

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

PCT

To:

see form PCT/ISA/220

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY (PCT Rule 43bis.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.
PCT/US2024/019537

International filing date (day/month/year)
12.03.2024

Priority date (day/month/year)
19.04.2023

International Patent Classification (IPC) or both national classification and IPC
INV. C08F210/16 C08F4/659

Applicant
DOW GLOBAL TECHNOLOGIES LLC

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 43bis.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 notified the International Bureau under Rule 66.1bis(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:



European Patent Office
D-80298 Munich
Tel. +49 89 2399 - 0
Fax: +49 89 2399 - 4465

Date of completion of
this opinion

see form
PCT/ISA/210

Authorized Officer

Thomas, Dominik

Telephone No. -0



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.
 - b. ☐ furnished subsequent to the international filing date for the purposes of international search (Rule 13*ter*.1(a)),
 - ☐ accompanied by a statement to the effect that the sequence listing does not go beyond the disclosure in the international application as filed.
4. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, this opinion has been established to the extent that a meaningful opinion could be formed without a WIPO Standard ST.26 compliant sequence listing.
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	<u>1-11</u>
	No: Claims	
Inventive step (IS)	Yes: Claims	
	No: Claims	<u>1-11</u>
Industrial applicability (IA)	Yes: Claims	<u>1-11</u>
	No: Claims	

2. Citations and explanations

see separate sheet

Re Item V

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

1 Reference is made to the following documents:

- D1 WO 2022/031397 A1 (DOW GLOBAL TECHNOLOGIES LLC [US])
10 February 2022 (2022-02-10)
- D2 US 2022/169762 A1 (ASKAR SHADID [US] ET AL) 2 June 2022
(2022-06-02)
- D3 US 2021/380737 A1 (MURE CLIFF R [US] ET AL) 9 December
2021 (2021-12-09)

2 D1 (WO 2022/031397)

D1 is directed to the preparation of thermoplastic compositions that balance mechanical properties and processability (see paragraph [003] of D1).

Paragraph [0092] (page 32, line 20) discloses that the thermoplastic composition may be used for the preparation of pipes.

In order to solve the above stated problem D1 discloses a bimodal polyethylene composition (see [004]) having:

- a density from 0.951-0.960 g/cm³ (see paragraph [0019]; page 5, line 9);
- a high load index of more than 25.0 g/10 min (see paragraph [0021], line 2);
- a viscosity at 0.1 rad /s at 190°C of greater than or equal to 30.000 Pa*s; (see paragraph [0031])
- a shear thinning index of 20, which corresponds to the shear thinning ratio of present claim 1 (see paragraph [004]; for the definition of the shear thinning index see paragraph [0016]; see also paragraph [0035] which discloses a range of from 15.0 to 20.0)
- ESCR values above 4000 hrs in all examples; a PENT value of greater than 30 hours is therefore regarded to be disclosed by the general disclosure of D1, as PENT and ESCR measure the same property of a polymer. This assumption is as well reflected by claim 9 of the present application, which refers back to claim 1 and discloses a ESCR value of greater than 1000 hours.
- an M_z of greater than 6;

The subject matter of present claim 1 regarded to be new (Art. 33(2) PCT) over the disclosure of D1. Multiple selections would be necessary to arrive at the

claimed subject matter while the features:

- relative amount of HMW component / LMW component and
- strain hardening modulus are not explicitly disclosed in D1.

D1 is considered to be a valuable starting point for the assessment of inventive step as it is directed to the provision of a polyolefin composition with good processability and good mechanical properties (see paragraph [003] of D1). The same problem is also addressed by the present invention (see page 1, lines 19-22).

Inventive Examples 8 and 9 are regarded to be the most promising starting points for an obvious development leading to the invention.

The examples disclose a bimodal polyethylene composition with the following properties:

- density of 0.9418 and 0.9431 (claim 1: >0.95)
- HLMI (I_{21}) of 34.3 and 34.2; (claim 1: 20-35)
- Mz/Mw of 6,0 and 5.9; (claim 1: >5.5)
- complex viscosity: 29.800 and 27.025 (>30.000)
- shear thinning index of 19.3 and 16.9 (claim 1: 15-25)
- ESCR of >4000 h (for samples IE2.8 and IE2.9 which were IE8 and IE9 compounded with carbon black. The presence of carbon black is regarded to have a minor influence on the ESCR values of the samples; the samples IE2.8 and IE2.9 even fall within the claimed density range - see table 11). (claim 1 PENT >30 hours; dependent claim 8: ESCR > 1000 hours).
- Mz/Mw of 6,0 and 5.9; (claim 1: >5.5)

The ratio of HMW component to LMW component is regarded to be implicitly disclosed by the teaching of D1, as the catalyst for making the bimodal polymer in D1 comprises the same components as the catalyst of the present invention. The strain hardening modulus is as indicated on page 6, lines 1-3 of the present application correlated with PENT / ESCR and is therefore also regarded to be implicitly met.

Technical effect and problem to be solved

Taking D1 as the closest prior art, the claimed invention differs from examples 8 and 9 of D1 by minor differences in density and complex viscosity.

As D1 already teaches viscosities and densities in the claimed range, it seems obvious to the person skilled in the art when starting from e.g., example 8 to

vary these parameters. The person skilled in the art would therefore arrive at the claimed invention without any inventive skill.

As D1 uses the same catalyst system as the present invention, there seems to be no bar to the person skilled in the art to obtain the claimed properties in combination.

The subject matter of present claims 1- 11 is therefore at the present stage not regarded to be inventive over the disclosure of D1 (Art. 33(3) PCT).

3 D2

D2 discloses (see paragraph [0010]) a bimodal poly(ethylene-co-1-alkene)copolymer comprising a higher molecular weight poly(ethylene-co-1-alkene) copolymer component (HMW copolymer component) and a lower molecular weight poly(ethylene-co-1-alkene) copolymer component (LMW copolymer component),

the bimodal copolymer composition being characterized by

(a) a density from 0.950 to 0.957 gram per cubic centimetre (g/cm^3) measured according to ASTM D792-13

(b) a high load melt index (HLMI or I_{21}) from 1 to 10 grams per 10 minutes (g/10 min.) measured according to ASTM D1238-13 (190°C. , 21.6 kg); and

(g) a molecular weight distribution M_z/M_w of greater than > 8.5 .

The examples of D2 disclose a viscosity at 0.1 rad/sec of greater than 30,000 Pas (see table 1a).

The SVR (shear viscosity ratio - corresponding to the shear thinning index) is for the examples outside the claimed range. The general range of the description for the SVR of D2 (see paragraph [0013]: 55- 80) is as well outside the claimed range (15-25).

D2 fails to disclose a multimodal high density polyethylene composition, the multimodal high density polyethylene composition comprising greater than 40 wt.% of a high molecular weight component and less than 60 wt.% of a low molecular weight component, based on the total weight of the multimodal high density polyethylene composition, wherein the multimodal high density polyethylene composition has:

b. a high load melt index (I_{21}) of from 20.0 to 35.0 g/10 min. ;

d. a shear thinning ratio of from 15.0 to 25.0;

e. a PENT value greater than 30 hours;

The subject matter of the present set of claims is therefore regarded to be new over the disclosure of D2 (Art. 33(2) PCT).

It seems as well not obvious to arrive at the claimed invention, when starting from D2 in view of the number of differences over the teaching of the present application (Art. 33(3) PCT).

4. D3

D3 (see paragraph [008]) is directed to a bimodal polyethylene composition with the following properties:

-the multimodal high density polyethylene composition comprising 35-65 wt.% of a high molecular weight component and 35 wt to 60 wt.% of a low molecular weight component, based on the total weight of the multimodal high density polyethylene composition, wherein the multimodal high density polyethylene composition has:

- a. a density from 0.945 to 0.960 g/cm³(claim 1: greater than 0.950 g/cm³);
- b. a high load melt index (I_{21}) of from 1-10 g/10 min(see [0011] of D1 ; claim 1 of the present application: 20.0 to 35.0 g/10 min
- d. a shear thinning ratio of from 96 -120 (claim 1: 15.0 to 25.0)
- f. a strain hardening modulus of greater than 61.00 MPa; (see example 1 in table 4 on page 12)
- g. a Mz/Mw of 8.7 (greater than 5.5).

D3 therefore at least fails to disclose

- b. a high load melt index (I_{21}) of from: 20.0 to 35.0 g/10 min
- c. a viscosity at 0.1 rad/sec of greater than 30,000 Pas;
- d. a shear thinning ratio of from 15.0 to 25.0
- e. a PENT value greater than 30 hours;

The subject matter of present claim 1 is therefore regarded to be new over the disclosure of D3 (Art. 33(2) PCT).

It seems as well not obvious to arrive at the claimed invention, when starting from D3 in view of the number of differences over the teaching of the present application (Art. 33(3) PCT).