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**Datasheet for the decision  
of 15 January 2018**

**Case Number:** T 0868/15 - 3.3.03

**Application Number:** 07252840.9

**Publication Number:** 2017302

**IPC:** C08L23/06, C08L23/08

**Language of the proceedings:** EN

**Title of invention:**

Moulded article comprising high density polyethylene copolymer

**Patent Proprietor:**

Borealis Technology Oy

**Opponent:**

Ineos Europe AG

**Relevant legal provisions:**

EPC Art. 56

**Keyword:**

Inventive step - (no)



**Beschwerdekammern**  
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Case Number: T 0868/15 - 3.3.03

**D E C I S I O N**  
**of Technical Board of Appeal 3.3.03**  
**of 15 January 2018**

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**Decision under appeal:** **Decision of the Opposition Division of the European Patent Office posted on 11 February 2015 revoking European patent No. 2017302 pursuant to Article 101(3)(b) EPC.**

**Composition of the Board:**

**Chairman** D. Semino  
**Members:** D. Marquis  
C. Brandt

## Summary of Facts and Submissions

- I. The appeal lies against the decision of the opposition division posted on 11 February 2015 revoking European patent No. 2 017 302.
- II. The European patent was granted on the basis of 14 claims, claim 1 reading as follows:
- "1. An injection moulded or compression moulded article comprising a multimodal high density ethylene hexene copolymer (HDPE) containing at least a lower molecular weight (LMW) polyethylene homopolymer component and a higher molecular weight (HMW) ethylene hexene copolymer component;
- wherein said HDPE has a MFR<sub>2</sub> of 0.1 to 20 g/10min when determined according to ISO 1133 at 190°C at load of 2.16 kg;
- a density of 945 to 975 kg/m<sup>3</sup> ;
- a tensile modulus of at least 850 MPa;
- a high temperature (23°C) charpy impact strength of at least 15 kJ/m<sup>2</sup> ;
- and
- an ESCR-B of at least 300h."
- III. A notice of opposition was filed in which revocation of the patent in its entirety was requested.
- IV. The following documents were cited inter alia in the decision of the opposition division:
- D1: EP 1 655 336 A1
- D5: J.T. Yeh, J-H Chen, H-S Hong, Environmental Stress Cracking Behavior of Short Chain Branch Polyethylenes, J. Appl. Polym. Sci., 1994, 54, pages 2171-2186

D6: D. Joubert et al., "Ethylene Copolymers with Fischer-Tropsch Olefins", Macromol. Symp. 2002, 178, pages 69-79

D8: J. Janzen, "Elastic Moduli of Semicrystalline Polyethylenes Compared with Theoretical Micromechanical Models for Composites", Polym. Eng. and Sci. 1992, 32, No. 17, pages 1242-1245

D11: Knuuttila et al, Metallocene-based polyolefins, 2000, pages 366 and 367

D12: FINA Chemicals: Finathene® Polyethylene XS<sup>ene</sup> The 4th generation PE pipe resins, published November 1998

- V. The decision of the opposition division to revoke the patent was announced at the oral proceedings on 20 January 2015. The decision was based on a main request (claims as granted), on auxiliary requests I to IV filed with letter of 2 March 2012 and on auxiliary request V filed with letter of 20 November 2014.

The opposition found that the main request was sufficiently disclosed but that it lacked an inventive step over D1 and in particular in view of example 3 of that document. The claimed subject matter differed from D1 i) in the presence of hexene comonomer in the high molecular weight HMW fraction instead of butene as in D1, and ii) in the Environmental Stress Crack Resistance ESCR-B value. The problem solved over D1 was the modification of the articles of D1 in order to increase their ESCR-B value without affecting negatively other mechanical properties. The solution was the replacement of butene as taught in D1 by hexene. Although D12 or D5 both concerned the technical field of pipes, the skilled person would have considered their disclosures in particular because they dealt with the problem of improving the environmental stress crack resistance of polyethylene compositions.

Regarding D5, although that document related to high molecular weight LLDPE, D8 and D11 taught that this fraction was responsible for the mechanical properties of a multimodal polyethylene composition. The skilled person would have considered any disclosure relating to articles prepared from similar polyethylenes. Therefore, the replacement of butene by hexene as a comonomer was not inventive in view of D12, or, alternatively, in view of D5 in the light of D11.

Since example 3 of D1 already disclosed the features added in claim 1 of auxiliary requests I, III, IV and V, the reasoning applied to the inventive step of the main request also applied to auxiliary requests I, III, IV and V. Compared to the main request, auxiliary request II additionally differed from D1 in the low temperature (-20°C) Charpy impact strength value of more than 8 kJ/m<sup>2</sup>. The underlying problem was the increase of the ESCR-B and the low temperature (-20°C) Charpy impact strength, without affecting the mechanical properties negatively. Increasing the ESCR-B value in D1 by replacing the butene comonomer in D1 by hexene was obvious in view of the teaching of D12 or D5 in the light of D11. Similarly, increasing the low temperature (-20°C) Charpy impact strength by replacing the butene co-monomer in D1 by hexene was also obvious in view of the teaching of D12 or D6. Auxiliary request II lacked therefore an inventive step.

- VI. The proprietor (appellant) lodged an appeal against that decision with letter dated 20 April 2015. Auxiliary request I to IV were mentioned in the statement of grounds of appeal and then provided later with letter dated 10 February 2016.

Claim 1 of auxiliary request I differed from claim 1 as granted in that the article was defined to be "a cap or closure".

Claim 1 of auxiliary request II differed from claim 1 of auxiliary request I in that the composition was additionally defined by "a low temperature (-20°C) charpy impact strength of at least 8 kJ/m<sup>2</sup>".

Claim 1 of auxiliary request III differed from claim 1 of auxiliary request I in that the ESCR-B of the composition was "at least 325h".

Claim 1 of auxiliary request IV additionally differed from claim 1 of auxiliary request II in that the minimum density of the composition was "951 kg/m<sup>3</sup>" and its ESCR-B was "at least 325h".

- VII. The respondent filed a reply to the statement of grounds of appeal and a second letter on 14 December 2017.
- VIII. In a communication sent in preparation of oral proceedings, the Board summarised the points to be dealt with and provided a preliminary view on the disputed issues.
- IX. Oral proceedings were held on 15 January 2018.
- X. The arguments provided by the appellant, as far as relevant to the present decision, can be summarised as follows:

Main request - patent as granted

Inventive step

D1 and in particular example 3 of that document was the closest prior art. Claim 1 of the main request differed from D1 in the use of hexene instead of butene and in a higher value of environmental stress crack resistance (ESCR-B). The examples of the patent showed that the composition S2 according to claim 1 displayed a higher environmental stress crack resistance and charpy impact strength than the composition C1 representing example 3 of D1. The data provided in the patent also showed that the processability and the organoleptic properties of the claimed articles had not deteriorated by using hexene as a comonomer. The problem that had been solved in view of D1 was to provide articles with improved environmental stress crack resistance without damaging their processability and organoleptic properties. The skilled person found no motivation in D1 to use hexene instead of butene to solve that problem.

The skilled person would have not considered the documents D12 and D5, since they had been published at least 10 years before the patent in suit and their teaching was not relevant to the claimed subject matter, as the documents concerned polyethylene compositions for pipes, a field that was remote from the injection or compression moulded articles of the patent. Furthermore, the compositions of D12 and D5 were not suitable for the preparation of injection or compression moulded caps and closures, since they had different densities, comonomer content and molecular weights. Also, neither D12 nor D5 contained a teaching relating to the organoleptic properties of the polyethylene compositions and D5 did not concern bimodal polyethylene compositions. There was no reason to combine the teaching of D12 or D5 with D1 and the

extrapolation needed to apply the teaching of these documents to D1 was such that it amounted to hindsight. Claim 1 of the main request was therefore inventive.

Auxiliary requests I to IV

The amendment of claim 1 of auxiliary request I differentiated even more the claimed subject matter from the teachings of D5 and D12. In auxiliary request II, the addition of the Charpy impact strength at -20°C constituted a further characterizing feature over D1 that was not taught in the prior art. The amendments performed in auxiliary requests III and IV were made to render the teachings of D12 and D5 even less relevant. The arguments of inventive step were otherwise the same as those provided for the main request.

XI. The arguments of the respondent, as far as relevant to the present decision, can be summarised as follows:

Main request - patent as granted

Inventive step

D1 was the closest prior art. In particular, claim 1 of the main request differed from the composition of example 3 of D1 in that hexene was used instead of butene and in a higher value of the environmental stress crack resistance ESCR-B. The patent showed that the use of hexene over butene resulted in improved stress crack resistance. It was obvious to use hexene in place of butene in bimodal ethylene copolymer compositions in view of D1 which already contemplated the use of hexene taken in combination with the teachings of D12 or D5.



D12 disclosed that the use of hexene as a comonomer of bimodal ethylene copolymer compositions resulted in these compositions having superior mechanical properties compared with butene. It was clear for the skilled person that this effect would apply regardless of the intended use of the polyethylene, and that it was just as relevant to bimodal polyethylene used in moulded articles as to that used in pipes.

The teaching in D5 was similar to that in D12, except that in D12 bimodal polyethylenes were discussed, whereas D5 concerned monomodal polyethylene compositions. The monomodal polyethylene of D5 corresponded to the high molecular weight fraction of the bimodal polyethylene compositions of D1. D11, which represented the common general knowledge in the field of polyethylene compositions, taught that that fraction was responsible for the mechanical properties of a bimodal composition. The skilled person therefore knew that the teaching of D5 relating to the advantageous use of hexene in ethylene copolymers also applied to the bimodal compositions of D1.

Claim 1 lacked therefore an inventive step, since it was obvious to the skilled person to replace butene with hexene to improve the mechanical properties of the compositions of D1.

Auxiliary requests I to IV

None of the features added to claim 1 in the auxiliary requests I to IV altered the reasoning of inventive step provided for the main request. In particular, the teachings of D12 and D5 remained relevant to the claimed subject matter. Claim 1 of these requests lacked therefore an inventive step.

- XII. The appellant requested that the decision under appeal be set aside and that the patent be maintained as granted, or, alternatively, that the patent be maintained on the basis of any of auxiliary requests I to IV filed with letter dated 10 February 2016.
- XIII. The respondent requested that the appeal be dismissed.

### **Reasons for the Decision**

Main request - patent as granted

1. Inventive step
  - 1.1 D1 sets out to provide multimodal polyethylene compositions for injection moulded articles, in particular for caps and closure articles (paragraph 1) having not only excellent rheological and good mechanical properties such as stiffness and environmental stress crack resistance (ESCR) after injection moulding but having also good taste and odour properties (paragraphs 10 and 14). In that respect, D1 is relevant to the patent in suit which aims at providing multimodal polyethylene compositions for injection or compression moulded caps and closure articles (paragraph 1) having very high environmental stress crack resistance (ESCR), impact and tensile properties without loss of processability or affecting organoleptic properties (paragraph 15).
  - 1.2 The examples of D1 disclose a multistage ethylene polymerisation process (paragraphs 114 to 116) leading to a bimodal polyethylene composition comprising two components, an ethylene homopolymer and an ethylene

butene copolymer. Among these examples, example 3 was found to be particularly relevant by the parties. Both parties agreed with the choice of D1 as the closest prior art and with the identification of the distinguishing features of claim 1 over the example 3 of D1, namely the choice of hexene over butene as comonomer in the ethylene copolymer component of the multimodal polyethylene composition and the environmental stress crack resistance (ESCR-B) of 300h instead of 45h in example 3. The Board has no reason to take a different approach.

- 1.3 Two examples of the patent describe the bimodal polyethylene compositions S2 and C1. The preparation conditions of these compositions reported in paragraph 94 and Tables 2 and 3 show that both compositions are made of an ethylene homopolymer and an ethylene copolymer and that while the ethylene copolymer of the composition S2 contains hexene as required by claim 1 of the main request, the ethylene copolymer of the composition C1 contains butene, as in D1. Table 4 summarizes the mechanical properties (tensile modulus, stress crack resistance FNCT and ESCR-B and charpy impact strength) and the rheological properties (melt flow ratio  $MFR_2$ , density, spiral flow and shear thinning index SHI) of both compositions S2 and C1. It is apparent from the values reported in Table 4 that while the melt flow ratio  $MFR_2$ , the density, the ESCR-B value and the tensile modulus relative to both compositions S2 and C1 are according to claim 1, the composition C1 however displays a charpy impact strength at 23°C (14 kJ/m<sup>2</sup>) that is outside the range claimed in the patent (at least 15 kJ/m<sup>2</sup>). The Board observes that the lower charpy impact strength at 23°C of the composition C1 may be accounted for by differences in the preparation process of the

compositions S2 and C1, such as the different comonomer feeds used (1.6 for butene in C1 and 1.9 for hexene in S2) as reported in Table I. In any case, the composition C1 of the patent was found by both parties to be representative of the composition of example 3 of D1 since it differs from the claimed composition in the critical distinguishing feature from example 3 of D1, namely the use of butene instead of hexene as comonomer, to which the Board agrees.

- 1.4 Table 4 provides evidence that the composition S2 according to claim 1 of the main request has overall better mechanical properties than the composition C1 representing D1, as shown by the values of tensile modulus, stress crack resistance and charpy impact strength, while the processability of the two compositions is comparable, as shown by the value of shear thinning index. In addition, Table 5 shows that both compositions S2 and C1 have comparable organoleptic properties as shown by the smell test results. Starting from example 3 of D1, it follows that the problem which can be considered as solved on the basis of the available evidence is in agreement with both parties the provision of injection moulded articles having improved mechanical properties without loss of processability and organoleptic properties.
- 1.5 The question that is to be answered in view of the problem posed is therefore whether the use of hexene instead of butene as a comonomer of the ethylene copolymer component, which was seen as the solution to the problem posed, was obvious in view of the available prior art.
- 1.6 While hexene is mentioned alongside butene and octene as a possible comonomer of the ethylene copolymers of

D1 (paragraph 62), there is no indication in D1 that hexene could be the solution to the problem posed. The use of hexene in ethylene copolymers is however considered in documents D12 and D5. The fact that both D12 and D5 were published more than 10 years before the patent in suit is in itself not a reason why they would not have been consulted by the skilled person. On the contrary, it shows that these documents belonged to the prior art and that their teaching was available to the skilled person before the filing of the patent in suit.

1.7 D12 is a brochure relating to the promotion of a new grade of bimodal hexene copolymer for polyethylene pipes. It provides an insight into the historical development of four generations of polyethylene copolymers and describes the continuous improvement of their physical properties from the introduction of medium density butene and hexene copolymers up to the use of modern high density bimodal hexene copolymers (pages 6 to 9 and 14). Besides, D12 provides a more general teaching concerning the use of long chain comonomers such as butene, hexene and octene to produce branched polyethylene copolymers having improved physical properties such as resistance to slow crack growth and rapid crack propagation (pages 3 to 5) as well as improved processability (page 9). In that respect, there is no doubt in D12 that hexene is superior to butene as to the improvements reported (pages 11 to 15). That general teaching of D12 is not bound to specific requirements relating to the density or the melt index of the polyethylenes of D12, so that there is no apparent reason why that teaching would not also apply to injection grade polyethylenes.

1.8 While the general teaching of D12 may have to be extrapolated or be adjusted to some extent in order to

be applicable to injection grade polyethylenes, that has not been shown to be beyond what can be expected from a person skilled in the art of bimodal polyethylene compositions as disclosed in D12 and D1. In that regard, even the introductory part of the patent in suit describing the prior art relevant to the claimed subject matter (paragraphs 1 to 8) also suggests that the common knowledge of the skilled person in the field of multimodal high density ethylene hexene copolymers encompasses all sorts of articles including pipes, caps and closures (paragraphs 2, 5, 6 and 7). There is therefore no reason why the skilled person concerned with the polyethylene compositions of the closest prior art D1 would disregard D12. On the contrary, having regard to the general teaching of D12 pointing to the advantages of using an ethylene hexene copolymer in bimodal polyethylenes, it would have been obvious for a skilled person to try to apply that knowledge to the bimodal polyethylene compositions of D1 in order to improve the mechanical properties of moulded articles therefrom.

1.9 As it was obvious for the skilled person to combine the prior art teachings of D1 and D12 in order to solve the essential part of the problem relating to the mechanical properties of the moulded articles, the presence of the other effects relating to the conservation of the processability and the organoleptic properties of the compositions is a bonus that as such does not imply the presence of inventive step, all the more as the skilled person had no reason to believe that those properties would become unsatisfactory when using hexene.

1.10 The teaching of D5 is coherent with that of D12. D5 investigates the environmental stress crack resistance

(ESCR) under constant load of polyethylene copolymers containing short chain branching resulting from the presence of comonomers of varying chain lengths in the copolymer (page 2171: Synopsis). D5 is relevant to the claimed polyethylene compositions since it concerns the mechanical properties and in particular the environmental stress crack resistance of polyethylene compositions. D5 establishes that the ESCR of injection moulded ethylene copolymers increases as the short chain length resulting from the use of butene, hexene or octene as comonomer increases (page 2172, Table I; page 2175, experiment starting on second column; page 2184, second column). In other words, D5 shows that the environmental stress crack resistance of injection moulded parts is improved by the use of hexene over butene in ethylene copolymers. Since the hexene content of the ethylene copolymer that was derived by the appellant from Table I of D5 (10 wt%) is in line with the hexene content generally allowed in the ethylene hexene copolymer of the patent in suit (up to 10 wt% in paragraph 20) and since the amount of hexene is not explicitly limited in claim 1 of the main request either, it cannot be concluded that the hexene content of the ethylene copolymers of D5 would not be suitable to injection moulding. While it is not disputed that the teaching of D5 does not concern bimodal polyethylene compositions per se, the teaching of D5 is nevertheless relevant to bimodal compositions as the ethylene copolymers disclosed in D5 correspond to the high molecular weight ethylene copolymer components of the bimodal polyethylene compositions of D1. Since D11 teaches that it is the high molecular weight component that influences more relevantly the mechanical properties of the composition (page 366, second paragraph of the section "Bimodal polyethylene and two-stage processes" and figure 1), the skilled person

would have expected in view of the teaching of D5 an improvement of the mechanical properties of the bimodal polyethylene compositions as a result of using hexene over butene in the ethylene copolymer component.

- 1.11 In view of this, the skilled person, starting from the composition of example 3 of D1 as the closest prior art, would, by application of the teaching provided in D12 or D5, use hexene in place of butene in the expectation of providing injection moulded articles having improved mechanical properties without loss of processability and organoleptic properties.
  
- 1.12 As to the range defining the environmental stress crack resistance (ESCR-B) in claim 1 of the main request (at least 300h), the description discloses preferred ranges of ESCR-B (paragraph 39) but it does not disclose the steps that are essential in order to cross the threshold of at least 300h beyond the use of hexene as a comonomer. The value reported in Table 4 of the patent for the composition C1 (310h) representing the compositions of D1 shows that, when measured under the conditions used in the patent, the value of ESCR-B of a composition with butene as a comonomer may actually already be within the claimed range. Moreover, it is undisputed that the use of hexene increases the value of ESCR-B. In other words, the data provided in the patent in suit indicates that a multimodal ethylene copolymer having a value of ESCR-B of at least 300h, as required in claim 1 of the main request, is possibly already obtained when using butene, which is even more the case when butene is replaced by hexene. Also, the patent is silent about the meaning of the threshold of 300h for the properties of the claimed articles. Under these circumstances, the range of ESCR-B as defined in claim 1 of the main request is considered to be on one



side arbitrary and on the other side the direct consequence of the use of hexene, so that its presence does not result in the provision of an inventive step.

- 1.13 For these reasons, claim 1 of the main request does not involve an inventive step.

#### Auxiliary requests I to IV

#### 2. Inventive step

- 2.1 Claim 1 of auxiliary request I differs from that of the main request by the added feature "wherein said article is a cap or closure". This feature which is present in D1 and does not constitute a further distinguishing feature therefrom was introduced by the appellant to further differentiate the claimed subject matter from the documents D12 and D5. The teaching of D12 or D5 has however been found to be generally applicable to the compositions of the closest prior art D1 in the context of the main request. Since the closest prior art D1 is concerned with the provision of injection or compression moulded articles for cap or closure (paragraph 14 and claim 22 of D1), the teaching of D12 or D5 is applicable to caps and closures as well and the amendment made in claim 1 of auxiliary request I does not invalidate that teaching. The issue with respect to inventive step remains therefore the same as that for the main request and, consequently, the same reasoning and the same conclusion apply (point 1 above).

- 2.2 Claim 1 of auxiliary request II further differs from that of the auxiliary request I by the specification of the charpy impact strength at a temperature of  $-20^{\circ}\text{C}$  of at least  $8 \text{ kJ/m}^2$ , which feature was meant to further

characterize the claimed subject matter from the disclosure of example 3 of D1, for which the charpy impact strength at  $-20^{\circ}\text{C}$  is  $7.3 \text{ kJ/m}^2$ , and add to the technical problem a further aspect relating to the increase of the impact properties. In this respect, the patent only provides a list of ranges that may define the charpy impact strength at  $-20^{\circ}\text{C}$  (paragraph 42), but does not contain a teaching showing in how far that range has a specific meaning for the claimed articles and how a value of more than  $8 \text{ kJ/m}^2$  may be obtained for that property other than by substituting hexene for butene in the bimodal ethylene compositions. Since D12 or D5 already teach the use of hexene in the compositions of D1 and since the ranges for the charpy impact strength at  $-20^{\circ}\text{C}$  taught in D1 are analogous to those of the patent, one of the preferred ranges taught in D1 ( $5 \text{ kJ/m}^2$  or more and up to  $20 \text{ kJ/m}^2$  in paragraph 42) overlapping with the one now claimed in the auxiliary request II, the skilled person would have arrived to the range now claimed without any inventive activity. Claim 1 of auxiliary request II lacks therefore an inventive step.

- 2.3 Claim 1 of auxiliary request III differs from that of the auxiliary request I in that the minimum value defining the range of ESCR-B was raised from 300h to 325h. That amendment was acknowledged by the appellant not to modify the discussion of inventive step carried out for auxiliary request I. Indeed, the minimum value of 325h for the ESCR-B as such was not shown to contribute to a different technical problem than the one which was formulated for the main request. While the substitution of hexene for butene in the bimodal ethylene compositions D1 is not inventive for the reasons already outlined for claim 1 of the main request, the specific value of 325h appears as an

arbitrary one among the normal values which the skilled person would have obtained without exercising an inventive activity. On that basis, the subject-matter of claim 1 of the auxiliary request III does not involve an inventive step for the same reasons as outlined above.

2.4 Claim 1 of auxiliary request IV differs from that of the auxiliary request II in that the minimum value defining the range of ESCR-B was raised from 300h to 325h and the minimum value of the range defining the density of the composition was raised from 945 kg/m<sup>3</sup> to 951 kg/m<sup>3</sup>. While it was acknowledged that the amendment of the minimum value for the density did not result in a further distinguishing feature with respect to example 3 of D1 (see Table II, example 3 has a density of 960.3 kg/m<sup>3</sup>), this amendment was meant to further characterize the claimed subject matter from the teaching of D12 and D5. Since however the teachings relating to the advantages of using hexene is nowhere made conditional to specific ranges of density in D12 or D5, the limitation of the density range in claim 1 of auxiliary request IV leaves the validity of their teaching untouched. As for the remaining amended features of claim 1, it was acknowledged by the appellant that they did not modify the argumentation already provided for the previous auxiliary requests. Under these circumstance, the reasoning relating to the obviousness of these amendments as provided for the auxiliary requests I to III remains the same with the consequence that claim 1 of auxiliary request IV does not involve an inventive step.

2.5 For these reasons, none of the requests on file meets the requirements of Article 56 EPC.

**Order**

**For these reasons it is decided that:**

The appeal is dismissed.

The Registrar:

The Chairman:



B. ter Heijden

D. Semino

Decision electronically authenticated