PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP2018/077848	12.10.2018	21.12.2017

International Patent Classification (IPC) or both national classification and IPC
INV. C08J5/04 D03D15/00

Applicant
DSM IP ASSETS B.V.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notifed the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA:	Date of completion of this opinion	Authorized Officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Fax: +49 89 2399 - 4465	see form PCT/ISA/210	Heinzelmann, Eric Telephone No. +49 89 2399-0

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/EP2018/077848

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:

      ☐ in the form of an Annex C/ST.25 text file.

      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	4, 9, 11-14
	No:	Claims	1-3, 5-8, 10
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-14
Industrial applicability (IA)	Yes:	Claims	1-14
	No:	Claims	

2. Citations and explanations

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Reference is made to the following documents:

D1	US 5 119 512 A (DUNBAR JAMES J [US] ET AL) 9 June 1992 (1992-06-09)
D2	US 4 983 433 A (SHIRASAKI YOSHIKAZU [JP]) 8 January 1991 (1991-01-08)
D3	WO 2005/066577 A1 (DSM IP ASSETS BV [NL]; JACOBS MARTINUS JOHANNES NICOL [NL]; STEEMAN RE) 21 July 2005 (2005-07-21)
D4	J. G.H. BOUWMEESTER ET AL: "CARBON/DYNEEMA? INTRALAMINAR HYBRIDS: NEW STRATEGY TO INCREASE IMPACT RESISTANCE OR DECREASE MASS OF CARBON FIBER COMPOSITES", ICAS 2008, 26TH INTERNATIONAL CONGRESS OF THE AERONAUTICAL SCIENCES, 1 January 2008 (2008-01-01), XP055371898,
D5	EP 1 908 586 A1 (NOVAMEER BV [NL]) 9 April 2008 (2008-04-09)

Re Item VIII

Certain observations on the international application

1 Lack of clarity

The application does not meet the requirements of Article 6 PCT, because claims 1 and 6 are not clear.

1.1 **Claim 1** discloses "a **high-performance polyethylene fiber arranged in a yarn having a tensile modulus of at least 110 GPa**". It is not clear from the formulation if the indicated tensile modulus is directed only to the fibre or to the whole yarn of the high-performance polyethylene fiber.

1.2 **Claim 6** tries to describe the HPPE fiber, comprised in the hybrid fabric, by means of the respective production processes melt spinning process, gel spinning process or solid-state powder compaction process (claims, page 1, line 21 - line 22). It is impossible to derive any of the process-related features of the fibers after production from the finished hybrid fabric and the fibers therein.

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

2 Lack of novelty

Furthermore, the above-mentioned lack of clarity notwithstanding, the subject-matter of claims 1-3, 5-8 and 10 is not new in the sense of Article 33(2) PCT, and the criteria of Article 33(1) PCT are therefore not met.

2.1 Claim 1

Document D1 discloses a hybrid fabric (abstract; column 1, line 13 - line 14) comprising: i) a high-performance polyethylene fiber (column 2, line 68 - column 3, line 3) arranged in a yarn (column 4, line 53 - line 54) having a tensile modulus of at least 110 GPa (column 3, line 12 - line 15, column 4, line 54 - line 55), as measured according to ASTM D885M-2014 (the testing method for the determination of the tensile modulus cannot be derived from the finished product and is therefore regarded as a non-limiting feature); and ii) a non-polymeric fiber arranged in a yarn (column 4, line 50, line 52), wherein the cross-sectional area of the HPPE yarn is equal to or smaller than the cross-sectional area of the non-polymeric yarn (column 4, line 52 - line 53, line 54, line 56; UHMWPE fibre: volumetric density = 0,97 g/cm^3, 650 den = 72,22 tex, cross-sectional area A_{UHMWPE} = 0,0075 mm^2, steel wire strand: diameter d_S = 0,11 mm, cross-sectional A_S = 0,0095 mm^2), the cross-sectional area being defined as the linear density of the yarn divided by volumetric density of the fiber (see above calculation).

2.2 Claims 2, 3, 5-8, 10

The different features of claims 2, 3, 5-8 and 10 are also known from document D1:

Claims 2, 3: see document D1 (column 3, line 12 - line 15, column 4, line 54 - line 55)

Claim 5: see document D1 (column 5, line 7 - line 9)

Claim 6: see document D1 (the indicated process features are regarded as non-limiting because they cannot be derived from the finished fabric, see above point 1.2)

Claim 7: see document D1 (col. 4, line 55; ρ_{UHMWPE} = 0,97 g/cm^3, tenacity 3,09 N/tex)

Claim 8: see document D1 (col. 3, line 12 - line 13, col. 4, line 54)

Claim 10: see document D1 (see col. 4, line 50 - line 57 , column 5, line 7 - line 8; the max. volume percentage of the UHMWPE fibre of the example shown in col. 4, line 50 - line 57 is 0,44%).

3 Lack of inventive step

Furthermore, the above-mentioned lack of clarity notwithstanding, the subject-matter of claims 1-14 does not involve an inventive step in the sense of Article 33(3) PCT, and the criteria of Article 33(1) PCT are therefore not met.

3.1 Claim 1

Document D2 can also be considered to be a prior art close to the subject-matter of claim 1, because it discloses a hybrid fabric (abstract; column 2, line 62 - column 3, line 9) comprising a high-performance polyethylene (HPPE) fiber (column 2, line 63 - line 64) and a non-polymeric fiber (column 3, line 7 - line 9), where the cross-sectional area of the HPPE fiber is equal to or smaller than the cross-sectional area of the non-polymeric fiber (column 5, line 61 - line 68), the cross-sectional area being defined as the linear density of the fiber divided by volumetric density of the fiber.

The cross-sectional area of the fibers given in D2 is calculated according to claim 1 of the application using the following values:

Ultra high molecular weight polyethylene filament (Dyneema SK-60, fineness = 300 denier, volumentric density = 0,97 g/cm^3) => **A_{UHMWPE} = 0,0343 mm^2**

Carbon fiber filament (Toho Rayon, HTA-7W-1000, fineness = 600 denier, volumentric density = 1,78 g/cm^3) => **A_{HTA} = 0,0374 mm^2**

The subject-matter of claim 1 therefore differs from this known hybrid fabric in that it comprises a high-performance polyethylene fiber with a tensile modulus of higher than 110 GPa.

The problem to be solved by the present invention may therefore be regarded as to provide a hybrid fabric with improved impact resistance and improved structural properties.

The problem is solved by using a high-performance polyethylene fiber with a tensile modulus of higher than 110 GPa in the hybrid fabric.

The solution proposed in claim 1 of the present application cannot be considered to involve an inventive step for the following reasons:

A high-performance polyethylene fiber with a tensile modulus which is higher than 110 GPa has already been employed for the same purpose in a similar hybrid fabric (see document D3, abstract, page 3, line 10 - line 14, page 11, line 17 - line 34). Document D2 (column 2, line 62 - column 3, line 1) teaches that a high tensile modulus is desireable. It would therefore be obvious to the person skilled in the art, namely when the same result is to be achieved, to apply the yarn of document D3 with corresponding effect to a hybrid fabric according to document D2, thereby arriving at a hybrid fabric according to claim 1.

The subject-matter of claim 1 does not therefore involve an inventive step in the meaning of article 33(3) PCT.

3.2 Claims 2-14

Dependent claims 2-14 do not appear to contain any additional features which, in combination with the features of any claim to which it refers, meet the requirements of the EPC with respect to novelty and/or inventive step.

3.2.1 Claims 2, 3

The subject-matter of claims 2 and 3 is further described in document D2 (column 3, line 9; column 5, line 61 - line 66).

3.2.2 Claim 4

As document D1 also describes the use of other non-polymeric fibres in place of metal fibres (col. 3, line 3, line 5, col. 4, line 16), a skilled person would also use such non-polymeric fibres because of their known high mechanical properties.

Furthermore, the use of inorganic fibres is also described in document D2 (abstract; column 1, line 41, col. 2, line 14 - line 15, col. 3, line 9) and D3 (page 3, line 11 - line 12).

3.2.3 Claims 5-12

The subject-matter of claims 5-12 is further described either in document D2 (column 3, line 9; column 5, line 61 - line 68; abstract; column 4, line 10) and/or D3 (page 11, line 17 - line 34; page 3, line 10 - line 11; page 3, line 5 - line 6; page 4, line 3 - line 4; page 4, line 16 - line 18). The tenacities as disclosed in claim 7 and the percentages of high-performance polyethylene fibres as disclosed in claim 10, can be derived from document D2 (see example 1, col. 5, line 63, line 65, line 68). The ratios of volume percentage of non-polymeric fibres and high-performance polyethylene fibres as disclosed in claim 12 are merely one of several straightforward possibilities which the skilled person would select, depending on the circumstances, without exercising inventive skills, in order to solve the problem posed.

3.2.4 Claims 13 and 14

An article as disclosed in claim 13, comprising the composite as disclosed in claim 11, and the use of these articles as disclosed in claim 14, are also described in documents D2 (abstract; column 2, line 10 - line 17; fig. 6; column 1, line 1 - line 3) or D3 (page 4, line 16 - line 17, line 22 - line 23).

Therefore, the subject-matter of claims 2-14 does not involve an inventive step in the meaning of article 33(3) PCT.

Re Item VII

Certain defects in the international application

4 Formal issues

4.1 2-part form

Independent claim 1 is not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art document D1 being placed in the preamble (Rule 6.3(b)(i) PCT) and the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).

5 Acknowledgement of prior art

Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in document D1 is not mentioned in the description, nor is this document identified therein.