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**Datasheet for the decision
of 5 October 2018**

Case Number: T 0281/15 - 3.3.09

Application Number: 04722422.5

Publication Number: 1607436

IPC: C08J9/16, C08J9/232

Language of the proceedings: EN

Title of invention:

Expandable resin beads of styrene-modified linear low-density polyethylene

Patent Proprietor:

Sekisui Plastics Co., Ltd.

Opponent:

BASF SE

Headword:

Relevant legal provisions:

EPC Art. 123(2), 123(3), 83, 54, 56

Keyword:

Amendements - added subject-matter (no)

Amendments - broadening of claim (no)

Sufficiency of disclosure - (yes)

Novelty - (yes)

Inventive step - (yes)

Decisions cited:

G 0001/10, T 1483/10

Catchword:



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Case Number: T 0281/15 - 3.3.09

D E C I S I O N
of Technical Board of Appeal 3.3.09
of 5 October 2018

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Decision under appeal: **Interlocutory decision of the Opposition**
Division of the European Patent Office posted on
28 November 2014 maintaining European patent
No. 1607436 in amended form

Composition of the Board:

Chairman W. Sieber
Members: J. Jardón Álvarez
D. Prietzel-Funk

Summary of Facts and Submissions

I. This decision concerns the appeal filed by the opponent against the interlocutory decision of the opposition division finding that European patent No. 1 607 436 as amended met the requirements of the EPC.

II. The opponent had requested revocation of the patent in its entirety on the grounds of Article 100(a) (lack of novelty and inventive step) and (b) EPC. The documents cited during the opposition proceedings included:

D1: JP 1284536 A (D1e: its translation into English);

D2: JP 4183706 A (D2e: its translation into English);

D3: EP 0 682 079 A2;

D5: DE 24 13 408 A1;

D6: DE 24 13 375 A1;

D10: Translator's declaration as regards the translation of claims 1 and 3 of the international patent application as published in Japanese (WO 2004/085527 A1) into English (dated 15 February 2013);

D10a: Translator's further declaration (dated 26 December 2013);

D11: Japanese Industrial Standard JIS K 7121-1987. "Testing Methods for Transition Temperatures of Plastics" (12 pages);

D16: ASTM Standard D 3418-99, "Standard Test Method for Transition Temperatures of Polymers By Differential Scanning Calorimetry" (5 pages), July 1999;

D17: Analytical Report: "Differential scanning calorimetry of the PE" by Mitsui chemical analysis & consulting services INC, 21 November 2013 (3 pages);

D18: Technical brochure "L-LDPE Ultzex[®]" (5 pages in Japanese language);

D19: Experimental report: "Melting point measurement of PE", 15 November 2013 (1 page);

D21: Report: Follow-up experiment on example 4 of D1, 29 November 2013;

D22: Report: Follow-up experiment on comparative example 1 of D1, 29 November 2013;

D23: Report: Follow-up on comparative example 2 of D1, 29 November 2013;

D24: Report: Follow-up experiment on example 1 of D2, 29 November 2013;

D25: US 4 282 334 A;

D26: US 3 243 481 A;

D27: US 3 658 946 A;

D28: US 3 428 712 A;

D29: Report: Follow-up experiment on example 1 of D3,
27 September 2014; and

D30: Copy of a letter dated 7 January 2014 in the
opposition procedure of EP 1 607 437 (23 pages).

III. The opposition division maintained the patent on the
basis of claims 1 to 7 of the main request filed by
letter of 18 February 2013. Independent claims 1, 3
and 5 read as follows:

"1. A method for producing expandable beads of a
styrene-modified linear low-density polyethylene-based
resin comprising, in the order recited, the steps of:

dispersing 100 parts by weight of non-crosslinked
linear low-density polyethylene-based resin beads,
50 to 1000 parts by weight of a styrene-based
monomer, and 0.1 to 0.9 parts by weight of a
polymerization initiator relative to 100 parts by
weight of the styrene-based monomer into a
suspension containing a dispersant;
impregnating the styrene-based monomer into the
low-density polyethylene-based resin beads by
heating the resultant dispersion at such a
temperature that polymerization of the styrene-
based monomer does not substantially take place;
performing polymerization of the styrene-based
monomer at a temperature of (T-15) to (T-8) °C or
(T+1) to (T+5) °C (where T °C is the melting point of
the low-density polyethylene-based resin beads);
and
impregnating a volatile blowing agent into the
resin beads during or after the polymerization,

whereby the resin components of the expandable beads contain less than 2 wt% of a gel fraction comprising a graft polymer,

wherein the gel fraction is determined according to the following equation:

$$\frac{\text{Weight of resultant solid}}{\text{Weight of sample}} \times 100 = \text{gel fraction}$$

wherein the term "weight of resultant solid" relates to the weight of a sample remaining on a wire gauze (\emptyset 0.12 mm, 80-mesh) which is insoluble in boiling toluene after 24 hrs and drying at 130 °C for 1 hour and wherein the term "weight of sample" relates to the weight of the sample resin beads prior to extraction with toluene."

"3. A method for producing expandable beads of a styrene-modified linear low-density polyethylene-based resin comprising, in the order recited, the steps of:

dispersing 100 parts by weight of non-crosslinked linear low-density polyethylene-based resin beads, 30 to 300 parts by weight of a styrene-based monomer, and 0.1 to 0.9 parts by weight of a polymerization initiator relative to 100 parts by weight of the styrene-based monomer into a suspension containing a dispersant;
impregnating the styrene-based monomer into the low-density polyethylene-based resin beads by heating the resultant dispersion at such a temperature that polymerization of the styrene-based monomer does not substantially take place;
performing a first polymerization of the styrene-based monomer at a temperature of (T-15) to (T-8) °C or (T+1) to (T+5) °C (where T °C is the melting point of the low-density polyethylene-based resin beads);

adding a styrene-based monomer and 0.1 to 0.9 parts by weight of a polymerization initiator relative to 100 parts by weight of the styrene-based monomer when the conversion ratio of polymerization reaches to 80 to 99.9%, and performing impregnation of the styrene-based monomer into the low-density polyethylene-based resin beads and a second polymerization of the styrene-based monomer at a temperature of (T-15) to (T-8)°C or (T+1) to (T+5)°C (where T° is the melting point of the polyethylene-based resin beads) (wherein the total amount of the styrene monomers used in the first and second polymerisations is more than 50 parts by weight and not more than 1000 parts by weight relative to 100 parts by weight of the low-density polyethylene-based resin beads); and impregnating a volatile blowing agent into the resin beads during or after the polymerization,

whereby the resin components of the expandable beads contain less than 2 wt% of a gel fraction comprising a graft polymer,

wherein the gel fraction is determined according to the following equation:

$$\frac{\text{Weight of resultant solid}}{\text{Weight of sample}} \times 100 = \text{gel fraction}$$

wherein the term "weight of resultant solid" relates to the weight of a sample remaining on a wire gauze (Ø 0.12 mm, 80-mesh) which is insoluble in boiling toluene after 24 hrs and drying at 130 °C for 1 hour and wherein the term "weight of sample" relates to the weight of the sample resin beads prior to extraction with toluene."

"5. Expandable beads of a styrene-modified linear low-density polyethylene-based resin comprising a volatile blowing agent and a base resin, the base resin containing more than 50 to 1000 parts by weight of a polystyrene-based resin component relative to 100 parts by weight of a non-crosslinked linear low-density polyethylene-based resin component, wherein the base resin contains less than 2 wt% of a gel component comprising a graft polymer of the polystyrene-based resin component and the low-density polyethylene-based resin component, wherein the gel fraction is determined according to the following equation:

$$\frac{\text{Weight of resultant solid}}{\text{Weight of sample}} \times 100 = \text{gel fraction}$$

wherein the term "weight of resultant solid" relates to the weight of a sample remaining on a wire gauze (\emptyset 0.12 mm, 80-mesh) which is insoluble in boiling toluene after 24 hrs and drying at 130 °C for 1 hour and wherein the term "weight of sample" relates to the weight of the sample resin beads prior to extraction with toluene."

Claims 2, 4, 6 and 7 were dependent claims.

IV. The opposition division's decision may be summarised as follows:

- Late-filed documents D25 and D29 were admitted into the proceedings due to their *prima facie* relevance, whereas D26, D27, D28 and D30 were not admitted. Concerning D30, the opposition division noted that it related to different opposition proceedings and that its relevance for the possible outcome of the present proceedings had not been established.

- The amended claims fulfilled the requirements of Article 123(2) and (3) EPC, because the amendment made was based on the original wording of the claims of the Japanese application and the amendment did not extend the protection conferred by the granted claims.
- The requirements of sufficiency of disclosure were met. The skilled person would use a differential scanning calorimetry (DSC) method according to JIS K 7121 and ASTM D3418-88 to determine the melting point of the polyethylene used. Furthermore, the patent itself gave clear instructions on how to determine the gel fraction without undue burden.
- The subject-matter of claim 5 was novel over the disclosure of D1, D2, D3, D5 and D6. As to D1 and D2, the patent proprietor had shown that the expandable beads of these documents contained more than 2 wt% of a gel component. Novelty over D3 was acknowledged because it had not been demonstrated that no formation of graft polymers of styrene on the linear low-density polyethylene took place during the extrusion process of D3. Lastly, D5 and D6 disclosed resin beads comprising low-density polyethylene, but not linear low-density polyethylene.
- Starting from D1 as the closest prior art, the opposition division defined the problem to be solved by the invention as how "to provide expandable resin beads having improved recyclability and a method of manufacture thereof". The evidence in the patent showed that gel fractions in an amount above 2 wt% lead to deteriorated recyclability, whereas gel fractions

below 2 wt% showed favourable recyclability. This effect justified an inventive step. D3 did not represent the closest prior art, but even if one were to start from this document, the claimed subject-matter would still involve an inventive step. Nothing in the prior art hinted at a relationship between gel content and recyclability of styrene-modified linear low-density polyethylene expandable beads.

- V. This decision was appealed by the opponent (in the following: the appellant), which requested that the decision under appeal be set aside and that the patent be revoked in its entirety. The appellant further requested that D30 be admitted into the proceedings.
- VI. In its reply to the statement of grounds of appeal, the patent proprietor (in the following: the respondent) requested that the appeal be dismissed (main request) or, alternatively, that the patent be maintained on the basis of the claims according to the auxiliary request filed on 30 September 2014 during the opposition proceedings. The respondent also filed the following documents and requested that they be admitted into the proceedings:

D21a: Supplemented version of D21;

D22a: Supplemented version of D22;

D23a: Supplemented version of D23;

D24a: Supplemented version of D24; and

D29a: Supplemented version of D29.

VII. In a communication the board indicated the points to be discussed during the oral proceedings. It also gave its preliminary view that the disclosure of D1 and/or D2 did not appear to anticipate the subject-matter of claim 5.

VIII. Both parties replied to the board's communication. The reply of the respondent included a second auxiliary request and the following further evidence:

D29b: corrected version of D29a; and

D31: Declaration of Mr. Morishima dated 22 August 2018 (1 page).

IX. Oral proceedings were held before the board on 5 October 2018. During the oral proceedings, the appellant withdrew its request that D30 be admitted into the proceedings. It also withdrew its novelty attack against claim 5 based on D1 and D2.

X. The appellant's relevant arguments may be summarised as follows:

- The patent (claims 1 and 3) could not be corrected under Rule 140 EPC for the reasons given in decision G 1/10. Moreover, claim 5 could not be the basis for the amendment of method claims 1 and 3.
- The amendment to claims 1 and 3 extended the scope of the protection of the granted claims. Due to the amendment, the claims embraced methods for producing expandable beads that were not covered by the granted claims.

- The claimed invention was insufficiently disclosed because there was no information in the patent concerning the method for measuring the melting point of the polyethylene-based resin. Furthermore, the determination of the graft polymer in the gel component was insufficiently disclosed.
- The disclosure of example 1 of D3 was novelty-destroying for the subject-matter of claim 5.
- The subject-matter of claim 5 lacked inventive step starting from D3 as the closest prior-art document and the subject-matter of claims 1 and 3 lacked inventive step starting from D1 and/or D2 as closest prior art. The evidence on file did not convincingly show any improvement of the claimed expandable beads or of their methods of preparation. The claimed subject-matter was therefore an obvious alternative to the expandable beads disclosed in D3 or to the methods disclosed in D1 and D2.

XI. The respondent's arguments may be summarised as follows:

- The amendments made to claims 1 and 3 were not corrections of the granted patent but "true" amendments based on the disclosure of the application as originally filed. The text of the international application as filed in Japanese and confirmed by the translator's declaration was the basis for the amendments to claims 1 and 3. Thus, the requirements of Article 123(2) EPC were fulfilled.

- The requirements of Article 123(3) EPC were also fulfilled. Amended claims 1 and 3 were now directed to methods of manufacture of the products of granted claim 5. A claim directed to a product *per se* had the broadest scope of protection and covered all processes for its manufacture.
- The invention was sufficiently disclosed because the skilled person would know how to determine the melting point of a polyethylene resin. This would be done by standard methods well known to the skilled person. The method for determining the gel content and the graft polymer was disclosed in the patent specification, and the appellant had not provided any evidence that this could not be carried out without undue burden.
- Example 1 of D3 did not anticipate the subject-matter of claim 5. The beads prepared in this example were not expandable beads produced from a styrene-modified linear low-density polyethylene-based resin. They were structurally different because, in D3, styrene was polymerised in the absence of polyethylene. Furthermore, D29b showed that the resin composition obtained in example 1 had a gel content of 10.4 wt% and that the polystyrene content in said gel was 16.2 wt%. Such a resin was not within the scope of claim 5 of the patent.
- D1, not D3, represented the closest prior art. Nothing in the prior art hinted that observing the limit of less than 2 wt% for the gel component, as defined in the claims, would lead to improved recyclability for the expanded moulded product. The

appellant's objections had clearly been made with knowledge of the invention.

XII. The appellant requested that the decision under appeal be set aside and that European patent No. 1 607 436 be revoked in its entirety. It further requested that the first auxiliary request of the respondent not be admitted into the proceedings and, if admitted, that the case be remitted to the opposition division for further consideration.

The respondent requested that the appeal be dismissed (main request) or, alternatively, that the patent be maintained on the basis of the claims according to auxiliary requests 1 or 2, auxiliary request 1 as filed on 30 September 2014 during the opposition proceedings and auxiliary request 2 as filed by letter of 5 September 2018. It further requested that documents D21a to D24a filed on 21 August 2015 and document D29b filed on 5 September 2018 be admitted into the proceedings.

Reasons for the Decision

1. New evidence

1.1 With its reply to the appeal, the respondent requested that the newly cited documents D21a to D24a and D29a be admitted into the appeal proceedings. With its letter dated 5 September 2018 it requested that D29a be replaced by D29b, which is identical to D29a apart from a corrected typing error.

- 1.2 The above documents are supplemented versions of the experimental reports D21 to D24 and D29 already filed during the opposition proceedings.
- 1.3 The appellant had not objected to the admission of these documents into the proceedings, and the board saw no reason to raise an objection on its own motion. They had been filed in direct reaction to the statement of grounds of appeal in support of arguments already made in the proceedings, and D29b merely corrects a typing mistake in D29a. Thus, the documents were admitted into the proceedings.

MAIN REQUEST (claims maintained by the opposition division)

2. *Amendments*

- 2.1 Independent claims 1 and 3 were amended in the opposition proceedings. In both claims the wording:

"whereby the resin components of the expandable beads contain a gel component comprising less than 2 wt% of a graft polymer,"

was changed to read:

"whereby the resin components of the expandable beads contain less than 2 wt% of a gel fraction comprising a graft polymer,"

- 2.2 The appellant saw this amendment as the correction of an error in the text of the granted patent under Rule 140 EPC, which according to G 1/10 was not allowable.

2.2.1 However, the respondent never pursued the amendment of claims 1 and 3 as a correction of the granted patent. It amended claims 1 and 3 as granted in the opposition proceedings to overcome the appellant's insufficiency objection in view of the different definitions of the gel component in claims 1 and 3 as granted on the one hand and claim 5 as granted on the other. Claim 5 as granted has always specified that "the base resin contains less than 2 wt% of a gel component comprising a graft polymer ...". After the amendment to granted claims 1 and 3, all independent claims now define the gel component in the same way, namely as in claim 5 as granted.

2.2.2 In this context, it should be noted that G 1/10 states in point 13 of the Reasons that:

"However, it is always open to a patent proprietor to seek to amend his patent during opposition or limitation proceedings and such amendment could remove a perceived error. Such an amendment would have to satisfy all the legal requirements for amendments including those of Article 123 EPC."

2.2.3 Thus, being an amendment under Article 123 EPC and not a correction under Rule 140 EPC, it has to be investigated in the present case whether the amendment satisfies the requirements of Article 123 EPC.

2.3 *Amendments (Article 123(2) EPC)*

2.3.1 In support of the amendment, the respondent referred to the wording of claims 1 and 3 of the international patent application which gave rise to the European patent application on the basis of which the patent in suit was granted. The international patent application

was filed and published in Japanese. The true wording of claims 1 and 3 of the international patent application is confirmed by a translator's declarations (D10/D10a).

In order to initiate proceedings at the EPO, a translation into English was filed pursuant to Article 153(4) EPC. However, the wording of claims 1 and 3 in the English version contained an incorrect translation with regard to the definition of the gel component (as confirmed by D10/D10a). This incorrect translation has been kept in claims 1 and 3 as granted, resulting in the discrepancy objected to between claims 1 and 3 as granted on the one hand and claim 5 as granted on the other.

2.3.2 According to Article 14(2) EPC, the translation of a European application may be brought into conformity with the application as filed throughout the proceedings before the EPO. The present application is deemed to be a European application pursuant to Article 153(2) EPC and must hence be treated as a regular European application. As a consequence, the provision of Article 14(2) EPC equally applies to the present application, and, by analogy, the translation may be corrected throughout the proceedings before the EPO (see, for instance, T 1483/10, reasons 2.1 to 2.3). The correct translation of the application as filed therefore forms the basis for the amendment of claims 1 and 3 of the present main request.

2.3.3 Taking into account the translator's declarations D10/D10a and that their accuracy has not been contested by the appellant, the board is satisfied that the amendment made to claims 1 and 3 reflects a correct translation of the Japanese text and that,

consequently, the amendment does not infringe Article 123(2) EPC.

2.4 *Amendments (Article 123(3) EPC)*

2.4.1 The appellant argued that the subject-matter of amended claims 1 and 3 extended the protection conferred by the granted claims because the amended method claims 1 and 3 allowed for the possibility that no gel fraction is present (less than 2 wt% and thus including 0 wt%), whereas granted claims 1 and 3 required the presence of a gel fraction (more than 0 wt%).

2.4.2 The board disagrees. According to established case law, a product claim confers protection to all processes for making that product, such that the replacement of a claim directed to a product by a claim directed to a specific process or method for making that product does not extend the protection conferred thereby (Case Law of the Boards of Appeal of the EPO 8th edition 2016, II.E.2.6.3).

2.4.3 As indicated in point 2.2.1 above, granted product claim 5 had already defined the gel content of the expandable beads in the same way as now done in amended claims 1 and 3. Thus, the protection conferred by granted claim 5 already covered the product as such and, consequently, any method of manufacturing it.

2.4.4 As a result, the protection conferred by method claims 1 and 3 does not extend beyond the protection conferred by granted product claim 5. Thus, the amendments comply with the requirements of Article 123(3) EPC).

3. *Sufficiency*

3.1 The appellant maintained that the disclosure was insufficient since the skilled person would not know how to determine:

- the melting point of the linear low-density polyethylene-based resin, and
- the gel fraction comprising the graft polymer.

3.2 Determination of the melting point of the linear low-density polyethylene-based resin

3.2.1 It is correct that the patent specification does not describe the test method for determining the melting point of the polyethylene. However, the board agrees with the respondent that the skilled person would know from their common general knowledge how to determine this parameter.

3.2.2 Indeed there are standard test methods for determining the melting point of polymers which belong to the common general knowledge of the skilled person, such as JIS K 7121 (D11) or ASTM D3418-99 (D16). Thus, the skilled person would determine the melting point by using, for instance, differential scanning calorimetry (DSC), which is known to be one of the most accurate methods for this purpose.

3.2.3 The opponent essentially argued that D11 described DSC, as well as differential thermal analysis (DTA), as methods generally suitable for determining the melting point of a polymer. Furthermore, even if the skilled person were to select the DSC method, the exact

conditions for conducting the measurement would not be known.

- 3.2.4 The board cannot accept the appellant's arguments. The experimental reports D17 and D19 filed by the respondent confirm that even different methods are suitable for determining the melting point of a polyethylene resin within good accuracy. Thus, the melting point of a specific polyethylene mentioned in the prior art cited by the appellant, namely "Ultzex 3021F", had been determined by DSC (122°C; D17) and hot stage microscope (122.1°C; D19). This value corresponded well with the 122°C indicated in the technical brochure (D18) for this commercial product.

As regards the conditions of the DSC method, there is nothing on file indicating that the usual conditions used for polyethylene would lead to any difficulty. Also, the fact that D4 reports a melting point of 123°C for "Ultzex 3021F", which is roughly 1°C higher than the values obtained in D17 and D19, is in itself not a reason for lack of sufficiency. This might, at most, lead to some lack of clarity at the edges of the temperature ranges required by claims 1 and 3. In any case, there is no experimental evidence on file showing that the use of the standard methods for determining the melting point would amount to an undue burden when carrying out the invention.

- 3.2.5 For these reasons the board is convinced that the skilled person would know from their common general knowledge how to determine the melting point of the polyethylene resin used.

3.3 Determination of the gel fraction

3.3.1 According to paragraphs [0007] and [0008] of the specification, the polymerisation of styrene monomer in the presence of a linear low-density polyethylene-based resin results in the formation of a gel fraction which may comprise two different components, namely (i) a gel component containing polystyrene and (ii) a gel component containing substantially no polystyrene. Gel component (i) is the result of graft polymerisation of styrene monomer on a polyethylene chain, whereas gel component (ii) is basically cross linked polyethylene.

3.3.2 The independent claims require that the resin components of expandable beads contain less than 2 wt% of a gel fraction comprising a graft polymer. The gel fraction is defined as the weight percentage of the part which remains insoluble in boiling toluene under specific extraction conditions. Thus, according to claims 1, 3 and 5, the gel fraction is determined as

$$\frac{\text{Weight of resultant solid}}{\text{Weight of sample}} \times 100 = \text{gel fraction}$$

where the term "weight of resultant solid" relates to the weight of a sample remaining on a wire gauze (\emptyset 0.12 mm, 80-mesh) which is insoluble in boiling toluene after 24 hrs and drying at 130°C for 1 hour, and where the term "weight of sample" relates to the weight of the sample resin beads prior to extraction with toluene. The method of extraction of the insoluble solid is also described in paragraph [0068] of the patent specification.

3.3.3 The insoluble solid is then analysed according to the method described in paragraph [0069] in order to determine its polystyrene content. It is the **convention** in the present patent that the amount of the

polystyrene in the gel fraction is the criterion for judging whether or not the gel component comprises a graft polymer. Thus, when the polystyrene content is 10 wt% or more, it was determined that a gel component comprises a graft polymer, but not a crosslinked polymer (paragraph [0070]).

- 3.3.4 This method has been used in the examples and comparative examples in the patent to determine the gel fraction. Moreover, the respondent has used this method for determining the gel fraction of several polyethylene-based resins of prior-art documents D1 and D2 (see D21a to D24a). In all cases the gel fraction and the polystyrene content could be determined.
- 3.3.5 The appellant objected that the method described in the patent would not allow the two gel components to be differentiated. However, as explained above, the criterion whether or not the gel fraction comprises a graft copolymer is based on a convention, and the appellant has not provided any experimental evidence that this convention would lead to any difficulty relating to sufficiency of disclosure.
- 3.3.6 At the oral proceedings, the appellant argued that the method disclosed in the patent did not allow the determination of the stage of the process at which the graft polymer was formed. In this context, it referred to the method of example 1 of D3.

This objection too must fail. First of all, the board notes that D3 relates to expandable beads prepared from a conventional polymer blend. As set out in point 4.3 below, the skilled person would not consider that such a blend is a styrene-modified linear low-density polyethylene-based resin. Thus, the sufficiency

objection with regard to D3 appears irrelevant. Secondly, even if the objection were to be considered, the respondent determined the gel fraction in a polymer according to D3, and by following the convention set out in the patent it found that the resin composition of example 1 of D3 had a gel content of 10.4 wt% with a polystyrene content of 16.2 wt% (D29b page 2, lines 3 to 7). The board cannot see how the appellant's objection amounts to a lack of sufficiency.

3.4 For these reasons the claimed invention as defined in the main request is considered to be sufficiently disclosed.

4. *Novelty*

4.1 The only novelty attack maintained by the appellant during the oral proceedings was that the subject-matter of claim 5 lacked novelty over example 1 of D3.

4.2 Example 1 of D3 discloses the preparation of expandable beads by mixing the following components in a twin-screw extruder at 200°C:

- 50 parts by weight of a polymer obtained by dissolving 8 parts by weight of a polybutadiene in 92 parts by weight of styrene followed by free radical polymerisation of the solution;
- 40 parts by weight of a linear polyethylene (Dowlex 2045 E from Dow); and
- 10 parts by weight of a linear, anionically polymerised styrene-butadiene block polymer having a polybutadiene content of 26% by weight.

6 000 g of this blend were transferred together with 21 000 g of demineralised water and further ingredients into a vessel, heated and pressurised with a mixture of n-pentane/isopentane and n-heptane (as volatile blowing agents).

D3 does not disclose whether the resulting beads of example 1 contain less than 2 wt% of a gel component.

- 4.3 There is a structural difference between the expandable beads of the invention and those of D3. Thus, the claimed beads are expandable beads of a styrene-modified linear low-density polyethylene-based resin that are made by "adopting linear low-density polyethylene and by adding a styrene monomer to polyethylene for polymerization at a specific range of temperatures under the presence of a specific amount of initiator" (paragraph [0011] of the specification).

In contrast to this, in example 1 of D3 the polyethylene is blended with a polymer prepared by polymerising styrene in the presence of polybutadiene (point 4.2 above). In other words, in example 1 of D3 the polystyrene is prepared by polymerising styrene in the absence of polyethylene. Therefore, the resin composition in example 1 of D3 cannot be regarded as being a styrene-modified linear low-density polyethylene-based resin within the meaning of claim 5 of the patent.

- 4.4 Apart from that, as set out in point 3.3.6 above, the respondent has shown that the content of the gel fraction comprising a graft polymer for the resin composition of example 1 of D3 was too high when following the convention set out in the patent.

4.5 Thus, the subject-matter of claim 5 is novel over the disclosure of example 1 of D3.

5. *Inventive step*

5.1 The invention aims to provide expandable beads of a styrene-modified linear low-density polyethylene-based resin for the production of an expanded moulded article which has excellent impact resistance and physical properties and which can be readily recycled by minimising generation of a gel component derived from graft polymerisation of styrene on a polyethylene chain (paragraph [0010] of the specification).

5.2 Closest prior art

5.2.1 The set of claims of the main request includes three independent claims, namely claim 5 directed to the expandable beads as such and claims 1 and 3 directed to methods for producing such expandable beads. As already discussed above in relation to Article 123(3) EPC, the broadest claim is claim 5.

5.2.2 The appellant saw the disclosure of D3 as representing the closest prior art for the subject-matter of claim 5. The respondent and the opposition division considered D1 as the closest prior art.

5.2.3 D1, like the patent in suit, relates to styrene-modified linear low-density polyethylene-based resin beads similar to those of the present invention (abstract). They are prepared by impregnating a polyethylene-based resin with styrene at a temperature at which polymerisation does not occur and then raising the temperature to polymerise the styrene (claim 1 of the English translation of D1, D1e; also

paragraphs [0006] to [0008] of the present patent specification, in which D1 is acknowledged).

5.2.4 As already discussed above in relation to novelty, the beads produced by the process of example 1 of D3 are structurally quite different from the beads of the invention, because in the process of D3, styrene is polymerised in the presence of polybutadiene but not polyethylene. Therefore, the resin of D3 cannot be regarded as being a styrene-modified linear low-density polyethylene-based resin.

5.2.5 Consequently, the board agrees with the respondent and the opposition division that D1 is the most appropriate starting point for the assessment of inventive step.

5.2.6 D1 is silent about the amount of gel component present in the resins therein prepared, but the respondent has repeated several examples and found that the amount of gel component is always higher than 2 wt%, namely: 3.8 wt% for example 4 (D21, last paragraph), 4.2 wt% for comparative example 1 (D22, last paragraph) and 4.3 wt% for comparative example 2 (D23, last paragraph).

5.3 Problem to be solved and its solution

5.3.1 According to the respondent, the technical problem to be solved by the patent in view of D1 was the provision of expandable beads of a styrene-modified linear low-density polyethylene-based resin having good mechanical properties and improved recyclability.

5.3.2 This problem is solved by the claimed beads, where the resin component of the beads contains less than 2 wt% of a gel fraction comprising a graft polymer.

5.3.3 The examples and comparative examples in the patent specification show that good recyclability is only obtained only when the gel fraction content is below 2 wt.% (see tables 2 and 5). All examples in the patent specification in which the resins have a gel fraction higher than 2 wt% are not acceptable for being recycled.

5.3.4 In this context, it is also noted that the appellant's observation that comparative example 9 was not suitable for being recycled is not correct. Although this example is marked as a comparative example because the required amount of initiator used was outside the amounts required by the method of claim 1, it does indeed result in resin beads according to claim 5. It has a gel content of 0.9 wt.% (table 2, column "gel fraction") and is acceptable for being recycled, as can be seen in said table 2, where "sufficient recyclability" was observed.

5.3.5 The board is therefore satisfied that the above technical problem has been credibly solved.

5.4 Obviousness

5.4.1 It remains to be decided whether or not it was obvious in view of the cited prior art to modify the resins of D1 so that they present a gel fraction of less than 2 wt%.

5.4.2 The board agrees with the respondent that nothing in the cited prior art hinted at the solution found in the patent. None of the documents recognises the importance of the gel fraction contained in the expandable resin beads for improving their recyclability. In fact, this

feature is not mentioned in any of the documents in the proceedings.

- 5.4.3 In view of the above, the board concludes that the person skilled in the art, starting from D1 as closest prior art, would not have arrived in an obvious manner at the subject-matter of claim 5 of the main request. The subject-matter of claim 5 therefore involves an inventive step.
- 5.4.4 This line of argument, starting from D1 as the closest prior art, was not contested by the appellant, which argued on the basis of D3 as closest prior art. However, this line must fail because, as set out above, D3 does not qualify as the closest prior-art document.
- 5.5 The appellant further argued that, starting from D1 or D2 as closest prior art, the subject-matter of claims 1 and 3 would lack inventive step because it would be obvious for the skilled person to arrive at the claimed conditions merely by routine experimentation.
- 5.6 The board notes that claims 1 and 3 are directed to methods for the preparation of the expandable beads according to claim 5. They essentially define the process conditions (reaction temperature, amount of initiator, etc.) that ensure that an expandable resin with less than 2 wt% of a gel fraction comprising a graft polymer is obtained. The examples and comparative examples in the specification show that products with the desired properties can be achieved only when working under the conditions specified in claims 1 and 3.
- 5.7 It is well-established that analogy processes are patentable in so far as they provide novel and

inventive products (Case Law of the Boards of Appeal of the EPO, 8th edition 2016, I.D.9.17). Since the board acknowledges that the product of claim 5 is novel and inventive, the processes of claims 1 and 3 involve an inventive step even if they are merely seen as analogy processes.

- 5.8 In view of the above, the board concludes that the skilled person would not have arrived in an obvious way at the subject-matter of independent claims 1, 3 and 5. The same applies, *mutatis mutandis*, to the subject-matter of dependent claims 2, 4, 6 and 7.

AUXILIARY REQUESTS

Since the main request is allowable, there is no need for the board to deal with these requests.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



M. Cañueto Carbajo

W. Sieber

Decision electronically authenticated