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Datasheet for the decision of 25 September 2014

Case Number: T 2212/11 - 3.3.03

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Language of the proceedings: EN

Title of invention:
Multimodal polyethylene composition for pipes

Patent Proprietor:
Borealis Technology Oy

Opponent:
Ineos Sales (UK) Limited

Relevant legal provisions:
EPC Art. 54, 56
RPBA Art. 13(1)

Keyword:
Novelty - main request (no)
Inventive step - Auxiliary requests 1 to 5 (no)
Late-filed auxiliary request 6 -
request clearly allowable (no)

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Case Number: T 2212/11 - 3.3.03

D E C I S I O N
of Technical Board of Appeal 3.3.03
of 25 September 2014

Appellant: (Opponent)	Ineos Sales (UK) Limited Hawkslease Chapel Lane Lyndhurst Hampshire SO43 7FG (GB)
Representative:	Smith, Julian Philip Howard Mathisen & Macara LLP Communications House South Street Staines-upon-Thames Middlesex, TW18 4PR (GB)
Respondent: (Patent Proprietor)	Borealis Technology Oy P.O. Box 330 06101 Porvoo (FI)
Representative:	Kador & Partner Corneliusstrasse 15 80469 München (DE)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 28 July 2011 concerning maintenance of the European Patent No. 1655333 in amended form.**

Composition of the Board:

Chairman B. ter Laan
Members: D. Marquis
C. Vallet

Summary of Facts and Submissions

I. The appeals by the patent proprietor and the opponent lie from the decision of the opposition division dated 28 July 2011 maintaining European patent N° 1 655 333 (based on application number 04 026 092.9) in amended form.

II. The patent was granted with a set of 22 claims of which independent claims 1, 18, 19 and 21 read as follows:

"1. A polyethylene composition comprising a base resin which comprises
(A) an ethylene homo- or copolymer fraction, and
(B) an ethylene copolymer fraction comprising at least one alpha-olefin comonomer having at least 4 carbon atoms,
wherein
(i) fraction (A) has a lower average molecular weight than fraction (B), and
(ii) the comonomer content and the density d of the base resin which is 949.5 kg/m^3 or lower satisfy the following relation:
comonomer [mol%] ≥ -0.0612 d [kg/m^3] mol%/(kg/m^3) + 58.6 , and
(iii) the base resin comprises more than 0.5 mol% of at least one alpha-olefin comonomer having at least 4 carbon atoms."

"18. A process for the production of a polyethylene composition according to any of the preceding claims comprising the steps of
i) polymerising ethylene monomers, and optionally one or more alpha-olefin comonomers, in the presence of a Ziegler-Natta catalyst to obtain the first ethylene homo- or copolymer fraction (A)

ii) polymerising ethylene monomers, and one or more alpha-olefin comonomers, in the presence of a Ziegler-Natta catalyst to obtain the second ethylene copolymer fraction (B) having a higher average molecular weight than fraction (A),
wherein the second polymerisation step is carried out in the presence of the polymerization product of the first step."

"19. An article comprising a polyethylene composition according to any of claims 1 to 18."

"21. Use of a polyethylene composition according to any of claims 1 to 17 for the production of an article."

Claims 2 to 17 were directed to preferred embodiments of claim 1. Claim 20 was directed to preferred a embodiment of claim 19. Claim 22 was directed to preferred a embodiment of claim 21.

III. A notice of opposition against the patent was filed in which the revocation of the patent was requested on the grounds according to Article 100(a) EPC (lack of novelty and lack of inventive step) and Article 100(b) EPC.

IV. By a decision announced orally on 25 May 2011, the opposition division maintained the patent in amended form on the basis of the auxiliary request filed with letter of 16 January 2009. The decision was based *inter alia* on the following documents:

D1: EP-A-0 897 934
D2: EP-A-1 489 112

In the decision it was held that the claims as granted (main request) were sufficiently disclosed but that claims 1 and 18 were not novel over D1. The auxiliary request however met the requirements of Articles 84, 123(2) and 123(3) EPC and was also novel and inventive because none of the cited documents disclosed or suggested that the combination of features of claim 1 or claim 18 would result in multimodal polyethylene compositions especially suitable for pipes having not only a good balance between certain mechanical properties such as slow crack propagation and rapid crack propagation resistance, but also a good balance between these mechanical properties and the processability with respect to the extrusion to pipes.

V. On 21 September 2011, the patent proprietor lodged an appeal against the decision of the opposition division and paid the prescribed appeal fee on the same day. The statement setting out the grounds of the appeal was filed on 18 November 2011. The patent proprietor requested that the patent be maintained on the basis of the main request (claims as granted) or any of two auxiliary requests filed with the statement of grounds of the appeal.

VI. On 27 September 2011, the opponent lodged an appeal against the decision of the opposition division and paid the prescribed appeal fee on the same day. The statement setting out the grounds of the appeal was filed on 5 December 2011. The opponent submitted the following documents:

D4: Technical datasheet for Eltex®TUB121N3000, published March 2002
D5a: production datasheet for lot number 9789 of Eltex®TUB121N3000

D5b: production datasheet for batch lot number 11136 of Eltex®TUB121N3000
D6: Declaration by Luc Dheur
D7: NMR results for batches 1102921-01 and 1102921-02
D8a: invoice 95065647 to Helwan, Egypt (Feb 2003)
D8b: invoice 6070005042 to Fardell Trading, USA (Feb 2004)

The opponent requested that the patent be revoked.

VII. By letter dated 5 April 2013, the opponent again requested the revocation of the patent and filed new documents:

D9: "PE100 resins for pipe applications", published December 1996.
D10: WO 97/47682
D11: WO 95/35323
D12: a 2006 experimental report from Mats Bäckman
D13: Prediction of MFR of bimodal polyethylenes, Hagstrom
D14: PPI "Handbook of Polyethylene Pipe", Chapter 13 page 4, 2009.

Objections of lack of novelty and lack of inventive step over D10 were raised against claim 1 of the main request and auxiliary requests 1 and 2.

VIII. by communication of 31 July 2014, the parties were summoned to oral proceedings to be held on 25 September 2015. The communication also contained the issues to be discussed.

IX. On 13 August 2014, the patent proprietor filed auxiliary requests 3, 4 and 5.

X. On 22 August 2014, the opponent filed document D15 (WO 00/22040) and requested that it be admitted to the proceedings.

XI. Oral proceedings were held on 25 September 2014. After discussion of the inventive step of auxiliary request 5, the patent proprietor filed auxiliary request 6.

XII. The patent proprietor's arguments may be summarised as follows:

Main Request

- Novelty

Example 4 of D1 disclosed a composition for film application (page 7, lines 20-25 and Table 2). That composition was not comparable to the compositions according to claim 1 of the main request which dealt with compositions for pipes, requiring different properties. D1 was silent about the fact that in order to be suitable for pipe applications the composition had to fulfil the specific relationship between comonomer content and density of the base resin as indicated in claim 1 as granted. Therefore, this feature was not disclosed in D1 so that claim 1 of the main request was novel over example 4 of D1.

Auxiliary request 1

- Novelty

D4 to D8 did not disclose a base resin containing two polymer fractions as claimed in auxiliary request 1. Also, D6 raised doubts as to the disclosure of those documents. The passage in D6 dealing with the

bimodality of the composition was only an allegation that the composition was bimodal. No data were provided to the patent proprietor and so there was no way for the patent proprietor of verifying the bimodality of the composition. On the basis of observations made on other compositions it was also only asserted that the molecular weight of the homopolymer fraction was lower than that of the copolymer fraction. That did not constitute a direct and unambiguous disclosure. Furthermore, no reasons were given that could excuse the late filing of those documents during appeal proceedings as the opponent recognized himself that they had been available to him since at least 25 March 2011, when they were mentioned for the first time. Therefore, D4 to D8 should not be admitted to the proceedings.

D10 to D14 formed the basis for an entirely new novelty objection against claim 1 of auxiliary request 1. They were filed after the reply to the statement of grounds of appeal without any reason as to their late citation. D12 revealed that the melt flow index values had only been estimated and could therefore not be trusted. Also, the data provided in Figures 1 to 3 of the letter of the opponent of 5 April 2013 relied on extrapolations of the comonomer content for values very far outside the data reported in the graphs. The data used for these extrapolations were predominantly based on compositions illustrating the comparative examples of the patent and was therefore not representative of the claimed compositions. The extrapolated values of the comonomer content in the composition were therefore unreliable. Those documents were therefore not *prima facie* relevant and should not be admitted to the proceedings.

- Inventive step

D1 was the closest prior art. Starting from example 8 of D1, the technical problem solved by the patent in suit was to provide polyethylene compositions suitable for pipes displaying an improved combination of properties made up of high mechanical strength, good long term stability, notch/creep resistance, crack propagation resistance and processability. Example 1 of the patent showed that that technical problem was solved over the comparative examples which represented compositions according to D1. The absence of a prepolymerisation in the comparative examples as compared to example 1 had no significant impact on the properties of the produced composition. The solution to the technical problem was a combination of the base resin, the limitation of density and its relation to the comonomer content and the shear thinning index. That combination of features was not taught in the prior art. In particular, D1 did not teach the use of a base resin density of 949.5 kg/m^3 or lower, a comonomer content of at least 0.5 mol% and a shear thinning index (SHI) of 50 or more. D15 related to a different problem, i.e. sagging in large diameter pipes. Its teaching could not be applied to D1. Also, Table 1 of D1 disclosed base resins with densities above 0.950, suggesting to increase and not to decrease the density of the base resin. The claimed subject-matter was therefore inventive. The arguments in favour of inventive step of auxiliary request 1 applied also to auxiliary requests 2 and 3.

Auxiliary requests 4 and 5

- Inventive step

D1 only disclosed that densities of the base resin could range from 940 to 965 kg/m^3; it did not suggest the more specific range of claim 1 of auxiliary requests 4 and 5 in combination with the claimed comonomer content and the shear thinning index in the context of pipes. The teaching provided by D1 about films could not be applied to pipes. Furthermore, D1 did not contain any teaching about the good balance of mechanical properties and processability of polyethylene compositions. The subject matter of claim 1 of auxiliary requests 4 and 5 was not obvious in view of the prior art.

Auxiliary request 6

The fact that the shear thinning index was further limited to above 100 constituted a clearer distinction and provided a significant contribution of the processability without compromising the long term stability of the pipes over those of D1. Example 1 of the patent showed that the processability of the composition was improved and that the mechanical properties of the resulting pipes were maintained. The claims of auxiliary request 6 were therefore allowable.

XIII. The opponent's arguments may be summarised as follows:

Main Request

- Novelty

Example 4 of D1 disclosed a polyethylene composition having a density of 949 kg/m^3 and comprising two polymer fractions; the melt index of the homopolymer was approximately 10000 times higher than that of the copolymer, hence its molecular weight was clearly and

unambiguously lower than that of the copolymer. From the values given in table 2 of D1, the comonomer content and the overall amount of comonomer (0.76 mol%) could be calculated to fall within the range now being claimed. Therefore, claim 1 of the main request lacked novelty over D1.

Auxiliary request 1

- Novelty

D4 to D8 showed that two polyethylene compositions comprising an ethylene/hexene copolymer had been sold in the form of the two specified batches LIA09789 and LIA11136 of Eltex®TUB121N3000 before the priority date of the patent in suit. Comonomer identity, content and shear thinning index were measured on retained samples of both batches, as described in declaration D6 and accompanying NMR analysis D7. Claim 1 of auxiliary request 1 lacked novelty over those two compositions. It had only been possible to obtain proof of the identity of the two compositions disclosed in D4 to D8 only after the opposition proceedings before the opposition division. Therefore, D4 to D8 should be admitted into the proceedings.

Example 4 of D10 showed a bimodal polyethylene composition of an ethylene homopolymer and an ethylene/butene copolymer having a density of 947 kg/m^3. The value of the final melt index proved that the ethylene/butene copolymer made in the gas phase reactor had a lower melt index, and hence higher molecular weight, than the ethylene homopolymer. Based on an extrapolation of data found in D11 to D14, it was highly likely that the comonomer content of the composition of example 4 of D10 was above 0.65 mol%.

D10 took away the novelty of claim 1 of auxiliary request 1 and should therefore be admitted to the proceedings.

- Inventive step

The composition of example 8 of D1 represented the closest prior art. The examples provided in the patent in suit did not demonstrate any technical effect over the compositions of D1. Starting from D1, the technical problem solved was therefore to provide further polyethylene compositions for pipes. The solution to that problem, a composition with a shear thinning index above 50, was obvious in view of the teachings of D1 and D15. D1 taught a decrease in density of the compositions and D15 taught that bimodal polyethylene compositions with good extrudability and good mechanical properties in pipes could be obtained with a shear thinning index of between 50 and 150, thereby rendering obvious claim 1 of auxiliary request 1. The arguments against inventive step of auxiliary request 1 applied also to auxiliary requests 2 and 3. No novelty objections were raised against the auxiliary requests 2 to 6 during oral proceedings.

Auxiliary requests 4 and 5

- Inventive step

The limitation of the subject-matter of claim 1 of auxiliary requests 4 and 5 to pipes did not distinguish the claimed compositions any further over that of example 8 of D1. Also, the data available in the patent in suit did not demonstrate any additional effect resulting from a density limited to a range of 945 to 949.5 kg/m^3 and a shear thinning index of more than 50

or 75. D15 showed that sagging, and therefore processability, was improved by the choice of a composition displaying a shear thinning index in the range of 50 to 150, which overlapped that of claim 1. The subject matter of auxiliary requests 4 and 5 was therefore obvious.

Auxiliary request 6

The argumentation of lack of inventive step of auxiliary request 6 was essentially the same as that provided for the previous requests. Raising the shear thinning index to more than 100 did not provide any further technical effect over the composition of example 8 of D1. Also, the patent did not show that such an increase of the processability was detrimental to the mechanical properties of the pipes. Therefore, the balance between those two properties did form any basis for an inventive step. Auxiliary request 6 was therefore not allowable.

XIV. The patent proprietor requested that the decision under appeal be set aside and that the patent be maintained as granted (main request), or on the basis of the first or second auxiliary request filed with letter of 22 March 2012 or on the basis of the third to fifth auxiliary requests filed with letter of 13 August 2014 or on the basis of auxiliary request 6 filed during oral proceedings before the Board.

XV. The opponent requested that the decision under appeal be set aside and that the European patent No. 1 655 333 be revoked.

Reasons for the Decision

1. The appeal is admissible.

Main request (as granted)

2. Novelty

2.1 Example 4 of D1 discloses the preparation of a polyethylene composition carried out in suspension in isobutane in two loop reactors connected in series. In the first reactor ethylene homopolymer (A) was produced, which was introduced in the second reactor, in which ethylene/hexene copolymer (B) was produced. The properties of both fractions (A) and (B) produced in the course of that two step polymerisation and of the resulting composition are reported in Tables 1 and 2 of D1.

2.2 According to Table 2, the melt index MI_2 of fraction (A) is 116 g/10min and the melt index MI_5 of fraction (B) is 0.015 g/10min. In view of the inversely proportional relationship between melt index and molecular weight and the order of magnitude of difference between both melt indices, it can be concluded that the ethylene homopolymer fraction (A) has a lower molecular weight than ethylene copolymer fraction (B). This was not contested by the patent proprietor.

2.3 The base resin of the composition of example 4 of D1 has a density 949 kg/m^3 (Table 2) and is within the claimed range (lower than 949.5 kg/m^3).

2.4 Regarding the content of hexene comonomer in the base resin of example 4 of D1, Table 2 states it to be 2,28 weight%, which amounts to 0.76 mol %. The hexene content in the base resin of example 4 of D1 is therefore within the range of more than 0.5 mol% now being claimed.

2.5 With a comonomer content of 0.76 mol% and a density of 949 kg/m^3 the composition of example 4 of D1 also fulfils the equation of
Comonomer [mol%] ≥ -0.0612 d [kg/m^3] mol%/(kg/m^3)+ 58.6.

2.6 The composition of example 4 of D1 therefore has all the features of present claim 1.

2.7 Claim 1 of the main request contains no requirement for the claimed composition other than that two fractions have to be present of which the homopolymer has to have a lower molecular weight than the copolymer and that the comonomer content and density lie within the indicated ranges and fulfil the indicated equation. Claim 1 does in particular not contain any requirement regarding the intended use of the composition.

Since Claim 1 uses terms well-established in the field, there is no reason to turn to the description in order to give a (different) interpretation to claim 1. The description may not be used to redefine the technical features required by the claim in a way not warranted by the wording of the claim itself. In particular, the description cannot be relied on to exclude subject-matter from the claim that the ordinary meaning of the terms used would include as part of what is claimed. Thus, the intended use of the polyethylene for the production of pipes can not be taken into account for the novelty assessment of claim 1 over D1 as it has not

been shown to characterize the claimed compositions and is not even mentioned in claim 1 of the main request. Also, the patent in suit does not set out any other requirement that the claimed polyethylene compositions should fulfil in order to be suitable for pipes. Paragraphs 2 and 6 of the patent in suit only mention examples of properties that polyethylene pipes may display in general terms from which it cannot be concluded that polyethylene compositions used in pipes must fulfill specific and defined requirements over the compositions disclosed in D1. In addition, claim 1 of the main request does not recite any of the properties of these paragraphs so that they cannot distinguish the claimed compositions over the compositions of D1. Finally, paragraph 7 only generally describes polyethylene compositions with fractions of different molecular weights according to claim 1 of the patent in suit. That condition however is already fulfilled by the composition of example 4 of D1 as shown above.

2.8 It can be concluded that the polyethylene composition of example 4 of D1 anticipates the subject matter of claim 1 of the main request. Claim 1 lacks therefore novelty over D1.

Auxiliary request 1

3. Amendments

3.1 The claims of auxiliary request 1 were not contested by the opponent under Articles 123(2), 123(3) and 84 EPC. Claim 1 of auxiliary request 1 corresponds to claim 6+2+1 as originally filed wherein the base resin has a density of lower than 949.5 kg/m^3 and the composition has a shear thinning index ($SHI_{(2.7/210)}$) of 50 or more. Claim 1 of auxiliary request 1 also corresponds to

claim 2 as granted. Claim 17 corresponds to originally filed claim 19 (claim 18 as granted) to which the passage "*and the polymerisation is carried out in a loop reactor/a gas-phase reactor combination*." was added. This passage finds a basis on page 11, lines 26 and 27 of the originally filed application. The claims of the auxiliary request 1 fulfils the requirements of Articles 123(2) and (3) EPC and 84 EPC.

4. Novelty

4.1 D1 does not disclose the shear thinning index values ($SHI_{(2.7/210)}$) of any of its polyethylene compositions. That was not disputed by the opponent. Since all of the auxiliary requests contain a requirement regarding the shear thinning index of the polyethylene compositions being claimed or being referred to in the claims, all auxiliary requests are novel over D1.

4.2 D4 to D8 were filed by the opponent in support of a novelty objection based on public prior use of the claimed compositions; that argument was raised for the first time with the statement of grounds of appeal. The admission to the proceedings of those late filed documents as well as the arguments based upon them underlies the discretion of the Board (Article 12(4) RPBA). One of the criteria for admitting late filed documents is their *prima facie* relevance.

4.2.1 D4 is a technical datasheet describing Eltex©TUB121N3000 as a high density ethylene-hexene copolymer suitable for the extrusion of pressure pipes. The natural density (948.5 kg/m^3) and pigmented density (959 kg/m^3) as well as the melt flow index MFR_5 (0.29 g/10min) are disclosed. D5a and D5b are production datasheets of two lots numbered 9789 and 11136) of

Eltex®TUB121N3000. D7 contains results of measurements on a product that has not been further identified and D8a and D8b are invoices regarding the sale of two batches of product.

4.2.2 According to D6, which is a declaration of an employee of the opponent, samples of the two batches 9789 and 11136 of Eltex®TUB121N3000 had been retained. They conformed to the general specification outlined in the technical datasheet D4. The NMR analysis of those batches provided in D7 revealed the presence of 1-hexene in an amount of 0.6 mol%. The shear thinning index ($SHI_{(2.7/210)}$) could be calculated from the measurement procedure referred to in D15. As to the molecular weight of the two fractions (A) and (B) of the base resin, still according to D6, the bimodality of those two batches could be confirmed by personal observation.

4.2.3 However, D6 is not supported by any data or measurements, in particular regarding the identity and the properties of the retained samples of the two afore-mentioned batches which were apparently available for NMR, impact and rheological testing. D7 gives no graphs, only results. There is no evidence on file that the polymer compositions of D4 to D8 are indeed bimodal. Also, there is no evidence in D6 that the molecular weight of those samples is in conformity with the present claims. The general indication in the last line of page 1 of D6 that that is usually the case for polyethylene compositions, cannot constitute a clear and unambiguous disclosure that such was indeed the case for the retained samples of batches 9789 and 11136.

4.2.4 It was further argued that at the time of the invention (2004), the only commercial polyethylene products with an MRS 10 rating, as was apparently the case of Eltex®TUB121N3000 according to D4, were all bimodal. Even if this were true, it still does not establish that the base resin is composed of an ethylene homo- or copolymer fraction (A) and an ethylene copolymer fraction comprising at least one alpha-olefin comonomer having at least 4 carbon atoms (B) according to the claimed subject-matter.

4.2.5 In view of the above, D4 to D8 are *prima facie* not relevant to the novelty of the claimed subject-matter. Therefore those documents are not admitted to the proceedings (Article 12(4) RPBA).

4.3 D10 to D14 were filed at an advanced stage of the appeal proceedings in support of the argument that the composition of claim 1 of auxiliary request 1 was anticipated by example 4 of D10. D10 does not disclose the butene comonomer content of the base resin. Based on the extrapolation involving D11 to D14 of data provided in the patent in suit, the opponent argued that the comonomer content of D10 was overwhelmingly likely within the claimed range. These extrapolations were however based on data provided in the patent which relate to a different comonomer (hexene vs. butene) in a different base resin. It was not shown how that data relating to hexene copolymers could be applied to butene copolymers. The validity of the extrapolations provided in D11 to D14 was therefore not established. For lack of any evidence that the extrapolation has been validly applied, the Board comes however to the conclusion that there is no clear and unambiguous disclosure of all the features of the present claims so that D10 is not *prima facie* relevant to the novelty of

the claimed subject matter. D10 to D14 are therefore not admitted to the proceedings.

4.4 The claims of the auxiliary request 1 fulfil the requirements of Article 54 EPC.

5. Inventive step

5.1 The patent in suit aims to provide polyethylene compositions for pipes having an improved combination of properties in particular having enhanced stress crack propagation resistance and, simultaneously, good long-term stability (paragraph 6).

5.2 D1 relates to a method of manufacturing ethylene polymer compositions comprising a homopolymer and a copolymer of ethylene which are particularly suitable for extrusion of pipes, in particular pipes for the transport of pressurized fluids, such as water and gas (paragraphs 1 and 37). Furthermore, pipes manufactured from these polyethylene compositions are characterised by a good resistance to slow propagation of cracks and a good resistance to rapid crack propagation (paragraph 38). Both opponent and patent proprietor regarded D1 as the closest prior art. The technical problem described in D1 concerns pipes made of polyethylene compositions and is at least partly related to that described in the patent in suit. D1 is the closest prior art.

Whereas example 4 of D1 was used against the novelty of the main request, the composition of that example pertains to films. However, in example 8, the polyethylene composition is used for manufacturing a pipe D1, paragraph 58). Therefore, example 8 is an appropriate starting point for the assessment of

inventive step.

5.3 The technical problem mentioned in the patent in suit was to provide polyethylene compositions for pipes that display a good balance between good processability and high mechanical strength, notch/creep resistance, high crack propagation resistance and excellent long term stability (paragraphs 3, 4 and 9). The patent in suit sees the solution to the technical problem posed in the combination of features as recited in claim 1 (paragraph 10). The question to be answered is whether that problem has been solved vis-à-vis the closest prior art document D1.

5.4 Example 8 of D1 discloses the preparation of a polyethylene composition according to the process of claim 1 of D1. That process does not include a prepolymerisation step. According to table 4 of D1, the polyethylene composition of example 8 comprises a first fraction constituted by a homopolymer of ethylene and a second fraction of a copolymer of ethylene and hexene. The comparison of the melt flow index MI_2 of the first fraction (575 g/10min) with the melt flow index MI_5 of the second fraction (0.03 g/10min) shows that the molecular weight of the first fraction is lower than that of the second fraction. The base resin has a density of 949.6 kg/m^3. The weight percentage of comonomer hexene of the composition (QT) is 1,5 wt.%, which amounts to 0.5041 mol%, from which it can be calculated that the equation set out in claim 1 of the auxiliary request is fulfilled. The shear thinning index ($SHI_{(2.7/210)}$) of the composition of example 8 of D1 is not disclosed. From that composition a pipe is made, so that it can be concluded that the composition is processable. As to the properties of the pipe, the resistance to slow propagation of cracks (ESCR) is more

than 7224 hours and the resistance to rapid crack propagation (RCP) is more than 12 bar both at 0°C and at -15°C.

5.5 In the examples of the patent in suit, the production of polyethylene composition base resins was performed in a multistage reaction comprising slurry prepolymerisation in a loop reactor, followed by transferring the slurry to a second loop reactor in which slurry polymerisation was performed in the presence of a Ziegler-Natta catalyst to produce the low molecular weight component, followed by a second polymerisation in a gas phase reactor in the presence of the product from the second loop reactor and hexene to produce the hexene comonomer containing high molecular weight component. The polymerisation conditions and properties of the resulting polyethylene polymers are listed in Table 1 of the patent in suit.

Example 1 is the only example in the patent in suit that falls within the scope of auxiliary request 1. The composition produced in example 1 had a base resin that contained 2 weight% of the ethylene prepolymer, 43 weight% of the ethylene homopolymer of the first fraction, 55 weight% of the ethylene/hexene copolymer of the second fraction ("split"). The density of that base resin was 947.5 kg/m^3, the comonomer content was 0.93 mol/% (Table page 8). The composition also contained 2.3 weight% carbon black.
The composition displayed a shear thinning index $SHI_{(2.7/210)}$ of 101, a rapid crack propagation (RCP-S4/Tc) of -12, a slow crack propagation (notch test at 9.2 bar) of 4280 and a slow crack growth (constant tensile load test, CTL) of 8562.

5.5.1 In comparative examples 2 to 4 of the patent in suit the polyethylene compositions were produced according to the process disclosed for example 1 in which a prepolymerisation of ethylene is performed before the main polymerisation. The base resins of those comparative examples differed in their densities and comonomer contents, the compositions in their shear thinning indices. Only the composition of comparative example 2 contained carbon black, in the same amount as in example 1. The example and comparative examples of the patent in suit therefore differ from one another not only by the features of claim 1 but also by other parameters (conditions during prepolymerisation and slurry polymerisation, presence of carbon black in the composition). These differences are expected to have a significant impact on the mechanical properties and processability of the resulting compositions. Thus, the prepolymerisation step is indicated in the patent in suit to provide more homogeneous polyethylene compositions (paragraph [0051]) which ultimately may affect the processability as well as the presence of carbon black which is known to raise the density of bimodal polyethylene compositions to which it is added (D15 page 27, lines 31 to 32 and second paragraph of page 3 of the letter of 22 August 2014 from the opponent). As a consequence, it is not possible to ascribe a technical effect to those essential features of claim 1 that are not already disclosed in D1. Therefore, none of the comparative examples can be seen as being representative of the composition and process according to D1. The problem effectively solved by the subject-matter of claim 1 over D1 can therefore only be seen as to provide further polyethylene compositions for pipes.

5.6 It remains to be decided whether the solution to that problem, as defined in claim 1, was obvious in view of D1. Starting from the polyethylene composition of example 8 of D1, which differs from the compositions of claim 1 of auxiliary request 1 in that the density is 949.6 kg/m^3 and for which the shear thinning index ($SHI_{(2.7/210)}$) is not disclosed, the question to be answered is therefore whether the person skilled in the art would expect the composition of claim 1, with a density lower than 949.5 kg/m^3 and shear thinning index ($SHI_{(2.7/210)}$) of more than 50 to solve the above-defined problem.

5.7 According to D1 (paragraph 33) the polyethylene composition may display a density varying over a range of 930 to 965 kg/m^3 which overlaps the claimed range of the patent in suit (lower than 949.5 kg/m^3). Furthermore, the polyethylene composition of example 10 of D1 (Tables 5 and 6) has a density of 948.7 kg/m^3. It is also used to make pipes (paragraph 62). Therefore, the skilled reader of D1 would expect the compositions of D1 to be suitable for making pipes at densities lower than 949.5 kg/m^3.

5.8 The shear thinning index ($SHI_{(2.7/210)}$) was not reported in D1, but this parameter is disclosed in D15. D15 discloses multimodal polymer compositions for pipes which are multimodal polyethylene compositions with a density of 0.930 to 0.965 g/cm^3, comprising a low molecular weight (LMW) ethylene homopolymer fraction and a high molecular weight (HMW) ethylene copolymer fraction, said HMW fraction having a weight ratio of the LMW fraction to the HMW fraction of (35-55):(65-45) (claim 1). The HMW fraction of the polyethylene composition may comprise any of 1-butene, 1-hexene, 4-methyl -1-pentene, and 1-octene as a comonomer (claim

4). In examples 2 and 3 the polyethylene compositions are formed into pipes (Tables 1 and 2) and their resistance to slow and rapid crack propagation is reported. These compositions display a comonomer content of between 0.34 and 0.5 mol% and a shear thinning index ($SHI_{(2.7/210)}$) between 66 and 113. On page 10, lines 14 to 30 of D15 it is indicated that the shear thinning index ($SHI_{(2.7/210)}$) of the claimed compositions may generally vary over the broader range of 50 to 150. The polyethylene compositions of D15 are therefore very similar to those of D1 and those of the patent in suit and they are also used to manufacture pipes with satisfactory properties. The teaching of D15 is therefore considered to be relevant to D1. In view of the above D15 has to be considered as prima facie highly relevant and is admitted to the proceedings (Article 12(4) RPBA).

5.9 The person skilled in the art learns from D15 that the shear thinning index ($SHI_{(2.7/210)}$) of those compositions can vary over a range of 50 to 150 and expects those compositions to provide pipes with good crack resistance. Therefore, in so far as the compositions of D1 did not already fulfil the required SHI, the skilled person would expect from D15 that compositions having an SHI within the claimed range would be suitable for making pipes.

5.10 For those reasons, the subject-matter of claim 1 of the auxiliary request 1 is obvious in view of D1 and D15.

5.11 Auxiliary request 1 does not fulfil the requirements of Article 56 EPC.

6. The claims of auxiliary requests 2 to 6 were not contested by the opponent under Articles 123(2),

123(3), 84 and 54 EPC at the oral proceedings. In view of the negative conclusion reached on inventive step, it is not necessary to provide a detailed reasoning as to why these requests satisfy the requirements of the above mentioned articles.

Auxiliary request 2

7. Inventive step

7.1 For the same reasons as indicated for auxiliary request 1 the limitation of the shear thinning index ($SHI_{(2.7/210)}$) to a range of 75 or more cannot be seen to be associated with any technical effect, even less so when compared to the range of 50 or more claimed in auxiliary request 1 since the teaching provided in D15 is valid over a range of 50 to 150 for the SHI. The same arguments as given for auxiliary request 1 therefore apply to auxiliary request 2, so that the subject-matter of claim 1 of the auxiliary request 2 is obvious in view of D1 and D15.

Auxiliary request 3

8. Inventive step

8.1 Claim 1 of auxiliary request 3 is directed to the use of a polyethylene composition for the production of pipes. That composition is defined as in auxiliary request 1. Example 8 of D1 disclosed the manufacture of pipes made of polyethylene compositions (paragraph 58). It therefore remains an appropriate starting point for the assessment of inventive step of auxiliary request 3. For lack of evidence of any effect due to the use of the polyethylene compositions according to claim 1 over that of D1, the problem effectively solved can only be

seen in providing further pipes made of multimodal polyethylene.

8.2 As shown above, both D1 and D15 disclose the use of their compositions for making pipes. The use of a polyethylene composition that has been found obvious in view of D1 and D15 for producing pipes can therefore not constitute an inventive step. For those reasons, the subject-matter of claim 1 of auxiliary request 3 is obvious in view of D1 and D15.

Auxiliary request 4

9. Inventive step

9.1 Claim 1 of auxiliary request 4 is directed to the use of a polyethylene composition for the production of pipes. It differs from claim 1 of auxiliary request 3 in that the density d of the base resin is higher than 945 kg/m^3 and therefore ranges from 945 kg/m^3 to 949.5 kg/m^3. The passage of the patent describing that feature (paragraph 30) and example 1, the sole example according to the claims, do not contain any evidence of an improvement or of a technical effect due to that feature compared to the composition of example 8 of D1, which has a density of 949.6 kg/m^3. The technical problem defined for auxiliary request 3 therefore remains the same for auxiliary request 4, namely to provide further pipes made of multimodal polyethylene.

9.2 D1 discloses in paragraph 34 that the density of the polyethylene compositions may vary in the range of 930 to 965 kg/m^3. In example 10 a bimodal polyethylene composition is disclosed having a density of 948.7 kg/m^3 which is suitable for pipes. Therefore, the skilled person, working within the framework of D1, would have

considered that compositions with a density of 945 to 949.5 kg/m^3 are suitable for the production of pipes.

9.3 The use of polyethylene compositions with a density within the claimed range for manufacturing pipes can also be found in D15 (densities of 930 to 965 kg/m^3; page 12, lines 3 to 17, in particular densities of 943 to 955 kg/m^3 for larger diameter HD pressure pipes; page 12, lines 10 and 11).

9.4 Therefore, in order to merely provide further pipes made of multimodal polyethylene, the skilled person would have used the densities over the whole range proposed in both D1 and D15, so that the limitation of the density range compared to that of auxiliary request 3 cannot render the claimed subject-matter inventive. For those reasons, the subject-matter of claim 1 of auxiliary request 4 is obvious in view of D1 and D15.

Auxiliary request 5

10. Inventive step

10.1 Claim 1 of auxiliary request 5 differs from claim 1 of auxiliary request 4 in that the shear thinning index ($SHI_{(2.7/210)}$) is further limited to a range of 75 or more, which is the same limitation as in auxiliary request 2 having regard to auxiliary request 1. The same arguments therefore apply so that the subject-matter of claim 1 of the auxiliary request 5 is obvious in view of D1 and D15.

Auxiliary request 6

11. Admissibility into the proceedings

11.1 Claim 1 of auxiliary request 6 corresponds to claim 1 of auxiliary request 5 for which the relation was modified as follows:
comonomer [mol%] ≥ −0.0612 d [kg/m^3] mol%/(kg/m^3) + 58.6 + (SHI/300) and the shear thinning index ($SHI_{(2.7/210)}$) is higher than 100. The modified relation between the minimum comonomer content, the density and the shear thinning index reflects that the comonomer content of fraction (B) is raised as a result of a higher value of shear thinning index.

11.2 Auxiliary request 6 was submitted at a late stage during the oral proceedings. In accordance with Article 13(1) RPBA, "Any amendment to a party's case after it has filed its grounds of appeal or reply may be admitted and considered at the Board's discretion. The discretion shall be exercised in view of inter alia the complexity of the new subject-matter submitted, the current state of the proceedings and the need for procedural economy.". A well-established criterion used by the boards of appeal for deciding whether to admit late-filed requests under Article 13(1) RPBA is whether the new claims are prima facie allowable.

11.3 The board considers that the amendments made do not overcome the objections under Article 56 EPC for the following reasons:

11.3.1 The passage of the patent describing the modified relation in claim 1 (paragraph 21) and example 1 do not provide an evidence of an improved or further technical effect related to that feature as compared to the

composition of example 8 of D1. In particular, it was not shown that the polyethylene composition of example 1 of the patent in suit displayed an improved processability over the composition of example 8 of D1 while maintaining its good mechanical properties. The technical problem posed for auxiliary request 1 remains the same for auxiliary request 5, namely to provide further polyethylene compositions for pipes.

11.3.2 The content of monomer units derived from 1-hexene in copolymer (B) of D1 is at least 0.4% by weight and at most 10% by weight (paragraph 7). D1 discloses a particularly preferred hexene content of at least 1% by weight to not more than 4% by weight. Starting from the polyethylene composition of example 8 of D1, which has an 1-hexene content of 1.5% by weight, the teaching of the closest prior art is that pipes may still be obtained when the 1-hexene content is raised up to 10% by weight and preferably up to at most 4% by weight. Even if the relation between minimum comonomer content, density and shear thinning index is not taught in D1, D1 teaches nonetheless that the 1-hexene content of the copolymer (B) may be raised to a significant extent without imparting on the properties of the pipes manufactured therefrom. Raising the 1-hexene content in the composition of example 8 of D1 to solve the technical problem posed of providing further compositions for pipes was therefore obvious for the skilled person.

11.3.3 As shown above for the auxiliary request 5, the person skilled in the art learns from D15 that the shear thinning index ($SHI_{(2.7/210)}$) of these compositions can vary over a range of 50 to 150 and therefore would expect that polyethylene compositions with a shear thinning index between 100 and 150 to provide pipes

with good crack resistance.

11.4 Therefore, as the subject-matter of claim 1 of the auxiliary request 6 is prima facie still obvious in view of D1 and D15, the subject-matter of claim 1 of auxiliary request 6 is not admitted to the proceedings (Article 13(1) RPBA).

Order

For these reasons it is decided that:

1. The decision of the opposition division is set aside.

2. The patent is revoked.

The Registrar: On behalf of the Chairman (according to Art. 8(3) RPBA):

B. ter Heijden C. Vallet

Decision electronically authenticated