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**Datasheet for the decision
of 2 April 2019**

Case Number: T 0573/17 - 3.3.09

Application Number: 11186751.1

Publication Number: 2455419

IPC: C08J5/24, C08K7/06, C08L101/00

Language of the proceedings: EN

Title of invention:
Prepreg and carbon fiber-reinforced composite material

Patent Proprietor:
Toray Industries, Inc.

Opponent:
Teijin Carbon Europe GmbH

Headword:

Relevant legal provisions:
EPC Art. 100(c)

Keyword:
Added subject-matter (yes) ; all requests

Decisions cited:

Catchword:



Beschwerdekammern

Boards of Appeal

Chambres de recours

Boards of Appeal of the
European Patent Office
Richard-Reitzner-Allee 8
85540 Haar
GERMANY
Tel. +49 (0)89 2399-0
Fax +49 (0)89 2399-4465

Case Number: T 0573/17 - 3.3.09

D E C I S I O N
of Technical Board of Appeal 3.3.09
of 2 April 2019

Appellant: Teijin Carbon Europe GmbH
(Opponent) Kasinostr. 19-21
42103 Wuppertal (DE)

Representative: Henkel, Breuer & Partner
Patentanwälte
Brienner Strasse 1
80333 München (DE)

Respondent: Toray Industries, Inc.
(Patent Proprietor) 1-1, Nihonbashi-Muromachi 2-chome
Chuo-ku
Tokyo 103-8666 (JP)

Representative: Mewburn Ellis LLP
City Tower
40 Basinghall Street
London EC2V 5DE (GB)

Decision under appeal: **Interlocutory decision of the Opposition
Division of the European Patent Office posted on
8 December 2016 concerning the maintenance of
European patent No. 2455419 in amended form.**

Composition of the Board:

Chairman W. Sieber
Members: N. Perakis
E. Kossonakou

Summary of Facts and Submissions

- I. This decision concerns the appeal filed by the opponent against the opposition division's interlocutory decision that European patent No. 2 455 419 as amended meets the requirements of the EPC. The European patent was granted for a divisional application of earlier European patent application No. 07792059.3.
- II. In the notice of opposition the opponent requested the revocation of the patent in its entirety on the grounds of Articles 100(a) (lack of novelty and lack of inventive step), 100(b) and 100(c) EPC.

The documents cited in opposition included:

D6 : JP 2005 105152 A (English translation);

D36: "Curing Agents for Epoxy Resin", Three Bond
Technical News, 32, 20 December 1990, pp 1-10;
and

D37: Mitsubishi Chemical Corporation, Curing Agent/
Chemical Property.

The opposition division decided that:

- the main request (claims as granted) was not allowable because the subject-matter of claim 1 lacked novelty over D6.
- the first auxiliary request was not allowable because the subject-matter of claim 1 was unclear.
- auxiliary request 2 was allowable. In particular, the subject-matter of claim 1 did not extend beyond the content of the earlier application as filed and

the divisional application as filed, was novel over the cited prior art and involved an inventive step.

Claim 1 of the second auxiliary request reads as follows:

"1. A prepreg containing a carbon fiber [A], a thermosetting resin [B], a thermoplastic resin particle of fiber [C] and a conductive particle or fiber [D], wherein the weight ratio expressed by [content of [C] (parts by weight)]/[content of [D] (parts by weight)] is 1 to 1000, and the prepreg, when formed as a laminate by laying-up the prepregs to locate the thermoplastic resin particle or fiber [C] and a conductive particle or fiber [D] between two carbon fiber layers constituted with the carbon fiber [A] and the thermosetting resin [B], has conductivity in thickness direction determined according to the following steps:

24 plies of unidirectional prepregs are laid-up quasi-isotropically in $[+45^{\circ}/0^{\circ}/-45^{\circ}/90^{\circ}]_3s$ constitution and molded in an autoclave at a temperature of 180°C for 2 hours under a pressure of 0.59 MPa and at a heating speed of $1.5^{\circ}\text{C}/\text{min}$ prior to the 2 hour cure; to prepare 25 pieces of laminate from each of these laminates, a sample of length 50mm x width 50mm is cut out and coated on both sides with a conductive paste; and resistivity in the laminate direction is measured by the four probe method, wherein 90 to 100wt% of each of the thermoplastic resin particle or fiber [C] and the conductive particle or fiber [D] is localized in a 20% depth range from both surfaces of the prepreg in the thickness direction."

III. This decision was appealed by the opponent (in the following: the appellant), who requested that the opposition division's decision be set aside and that the patent be revoked in its entirety. With the statement setting out the grounds of appeal the appellant submitted the following documents:

D47: EP 1 018 507 A1;

D48-1: Microscopic photos, 2 pages;

D48-2: Experiment Certificate, Toho Tenax Co. Ltd.,
Technical Development Group, Kazuma Kurokawa;
3 April 2017;

D49-1: Handbook (in Japanese), "Powder, Theory and
Application", K. Kubo *et al.*, Maruzen Co. Ltd.,
1962, pp 75-78;

D49-2: English translation of D49-1;

D50: Handbook of Epoxy Resins, H. Lee *et al.*,
McGraw-Hill Inc., 1967, pp 5-1 to 5-29.

D51: Report DOT/FAA/CT-89/22, Aircraft Lightning
Protection Handbook, US Department of
Transportation, Federal Aviation Administration,
1989, pp 149-156.

IV. In a letter dated 12 September 2017, the patent proprietor (in the following: the respondent) requested that the appeal be dismissed (main request) and filed auxiliary requests 1 to 7 and the following document:

D52: Technical report regarding PKHP-200, signed by
H. Kishi and dated 10 December 2018.

The claims of the **main request** are the claims considered allowable by the opposition division. For claim 1 of this request see point II above.

Claim 1 of **auxiliary request 1** corresponds to claim 1 of the main request with the following feature added at the end:

"wherein a total weight of the thermoplastic resin particle or fiber [C] and the conductive particle or fiber [D] is 1 to 20wt% with respect to the prepreg".

Claim 1 of **auxiliary request 2** corresponds to claim 1 of the main request with the weight ratio expressed by [content of [C] (parts by weight)]/[content of [D] (parts by weight)] limited to "1 to 500".

Claim 1 of **auxiliary request 3** corresponds to claim 1 of the main request with the following feature added at the end:

"wherein each of the thermoplastic resin particle or fiber [C] and the conductive particle or fiber [D] has an average diameter of 1 to 150 μm ".

Claim 1 of **auxiliary request 4** corresponds to claim 1 of the main request with the following feature added at the end:

"wherein the thermoplastic resin particle or fiber [C] is polyamide".

Claim 1 of **auxiliary request 5** corresponds to claim 1 of the main request with the following features added at the end:

"wherein each of the thermoplastic resin particle or fiber [C] and the conductive particle or fiber [D] has an average diameter of 1 to 150 μm "

and

"wherein a total weight of the thermoplastic resin particle or fiber [C] and the conductive particle or fiber [D] is 1 to 20wt% with respect to the prepreg".

Claim 1 of **auxiliary request 6** concerns the use of the prepreg of claim 1 of the main request in a carbon fiber reinforced composite material in an aircraft structural member.

Claim 1 of **auxiliary request 7** corresponds to claim 1 of the main request with the following feature added at the end:

"wherein the conductive particle or fiber [D] has a volume resistivity of 10 to 10^{-9} Ωcm ".

V. With letter dated 7 January 2019, the respondent submitted the following documents in support of its arguments:

D53: First declaration of professor H. Kishi, dated 10 December 2018; and

D54: Second declaration of professor H. Kishi, dated 25 December 2018.

VI. With letter dated 25 January 2019, the appellant submitted additional arguments concerning the main request, raised objections to the patentability of the auxiliary requests and filed the following document:

D55: "Electrical resistivity and conductivity",
Wikipedia, fourteen pages, last edited on
29 December 2018.

- VII. On 11 March 2019 the board issued a communication in preparation for the oral proceedings.
- VIII. The oral proceedings were held before the board on 2 April 2019 as scheduled.
- IX. The relevant arguments put forward by the appellant in its written submissions and during the oral proceedings may be summarised as follows:

Main request

The subject-matter of claim 1 of the main request extended beyond the content of the earlier/divisional application as filed for the following reasons.

- The wording of claim 1 in respect of the method for determining the conductivity in the thickness direction differed from that disclosed on page 47, lines 1-10 of the application as filed.
- This method was disclosed in the application as filed only in the context of the exemplified prepregs, i.e unidirectional prepregs containing as thermosetting resin an epoxy resin composition which was moulded and cured at a temperature of 180°C, specific thermoplastic particle or fiber [C] and specific conductive particle or fiber [D]. It was clear from D36 and D37, for example, that not every thermosetting resin could be moulded and cured at the cited temperature.

- Contrary to the description of the earlier application as filed, claim 1 neither specified the apparatus used to carry out the four probe method nor the conductive paste used in the method for determining the conductivity.

Auxiliary requests 1-7

- The subject-matter of claim 1 of the auxiliary requests also extended beyond the content of the earlier application as filed for the reasons provided in the context of the main request. Although each claim 1 of the auxiliary requests contained further limitations, none of them concerned the definition of the thermosetting resin.

X. The relevant arguments put forward by the respondent in its written submissions and during the oral proceedings may be summarised as follows:

Main request

- The subject-matter of claim 1 was disclosed in the application as filed. In particular, the method for determining the conductivity in the thickness direction was disclosed on page 47, lines 1-10 of the earlier application as filed.
- Despite the language imperfections in claim 1 when defining the method for determining the conductivity in the thickness direction, there was no real deviation from the wording used in the description of the earlier application as filed; furthermore the skilled person would have no difficulty in understanding its meaning.

- Although the method for determining the conductivity in the thickness direction was disclosed in the part of the description concerning the examples, the method was generally applicable and not limited to the exemplified prepregs.
- The skilled person would not consider thermosetting resins, which were not appropriate for carrying out the method for determining conductivity in the thickness direction, as being part of the claimed subject-matter.
- The absence of the specific type of apparatus used to carry out the four probe method or of the specific type of conductive paste was irrelevant. It was sufficient that claim 1 contained the feature that conductivity in the thickness direction was measured by the four probe method and that a conductive paste was used.

Auxiliary requests 1-7

- The auxiliary requests contained limitations which moved in the direction of the examples.
- XI. The appellant requested that the decision under appeal be set aside and that European patent No. 2455419 be revoked. Furthermore, it requested that D47, D48-1, D48-2, D49-1, D49-2, D50, D51 and D55 be admitted into the proceedings, while D52 to D54 should not be considered.
- XII. The respondent requested that the appeal be dismissed (main request) or that the patent be maintained on the basis of one of auxiliary requests 1 to 7, submitted

with the letter dated 12 September 2017. Furthermore, it requested that D52 to D54 be admitted into the proceedings, while D47, D48-1, D48-2, D49-1, D49-2, D50, D51 and D55 should not be admitted. Finally, it requested that the case be remitted to the opposition division in case any one of those documents were admitted into the proceedings and an adverse decision on patentability were to be reached on the basis of such a document.

Reasons for the Decision

1. Main request

1.1 In the appeal proceedings, the appellant maintained its objection that the subject-matter of claim 1 of the main request, i.e. the request upheld by the opposition division, extended beyond the content of the earlier application as filed and the divisional application as filed (Article 100(c) EPC).

Since the description of the earlier application and that of the divisional application are the same, the board will refer only to the description of the earlier application as filed.

1.2 As set out in the decision under appeal (point 15.2), the features of claim 1 of the main request as such are disclosed in claims 1, 2 and 10 and on page 26, lines 19-30 and page 47, lines 1-10 of the earlier application as filed.

1.3 However, the appellant contested the combination of the method for determining the conductivity in the thickness direction with the other features of claim 1.

Thus, it will have to be assessed whether the disclosure on page 47, lines 1-10 of the earlier application as filed could be considered as disclosing a **general** method for determining the conductivity of a prepreg in the thickness direction, i.e. a method which applies to all prepregs, not only to unidirectional ones, which contain any carbon fiber [A], any thermosetting resin [B], any thermoplastic particle or fiber [C] and any conductive particle or fiber [D] and not only those of the exemplified prepregs.

1.3.1 It is not disputed that the passage on page 47, lines 1-10 is part of the description of the working examples of the earlier application as filed which extends from page 36, line 8 to page 57, line 22. It is also not disputed that in all the examples specific unidirectional prepregs were applied, which included a specific epoxy resin as thermosetting resin [B], namely a mixture of a bisphenol A type epoxy resin, tetraglycidyl-diaminodiphenylmethane, a specific polyethersulfone and 4,4'-diaminodiphenyl sulfone (page 36, lines 19-26; tables 1-5). Moreover, in all the prepregs polyamide particles or fibers, respectively, were used as particles/fibers [C] (page 36, line 27 to page 37, line 15; tables 1-5).

1.3.2 The measurement method disclosed on page 47, lines 1-10 requires a curing step at a curing temperature of 180°C for 2 hours under a pressure of 0.59 MPa. The appellant pointed out that, while the disclosed curing conditions are suitable for the specific epoxy thermosetting resins of the examples, the same curing conditions are not appropriate for other thermosetting resins.

D36 and D37 corroborate the appellant's argument.

Reference can be made to the following passages in D36:

"The curing temperature significantly influences the curing speed, heat generation and the properties of the cured resin." (page 5)

and

"Aliphatic amine (Three Bond 2103) is [a] curing agent for epoxy resin an[d] able to cure at room temperature. The cured resin has excellent properties, and its heat resistance is 100°C. Aromatic amine has been developed to achieve greater heat resistance and chemical resistance than those of aliphatic amine." (page 2)

Consequently, there are epoxy thermosetting resins which have a heat resistance which is significantly lower than the curing temperature of 180°C used in the measuring method disclosed in the earlier application as filed. This also follows from table 1 on page 3 of D36, in which several amine-based curing agents are mentioned with curing temperatures far below 180°C (aliphatic polyamines with curing temperatures ranging from normal temperature to 150°C and aromatic amines with curing temperatures from 80-150°C), and with a heat deformation temperature (which is a dimension dependent on the heat stability) of far below 180°C (for aliphatic polyamines ranging between 47-150°C).

The same conclusions can be drawn from tables 5, 8 and 10 of D37, which disclose curing temperatures of the curing agents for epoxy resins of 0°C, 23°C, 100°C and 175°C.

- 1.3.3 It is therefore clear to the skilled person that the method for determining the conductivity of a prepreg in the thickness direction disclosed on page 47,

lines 1-10 of the earlier application is a method specifically devised for determining the conductivity of the prepregs of the working examples with a specific thermosetting resin, but not for determining the conductivity of a prepreg with other thermosetting resins and in particular not for prepregs including thermosetting resins which are not stable at 180°C under a pressure of 0.59 MPa.

1.3.4 Thus, the subject-matter of claim 1 of the main request, which is not restricted at all to specific thermosetting epoxy resins, but refers to the presence of a thermosetting resin [B] in general, and includes resins for which this measurement method is not applicable, extends beyond the content of the earlier application as filed.

1.4 The respondent pointed out that the description of the earlier application as filed disclosed in the part relating to the examples the following six protocols used to determine various parameters:

- (1) Determination of average diameter of particles [C] and [D];
- (2) Determination of average fiber diameter of the fiber of [C] and [D];
- (3) Containing ratio of the particle or fiber of [C] and [D] present in depth range 20% of prepreg thickness;
- (4) Determination of volume resistivity of conductive particle or fiber;
- (5) Determination of compressive strength after impact of fiber reinforced composite material; and
- (6) Determination of conductivity of fiber reinforced composite material.

According to the respondent, these protocols had a general application and were not limited to the exemplified prepregs, although they were included in the part concerning the examples.

The board concedes that protocols (1) to (5) may be generally applicable. However, for the reasons provided above, protocol (6) cannot be considered to have an application extending beyond that of the exemplified prepregs. Thus, this argument must fail.

- 1.5 The board can also not accept the respondent's argument that the method in claim 1 would implicitly limit the thermosetting resin, because the skilled person would only consider those thermosetting resins which could be used in the method cited in claim 1. There is no disclosure whatsoever in the earlier application as filed that the method for determining the conductivity of the prepregs in the thickness direction is intended to be an implicit limitation for the thermosetting resin [B]. On the contrary, this would be in contrast to the teaching of the earlier application as filed. Thus, it is explicitly stated on page 7, lines 7 to 9:

"The thermosetting resin [B] used in the present invention is not especially limited, as far as it is a resin capable of forming a three-dimensional cross-linked structure at least partially by progressing a cross-linking reaction by heat".

- 1.6 Thus, for the above reason alone, the subject-matter of claim 1 extends beyond the content of the earlier application as filed and the divisional application as filed, so that the main request is not allowable. In these circumstances the board sees no reason to

elaborate on the respondent's other objections relating to added subject-matter.

2. Auxiliary requests 1 to 7

2.1 The subject-matter of claim 1 of auxiliary requests 1 to 5 and 7 compared with that of claim 1 of the main request contains additional features concerning:

- the amount of particles or fibers [C] and [D] in the prepreg (auxiliary request 1);
- the ratio of particles or fibers [C]/[D] in the prepreg (auxiliary request 2);
- the average diameter of the particles or fibers [C] and [D] (auxiliary request 3);
- the chemical nature of the thermoplastic resin particle or fiber [C] (auxiliary request 4);
- the average diameter of the particles or fibers [C] and [D] and the amount of particles or fibers [C] and [D] in the prepreg (auxiliary request 5);
- the volume resistivity of the conductive particle or fiber [D] (auxiliary request 7).

These additional features certainly bring the claimed subject-matter closer to the examples of the earlier application as filed. However, the definition of the thermosetting resin [B] is not affected by these further limitations. Thus, the reasoning set out above with regard to the main request still applies to these auxiliary requests, which are therefore not allowable.

- 2.2 Claim 1 of auxiliary request 6 relates to the use of the prepreg of claim 1 of the main request. As the definition of the prepreg remains unchanged, the reasoning set out above with regard to the main request applies to auxiliary request 6, which therefore is not allowable.
3. To conclude, none of the requests is allowable.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The patent is revoked.

The Registrar:

The Chairman:



M. Cañueto Carbajo

W. Sieber

Decision electronically authenticated