19: there was no legal reason for admitting this, consistently with the findings of the decision under appeal.

Enclosures 5.1-5.3 provided with the statement of grounds of appeal: these contained comparative examples and were a reaction to the - unexpected - findings of the opposition division in respect of the non-suitability of the data then on file to support the position on inventive step.

Enclosures 3 and 4: these were relevant to the question of inventive step since unlike other submissions of the appellant, they contained data relating to polycarbonates, and could be seen as a response to D21 of opponent 1 which had been admitted to the proceedings by the opposition division. These declarations filled in gaps in the

data thus far submitted and were necessary to defend the case in particular should D8 be regarded as the closest prior art.

(b) Main request - inventive step - claim 5

D2 did not address the same problem as the patent in suit and hence was not the closest prior art.

The subject-matter as claimed was distinguished from the disclosure of D2 by the nature of the graphite.

The problem with respect to D2 was the provision of thermally conductive polymer compositions with improved thermal conductivity and good - not necessarily improved - processability, as expressed by spiral flow, whilst maintaining the mechanical properties. This was set out in paragraphs [0005], [0036] and [0037] of the patent. The data of Enclosure 5 as well as those of D20 showed that this problem had been solved.

Regarding the admissibility of invoking maintenance of good processability for formulating the technical problem the case law, for example T 39/93, T 246/91 and T 386/89, permitted the problem to be (re)formulated on the basis of any technical effect mentioned in the application. Thus it was permissible to reformulate the problem taking into account maintenance of good processability on the basis of the disclosure of the melt flow.

D2 was silent with respect to this problem since melt flow and thermal conductivity were not

addressed. Hence there would have been no reason to consult the document in view of the problem underlying the patent in suit and, even if the document had nevertheless been considered, no pointers to the claimed subject-matter would be found. In particular the specific combination of properties of the graphite in terms of particle size and BET surface area was not disclosed in or derivable from D2. The same considerations applied to D1 and D5. Taking into account the teachings of D8 would not have led to a different conclusion since D8 was silent with respect to the problem underlying the patent, being restricted to considerations of thermal conductivity. D8 provided no motivation to make the necessary modifications to the compositions of D2 in the expectation of solving the problem underlying the patent in suit. Even if nevertheless the necessary adjustments were to be made to arrive at the subject-matter claimed, D8 provided no indication that these would be expected to lead to the desired outcome for solving the problem. Furthermore D8 showed that the graphites as defined in the operative claims were unsuitable for use in thermoplastic polycarbonates and polyesters and also taught that for thermoplastics small particle sizes were required. The particle size as defined in the claim was higher than the range identified as suitable in D8. Thus D8 taught away from this aspect of the claimed invention.

(c) Auxiliary requests 1 and 2 - inventive step

The subject-matter had been restricted compared to the main request to emphasise the inventive features. The same considerations applied as for

the main request.

(d) Auxiliary requests 3 and 4 - inventive step

These represented further limitations of the main request and were inventive for the same reasons. Auxiliary request 3 contained additional features compared to auxiliary request 4, which had been introduced in order to address a potential objection in respect of added subject-matter in respect of auxiliary request 4.

(e) Auxiliary request 5 - admittance

The appellant found it unforeseeable and surprising that none of the requests, in particular auxiliary request 3, had not been found to meet the requirements of inventive step. The appellant was somewhat uncertain as to the starting point for consideration of inventive step within D2 and the rationale underlying the Board's decision on inventive step.

There would have been no cause to file such a request at an earlier stage of the procedure.

The amendments now offered as auxiliary request 5 were not complicated and were convergent, corresponding to a restriction of a request previously submitted. Accordingly no new issues were introduced and the scope of discussion had not been extended. Nor was there any requirement for investigative effort on the part of the Board or the respondents to deal with this request.

There was no legal ground for the objections of the

respondents to the admittance of the request. PA4,6 was demonstrated in the examples on record. Also none of the documents on file referred to PA4,6 which confirmed that this was non-obvious.

XII. The arguments of the respondents can be summarised as follows:

(a) Admittance of documents

(i) D17, D20: The carbon black employed in these reports was very different to that employed in the examples of the patent. More seriously, it had not been shown that this material had been generally available at the priority date of the patent in suit. Hence the opposition division had incorrectly exercised its discretion in deciding to admit these reports.

(ii) D19: It would be of relevance if starting from D8 as the closest prior art and hence should be admitted.

(iii) Enclosure 5.1 to 5.3, submitted with the statement of grounds of appeal: Two new graphites were employed. It was questionable what additional information was provided by these data compared to that in the patent. At most these data confirmed what was stated in the patent to be known. A different polyamide had been employed compared to that in the examples of the patent leading to the question whether these data were suitable to show a

technical effect and what information was thereby added to the data in the patent.

(iv) Enclosure 3: this related to matters that had been invoked in the notice of opposition, and hence could and should have been submitted at an earlier stage of the procedure, not towards the conclusion of the appeal proceedings. It should therefore be disregarded.

(v) Enclosure 4: In writing the appellant had explicitly stated that admittance of this document was not requested. Accordingly based on the written submissions there had been no reason for the document to be considered further. There was no ground apparent why this situation should be changed at the oral proceedings. In any case there had been no opportunity to verify the statements made in the 2nd Declaration.

In any case both Enclosures 3 and 4 (declarations 1 and 2) were of doubtful relevance.

(b) Main request- inventive step

There was no basis in the patent for invoking processability in the definition of the problem, The application mentioned only the spiral flow measurement and furthermore in a rather vague manner. The measurement conditions needed to be defined. Reformulation of the problem was permitted only to a limited extent, namely that the problem

could be derived from the application as originally filed.

Hence the only effect or property which could be taken into account was thermal conductivity.

D2 was a suitable starting point for the analysis of inventive step in particular because graphite was employed in D2 to provide thermal conductivity to the compositions. Even if D2 emphasised electrical conductivity, it was also required as a matter of course that such compositions exhibited good thermal conductivity. The subject-matter claimed differed from D2 only in the particle size distribution. However there were no examples which demonstrated an effect deriving from this feature. The only difference in the properties of the graphites used in the examples of D17 was the BET surface area. The data of Enclosures 5.1-5.3 differed in three respects from the claimed subject-matter and were also unsuitable to show any effect deriving from the particle size.

It was in any case known from D8 that Timrex® BNB90 graphite resulted in higher thermal conductivity at the same filler loading than for example the KS series graphites. Hence in the search for alternative compositions to those of D2, D8 provided a strong motivation to employ a graphite as claimed. The fact that BNB90 resulted in poorer processability was not of relevance. This was a trade off - a given thermal conductivity could be attained at lower filler loading and the lower processability could be adjusted or compensated for by other means. This was confirmed by D20.

On this basis, an inventive step should not be acknowledged.

(c) The same considerations applied to auxiliary requests 1-4.

(d) Auxiliary request 5 - admittance

The request should not be admitted to the procedure. Nothing new had transpired in the course of the oral proceedings compared to the written proceedings. The conclusions of the Board had been based on the same combination of documents as had been in the proceedings since the outset and on which the decision of the opposition division had been based. Such a claim could have been filed with the statement of grounds of appeal. There was no evidence that there was anything "special" about the now specified polyamide. Furthermore the amendment represented a late change of case. Thus far D2 had been considered to be the closest prior art. The limitation to PA4,6 might have as a consequence that D2 was no longer the closest state of the art. Thus the respondents required the opportunity to analyse the new situation and, if necessary, carry out a further search which was not possible in the time available. The arguments of the appellant itself demonstrated that auxiliary request 5 represented a fresh case.

The request was furthermore not *prima facie* clearly allowable since there was potentially an objection pursuant to Article 123(2) EPC.

XIII. The appellant requested that the decision under appeal be set aside and the patent be maintained on the basis

of the main request, or in the alternative on the basis of one of auxiliary requests 1 to 4 as filed with the letter of 3 December 2019, or on the basis of auxiliary request 5 filed during the oral proceedings of 13 February 2020.

XIV. The respondents requested that the appeal be dismissed.

Reasons for the Decision

1. Admittance of documents

1.1 D17 and D20

These documents had been submitted by the patent proprietor with letters of 7 January 2016 and 26 August 2016 respectively. According to the decision, section 3 of the reasons, D20 was admitted to the proceedings on the grounds that this addressed points raised by the opposition division, and hence was potentially relevant. This assessment of the opposition division demonstrates that the "correct principles" had been applied in deciding upon the admittance of D20 - see T 640/91, Headnote III. This in turn means that there are no grounds or justification for the Board to overturn this discretionary decision of the Opposition Division. Regarding D17, there is no corresponding explicit discussion of its relevance or a decision regarding its admittance either in the minutes or in the grounds for the decision. However as may be derived from page 10 first complete paragraph of the decision in which D17 is discussed together with D20, the same basic considerations had been applied.

Accordingly following the established case law referred to above the Board can identify no reason to exclude D17 and D20 from the procedure.

1.2 Enclosures 5.1-5.3 - provided with the statement of grounds of appeal

These reported further experimental data relating to different graphites two of which were according to the claim and one of which was comparative.

According to the explanations provided these data had been submitted in the light of the conclusion in section 11 of the decision relating to the unsuitability of the data then on file - in the patent itself and that of D17 and D20 - to substantiate an inventive step, in particular with respect to the unsuitability of the graphite employed in D17 and D20 (decision, first complete paragraph on page 10; statement of grounds of appeal, second and third paragraphs in section "Inventive Step"), which objection had not been raised prior to the oral proceedings before the opposition division.

The submission of Enclosures 5.1-5.3 can thus be seen as a direct response to a part of the reasoning of the decision, which reasoning furthermore emerged, or was refined, in the course of the oral proceedings before the opposition division. Accordingly there would have been no reason, cause or indeed opportunity to submit said data any earlier.

Accordingly the Board can identify no grounds to make use of its discretion to hold inadmissible Enclosures 5.1-5.3 under Article 12(4) RPBA 2007 which still

applies according to Article 25(2) RPBA 2020.

1.3 D19

This document was not admitted by the opposition division (decision, page 6, second complete paragraph) because it would only be of relevance if D8 represented the closest prior art which according to the opposition division was not the case. D8 was in effect resubmitted with the rejoinder of respondent-opponent 2 to the appeal (section 1.4), and was stated to relate to general knowledge of polyamides, in particular in the context of engineering applications, i.e. the technical field of the patent. Moreover an attack based on D8 including reasons why this document could indeed represent the closest prior art was submitted.
In view of this, the Board considers the reasons of the opposition division to be moot and can identify no reason to make use of its discretion to hold said document as inadmissible under Article 12(4) RPBA, which still applies according to Article 25(2) RPBA 2020.

1.4 The further documents, the admittance of which is under dispute (Enclosures 3 and 4 submitted by the appellant with letter of 3 December 2019 and document A1 submitted by respondent-opponent 2 with letter of 18 December 2019) were provided in respect of the consideration of inventive step based on D8 as the closest prior art. However as will emerge from the following, this matter is not of relevance to the decision.

At the oral proceedings the appellant submitted that said enclosures were also relevant for the attack on inventive step based on D2. As noted by the respondents

this was a new approach for which it was not possible to carry out adequate considerations or prepare an adequate response in the time available.

Insofar as these enclosures were cited in connection with an attack on inventive step based on D8 as closest prior art, there is no need for the Board to take a decision on admittance of these further documents.

Insofar as these documents were to be considered in association with the consideration of inventive step based on D2, this represented a - very late - modification of the case. Moreover there was no justification for such a modification, as the attack was central in the decision and had not changed in appeal. Accordingly the Board decided these were not to be admitted (Article 13(3) RPBA 2007 which according to Article 25(3) RPBA 2020 applies).

2. Main request- inventive step

Claim 1 of the main request is directed to a process for preparing a heat-processable thermally conductive polymer composition whilst claim 5 is directed to the composition itself.

In their submissions on inventive step the parties addressed principally the subject-matter of claim 5. The Board will do likewise.

2.1 Closest prior art

The patent in suit is directed to the provision of heat-processable thermally conductive polymer compositions (title, paragraph [0001]). It is explained in paragraph [0003] that in art-known compositions a

relatively high content of filler is required - generally more than 50 weight % - which in turn results in poor mechanical properties and/or poor mouldability. According to paragraph [0005] an object of the invention was to provide heat-processable thermally conductive compositions which, compared to prior art known compositions, should exhibit relatively high thermal conductivity at relatively low filler content, which in turn resulted in good mechanical properties. Processability is not mentioned in this section of the patent as part of the problem to be solved.

Two documents have been proposed as representing the closest prior art, D2 (alternatively, with similar reasoning, D1 and D5) and D8.

2.1.1 D1, D2 and D5, which have broadly the same teaching as each other, were treated on equal footing.

During the appeal proceedings the focus was placed on D2. The Board has no reason to take a different approach.

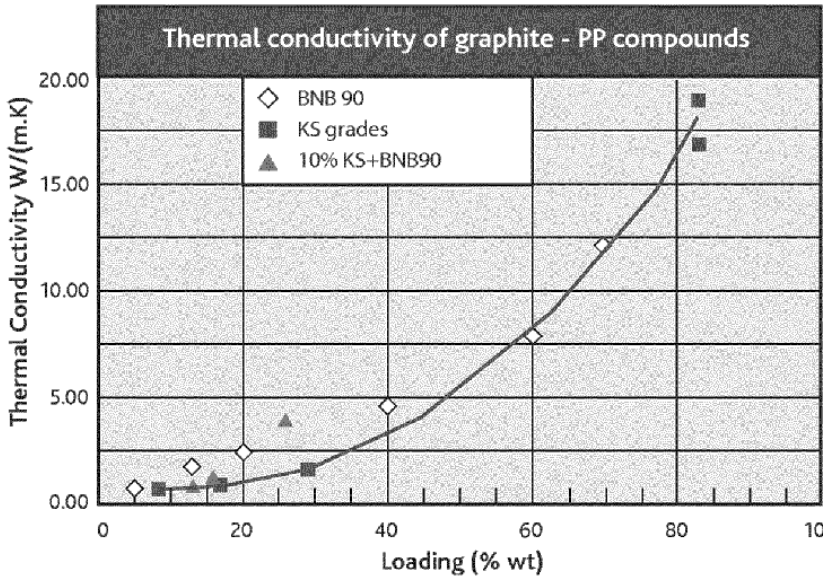
D2 relates to graphite platelet nanostructures, and in paragraphs [0011]-[0013] discusses the use of these compositions in filled polymers to provide them with thermal and electrical conductivity. Although the document emphasises electrical conductivity, in paragraph [0013] it is taught that graphite can imbue compositions with thermal conductivity. The extent of improvement in these conductivity properties is stated to be limited by the size and morphological properties of the graphite. In this connection it is further taught that the amount of graphite to be incorporated is set by the influence thereof on physical properties.

The appellant disputed that D2 would relate to the same problem as addressed in the patent in suit and hence that it was not suitable to form the closest state of the art.

This position is not tenable in the light of the information provided in the aforementioned paragraph [0013] of D2, in particular when the further teachings of paragraphs [0017] and [0019]-[0020] that the problem addressed by D2 is to provide graphites which can be added to polymers to enhance - among others - the mechanical properties is taken into consideration.

This is the same general problem as addressed by the patent in suit, whereby that property emphasised in the patent - thermal conductivity - is also explicitly addressed in D2. Accordingly the Board is satisfied that D2 can be considered as representing the closest state of the art

2.1.2 D8 is a product brochure relating to various carbon and graphite products. Page 22 discusses the application of the materials as components of thermally conductive polymer compositions. The page contains a graph showing the thermal conductivity of graphite/polypropylene compounds as a function of the loading of graphite:



One of the graphites demonstrated is Timrex® BNB90 (open diamond on the chart), which is a graphite falling within the scope of the claims, as is seen from paragraph [0046] of the patent in suit and is used in the examples of the patent.

2.1.3 Both of these sets of documents, i.e. D2 (D1, D5) and D8 relate to the same technical field and problem within that field, namely the provision of thermally conductive filled polymer compositions based on a polymer and a filler such as graphite.

Under these circumstances where a plurality of documents are shown to be equally valid for consideration as the closest state of the art, it is necessary that an inventive step be shown starting from each. A conclusion that based on one of these documents no inventive step can be recognised is sufficient to conclude that the requirements of Article 56 EPC are not met independently of the conclusions that might be reached starting from another document.

2.2 Analysis of inventive step based on D2.

2.2.1 Distinguishing feature

The graphites according to D2 are defined in terms of their aspect ratio, footprint, specific surface area, and thickness (claims 1-4). Particle size distribution is defined in paragraph [0150] in the context of the example.

Considering the properties common to those graphites disclosed in D2 and those specified in the claim the following is of significance:

Operative claim 5 requires that the graphite has a thickness of less than 500 nm. D2 in claim 4 specifies a thickness of less than 100nm. Accordingly the thickness does not represent a distinguishing feature.

Claim 5 requires that the BET specific surface area is as at least $10m^2/g$, whereas D2 requires in claim 3 a specific surface area at least 5 m^2/g. Thus the graphites as defined in the claim have a surface area which is restricted compared to that of D2 by being higher.

Claim 5 requires a particle size distribution of D(v, 0.9) at least 50µm. The particle size distribution is not defined in the claims of D2. However in the example of D2 (paragraphs [0149] and [0150]) a graphite having a D_{50} of 18µm and D_{100} of 67µm is employed.

Accordingly the particle size of the graphite according to the claim is restricted to higher values than that disclosed in of D2.

In the example of D2 a composition based on nylon 6 at 20% loading by weight is prepared. Accordingly the nature of the polymer and the weight proportions do not represent distinguishing features.

Therefore the composition of operative claim 5 differs from the disclosure of document D2, in particular its example in which nylon 6 is used, in the nature of the graphite, in particular its particle size distribution as expressed by D(v, 0.9) and its surface area.

2.2.2 Technical effect

The examples of the patent employ a graphite - Timrex® BNB90 having BET surface area of 28.4 m^2/g, and D(v, 0.9) of 85.2µm (paragraph [0046]), as representing the subject-matter claimed.

In D17 and D20 examples and comparative examples were provided using the following graphites, as set out in Table 1 of D17:

Graphite	d(v, 0,9) measured by laser diffraction	BET Specific surface Area (m^2/g)	Thickness of less than 500 nm
SGF150	204.4 µm	1.4	no
KS44	53.3 µm	8.8	no
BNB	141.2 µm	20.5	yes
EcoPhit	4216.7 µm	17.4	yes

whereby the first two are comparative and the third and fourth entries - non-specified graphites of the "BNB" and "EcoPhit" series respectively - are indicated by means of the stated properties and the statement in D17 (line below the table) as being according to the claims.

In report D20 results of a series of tests incorporating three of these graphites - with the exception of the BNB grade - in a PA4,6/PA6 1:1 blend

were reported:

	Polymer (amount in wt %)	Graphite (amount in wt %)	Processability - spiral flow length (mm) at particular pressure (bar)		Thermoconductivity (W/mK)	
			800	900	Through plane	In plane
EX VIII	PA46/PA6 1:1 90%	EcoPhit 10%	129	137	0.78	1.33
EX IX	PA46/PA6 1:1 80%	EcoPhit 20%	118	128	1.49	4.90
EX X	PA46/PA6 1:1 70%	EcoPhit 30%	112	120	1.89	11.90
CE VII	PA46/PA6 1:1 90%	SFG150 10%	124	135	0.51	0.91
CE VIII	PA46/PA6 1:1 80%	SFG150 20%	113	123	0.77	2.29
CE IX	PA46/PA6 1:1 70%	SFG150 30%	113	122	1.01	5.04
CE X	PA46/PA6 1:1 90%	KS44 10%	125	130	0.43	0.72
CE XI	PA46/PA6 1:1 80%	KS44 20%	106	112	0.68	1.44
CE XII	PA46/PA6 1:1 70%	KS44 30%	88	94	0.98	2.77

Nm=not measured

Together with the statement of grounds of appeal further data were provided (Enclosures 5.1-5.3) whereby the graphites employed were the following:

Graphite	d(v, 0,9) measured by laser diffraction	BET Specific surface Area (m^2/g)	Thickness of less than 500 nm
Sigatherm GFG75	>75 µm	25	yes
CTherm002	81 µm	25	yes
KS44	45.4 µm	9	no

the first two named being according to the claims, the final one - KS44 as above, being comparative.

These graphites were used in the same polyamide composition as in D20 and gave the following results:

	Polymer (amount in wt %)	Graphite (amount in wt %)	Processability - spiral flow length (mm) at 1000 bar	Relative processability in % with respect to unfilled PA46/PA6 1:1	Thermoconductivity (W/mK)		Mechanical Properties	
					Through plane	In plane	Tensile Strength (MPa)	E.a.b. (%)
EX A	PA46/PA6 1:1 90%	GFG75 10%	107.8	65.3	0.83	1.29	59	3.5
EX B	PA46/PA6 1:1 80%	GFG75 20%	105.4	63.9	1. 15	6.25	58	1.8
EX C	PA46/PA6 1:1 70%	GFG75 30%	87.6	53.1	1.31	13.59	58	1.0
EX D	PA46/PA6 1:1 90%	Ctherm002 10%	107.9	65.4	0.90	1.64	59	3.1
EX E	PA46/PA6 1:1 80%	Ctherm002 20%	88.0	53.3	1.27	7.05	61	1.7
EX F	PA46/PA6 1:1 70%	Ctherm002 30%	81.1	49.2	1.45	13.95	64	1.0
CE A	PA46/PA6 1:1 90%	KS44 10%	133.0	80.6	0.42	0.67	77	5.0
CE B	PA46/PA6 1:1 80%	KS44 20%	117.6	71.3	0.67	1.42	72	4.1
CE C	PA46/PA6 1:1 70%	KS44 30%	91.1	55.2	0.97	3.12	73	2.5
CE D UF Reference	PA46/PA6 1:1 100%	No graphite	165.0	100	0.2	0.2	100	40

These data show the following:

In those compositions containing a graphite according to the claims the thermal conductivity is, for a given loading of graphite, consistently higher both in- and through plane than for those compositions containing "comparative" graphites.

Furthermore spiral flow - a measure of processability - is about the same across the inventive and comparative examples.

The data of enclosure 5 show similar results as far as thermal conductivity is concerned. With regard to spiral flow, these data show a worsening in the case of the "inventive" compositions. It is also seen that the mechanical properties of the comparative examples are superior to the corresponding "inventive" examples.

This is seen by comparison of D20, examples EX VIII/CE VII/CE X; EX IX/CEVIII/CEXI; EX X/CEIX/CE XII and of Enclosures 5.1-5.3 EX A/EX D/CE A; EX B/EX E/CE B; EX

C/EX F/CE C.

Whilst the data do not provide a direct comparison with the closest prior art, it can be accepted that they consistently show an improvement in thermal conductivity when using graphite as defined in claim 5. As far as processability and mechanical properties are concerned, they are worsened and only occasionally maintained.

2.2.3 Objective technical problem

Based on these data the technical problem, in line with what is stated in the title and paragraph [0005] of the patent in suit, has to be formulated as the provision of compositions with improved thermal conductivity. This is consistent with the statements in the patent, paragraphs [0001]-[0005], which emphasise the provision of compositions with high thermal conductivity at low filler loadings as the problem to be solved.

Regarding the aspect of processability and mechanical properties it was submitted by the appellant that it was part of the problem to be solved that these should remain "reasonable" and that in particular there should be no worsening thereof with respect to the prior art compositions (see section XI.(b)).

This problem formulation relied however on placing some arbitrary (lower) limitation on these properties. There is however no basis in the patent for imposing, in general any such arbitrary limitation on (the change in) these properties.

Furthermore it is observed that, compared to those compositions representing the prior art, these

properties are worsened in the claimed compositions. Thus there is also no implicit basis provided by the data for invoking - to any extent - maintenance of said properties as an aspect of the problem(s) to be solved by the subject-matter of the patent in suit, let alone imposing some arbitrary quantitive limit thereon.

Consequently these aspects cannot be taken into account in formulating the technical problem to be solved and it is not necessary for the Board to take position on the case law cited by the appellant concerning admissibility of a reformulation of the technical problem (T 39/93, T 246/91 and T 386/89).

Accordingly the only problem which can be considered for assessment of inventive step is the provision of compositions having improved thermal conductivity.

2.2.4 Obviousness

D8 is an information brochure relating, among others, to different forms of graphite of the Timrex® series.

Among those listed are BNB90, i.e. the "inventive" graphite used in the examples of the patent, KS44 and SFG150, both of which are comparative graphites (Table on page 8).

According to the table on page 9 of D8, BNB90 exhibits superior thermal conductivity to the KS and SFG grades. Processability is lower. On page 18, right hand column it is stated that graphites can impart high thermal conductivity to polymers. It is also indicated that polyamides are one of the polymers in which graphite may be incorporated. On page 22 is the graph depicted in section 2.1.2, above showing thermal conductivity of

polypropylene containing various graphites. From this it can be derived that - in general - for a given graphite loading the BNB90 grade provides higher thermal conductivity than does the KS grade.

In the light of the teaching of D8 it would therefore be a matter of obviousness that in order to improve the thermal conductivity of filled polymer compositions a graphite having in general the properties according to the claim, in particular Timrex® BNB90 having a surface area according to claim 5 and a higher particle size than that of the graphites of D2 would have to be employed.

The fact that other properties might be worsened and that other graphites could be appropriate for specific uses in which these properties are relevant would not discourage the skilled person from using graphites according to the claim when aiming at obtaining compositions with improved thermal conductivity.

Accordingly no inventive step can be acknowledged for the subject-matter of claim 5 of the main request.

3. Auxiliary requests 1-4

Auxiliary request 1 restricts the polymer to polyamide or polycarbonate and auxiliary request 2 restricts this further to polyamides. Auxiliary requests 3 and 4 restrict to specific polyamides, including Nylon 6, which in auxiliary request 3 are additionally defined as "semicrystalline".

However none of these requests introduces further distinguishing features compared to the main request, nor were separate arguments presented by the appellant

to show that a different line of reasoning would apply.

The conclusion is that the same assessment applies as for the main request with the consequence that no inventive step for the auxiliary requests 1-4 can be recognised.

4. Auxiliary request 5 - Admittance

4.1 This request was submitted during the oral proceedings following discussion of the higher ranked requests.

4.2 The appellant stated that they were at something of a loss to understand the rationale for the findings of the Board in respect of inventive step.

In this respect the Board notes the following:
Firstly, the findings of the Board were the result of detailed and extensive discussions both in writing and in the oral proceedings. The Board ensured that all points raised were summarised for the parties so that - as necessary - the opportunity was given for supplementary or corrective comments to be advanced. Under these circumstances the Board does not find it credible - as implied - that the considerations on which the Board based its conclusions were in some way opaque, obscure or unknown to the parties.

In this connection it is recalled that it is not required or foreseen that detailed reasoning be given orally. This is the purpose of the written reasons of the decision. In this respect reference can be made to the provisions of Article 15(4)-(6) RPBA 2020.

4.3 Claim 1 is restricted to a specific polyamide.

This polyamide, although encompassed by the claims, had never been given prominence and no discussion specifically with respect thereto had taken place.

4.4 The respondents indicated that they were unable to deal with this request in the context of the oral proceedings in particular since the existing citations would have to be reappraised and it might be necessary to provide further evidence to defend their case, which the Board finds to be a reasonable position.

4.5 Accordingly the provisions of Article 13(3) RPBA 2007, which is the applicable law in this case, (see Article 25(3) RPBA 2020) apply, with the consequence that the amendment to the case consisting of auxiliary request 5 cannot be admitted to the proceedings.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

B. ter Heijden D. Semino

Decision electronically authenticated