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Datasheet for the decision of 1 March 2021

Case Number: T 1585/18 - 3.3.03

Application Number: 11700357.4

Publication Number: 2526134

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Title of invention:
NOVEL POLYMERS

Patent Proprietor:
INEOS Manufacturing Belgium NV

Opponents:
Total Research & Technology Feluy
Borealis AG

Relevant legal provisions:
EPC Art. 100(b)

Keyword:
Grounds for opposition - insufficiency of disclosure (yes)

Decisions cited:
T 0435/91

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Case Number: T 1585/18 - 3.3.03

D E C I S I O N
of Technical Board of Appeal 3.3.03
of 1 March 2021

Appellant: (Patent Proprietor)	INEOS Manufacturing Belgium NV Scheldelaan 482 2040 Antwerpen (BE)
Representative:	Smith, Julian Philip Howard Mathisen & Macara LLP Communications House South Street Staines-upon-Thames, Middx TW18 4PR (GB)
Respondent: (Opponent 1)	Total Research & Technology Feluy Zone Industrielle C 7181 Seneffe (BE)
Representative:	Raboin, Jean-Christophe Total Research & Technology Feluy Zone Industrielle C 7181 Seneffe (BE)
Respondent: (Opponent 2)	Borealis AG IZD Tower Wagramerstrasse 17-19 1220 Wien (AT)
Representative:	Dehns St. Bride's House 10 Salisbury Square London EC4Y 8JD (GB)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 17 April 2018 revoking European patent No. 2526134 pursuant to Article 101(3)(b) EPC.**

Composition of the Board:

Chairman	D. Semino
Members:	D. Marquis
	W. Ungler

Summary of Facts and Submissions

I. The appeal of the patent proprietor lies against the decision of the opposition division posted on 17 April 2018 revoking European patent number 2 526 134.

II. The decision of the opposition division was based on a main request filed during the oral proceedings before the opposition division on 22 March 2018, on the first auxiliary request filed with letter dated 22 January 2018 and on the second auxiliary request also filed during said oral proceedings.

III. Claim 1 of the main request read:

"1. A copolymer of ethylene and an α-olefin said copolymer having
(a) a density D in the range 0.915-0.940 g/cm^3 measured in accordance with ISO 1183-1 (Method A), the sample being prepared by the method disclosed in the examples section,
(b) a melt index MI_2 (2.16 kg, 190°C) in the range of 0.3-5 g/10min measured in accordance with ISO 1133,
(c) a melt index MI_2 (2.16 kg, 190°C) and Dow Rheology Index (DRI), determined by the method disclosed in the examples section, satisfying the equation [DRI/MI_2]>2.65,
(d) a Dart Drop Impact (DDI), as measured by ASTM D 1709-98 (Method A), in g of a blown film having a thickness of 25µm produced from the copolymer satisfying the equation
$DDI \geq 19000 \times \{1 - Exp[-750(D-0.908)^2]\} \times \{Exp[(0.919-D)/0.0045]\}$,

and
(e) a Dow Rheology Index (DRI) in the range 1-15."

Claim 1 of the first auxiliary request differed from claim 1 of the main request in that the upper limit of the range (0.915-0.940 g/cm^3) defining the density D of the copolymer of ethylene and an α-olefin was lowered to 0.935.

Claim 1 of the second auxiliary request concerned a process for the preparation of a copolymer of ethylene and an α-olefin according to claim 1 of the main request with the upper limit of the range (0.915-0.940g/cm^3) defining the density D of the copolymer lowered to 0.933 and with the following addition at the end of the claim: "said process comprising polymerizing ethylene and an α-olefin in the presence of a metallocene catalyst system which is a monocyclopentadienyl metallocene complex, the process being performed in the slurry phase in a multistage polymerisation process".

IV. The contested decision, as far as it is relevant to the present appeal, can be summarized as follows:

- The main request did not meet the requirements of Article 123(2) EPC because the subject-matter claimed was the result of a plurality of selections from the original disclosure (decision, page 4, first section).

- Furthermore the requirements of sufficiency of disclosure were not satisfied. The claims defined broad ranges for the parameters melt index, Dow Rheology Index (DRI) and density and a condition on a further parameter on a film made by the claimed

copolymer (Dart Drop Impact, DDI). However the examples related only to very small parts of these ranges and the patent contained no indication of how the parameters could be modified to obtain copolymers covering the broader ranges claimed. Furthermore the patent was silent on the interaction between the various parameters. There was also no information on how the process parameters, including the catalyst, influenced the various properties and no teaching on how these were to be adjusted to arrive at further polymers within the claimed ranges without the exercise of trial and error.

- The same conclusions applied to the first auxiliary request.

- The second auxiliary request, claim 1 of which was directed to a multistage process operated in the slurry phase defined in one respect by the type of catalyst, was held to meet the requirements of Article 123(2) EPC. This request was held not to meet the requirements of sufficiency of disclosure on the same grounds as the main request, namely the lack of indication in the patent of how to modify the process to arrive at polymers exhibiting parameters within the scope of the claims but beyond those shown in the examples.

- Accordingly the patent was revoked.

V. The patent proprietor (appellant) filed an appeal against the decision of the opposition division. Three sets of claims were filed with the statement of grounds of appeal as main request, first auxiliary request and second auxiliary request, alongside document D19

(Simpson, D. M. and Vaughan, G. A., Ethylene Polymers, LLDPE, Encyclopedia Of Polymer Science and Technology, 2001, pages 450-454). Document US 6114486 (cited in paragraph 15 of the patent in suit) was also referred to by the appellant in appeal.

Claim 1 of the main request corresponded to claim 1 of the main request dealt with in the contested decision that was further limited in that the range defining the density D was 0.915-0.933 g/cm^3.

Claim 1 of the first auxiliary request was identical to claim 1 of the main request.

Claim 1 of the second auxiliary request, which was directed to a process for the preparation of a copolymer whose definition corresponded to that of claim 1 of the main request, was identical to claim 1 of the second auxiliary request dealt with in the contested decision.

VI. The parties were summoned to oral proceedings. Issues to be discussed at the oral proceedings were then specified by the Board in a communication dated 24 September 2020.

VII. By letter of 27 January 2021 the appellant filed new main and first auxiliary requests, these requests differing from the main and first auxiliary requests filed with the statement of grounds of appeal in that claim 4 was deleted in the main request and claim 3 was deleted in the first auxiliary request.

VIII. Oral proceedings were held on 1 March 2021, the parties being present by videoconference.

IX. The appellant's arguments, insofar as relevant to the present decision, may be summarised as follows:

Sufficiency of disclosure

- The person skilled in the art was able to prepare the copolymers of ethylene and α-olefin of operative claim 1 using the guidance provided in the patent in suit and the common general knowledge in the field. It was in particular well known how to make polyethylenes having given, wide ranges of densities and melt indexes.

- The Dow Rheology Index (DRI) was known in the art and was compositionally related to the processability of a polymer, its molecular weight distribution (MWD) as well as to its degree of long chain branching (LCB), as derivable from the patent in suit (paragraphs 15 and 18). A broad MWD and/or the presence of LCB resulted in a high DRI value. DRI also varied with the melt index (MI_2) since the processability of a polymer depended on its flowability. The skilled person thus knew that raising the melt index would raise the DRI of a polymer composition. As a result, the DRI/MI_2 feature (c) of operative claim 1 was effectively a normalised version of DRI intended to eliminate this variation: thus feature (c) specified that the compositions of the invention had a relatively high DRI for their particular melt index and feature (e) placed absolute limits on the range of DRI. The choice of the catalyst used in the preparation of the polymer was also a way to adjust the DRI/MI_2 as could be derived from a comparison of example 3 with examples 4-5 of the patent in suit. The skilled person wishing to produce copolymers

according to operative claim 1 could for instance prepare any copolymer according to examples 3 or 4 of the patent in suit and make adjustments in order to obtain a higher melt index thereby raising the DRI without changing the ratio DRI/MI_2. Also, in order to make compositions having a DRI within the claimed range (1-15) at values of MI_2 above 0.8 g/10 min the skilled person could prepare a composition having a lower DRI/MI_2 ratio analogous to that of example 3 made with catalyst A and could raise the MI_2 according to common general knowledge. The patent in suit therefore provided sufficient guidance as to features (c) relating to DRI/MI_2 and (e) relating to the DRI alone of the claimed polymer.

- The Dart Drop Impact (DDI) was known to be affected by density. D19 showed that increasing the density of an LLDPE polymer would reduce its DDI value. Thus, starting from example 4 of the patent in suit, the skilled person could expect that raising the density would lead to a decrease of the DDI. It was also common knowledge that impact resistance improved with an increase of the molecular weight (or reduced melt index). Starting from example 4 of the patent in suit, the skilled person knew what the effect of changing the melt index and/or the density would be on DDI, and would therefore be able to select appropriate melt indexes and densities when seeking to make similar compositions to those of the examples which were also inside claim 1.

- Besides, the opponent had not discharged their burden of proof showing that claim 1 was not sufficiently disclosed over its whole scope, in

particular that a composition similar to that of example 4 but with a higher density up to 0.933 g/cm^3, would not lead to a composition which still satisfied feature (d) of operative claim 1. On the contrary, the graph provided by the respondent relied on an extrapolation based on three data-points only and did not flatten at higher densities, unlike the relationship specified in (d). This graph was thus questionable.

- The patent in suit also contained clear directions over the preferred process and catalyst to use. Paragraph 18 taught that it was the "use of metallocene catalysts, preferably in a multistage process" which allowed to obtain the compositions of the invention. Paragraph 31 provided guidance as to the metallocene catalysts and their configurations and paragraphs 75-76 and 80-82 concerned the process conditions that would lead to copolymers according to operative claim 1.

- Regarding the connection between DDI and DRI/MI_2, whilst MI_2 could influence DDI, the various relationships between density, MI_2 and DDI/DRI were all known in the art. The skilled person could use common general knowledge in combination with the teaching of the invention to prepare the claimed compositions.

- The claims according to all requests on file were therefore sufficiently disclosed. Indeed the same argumentation applied to all requests.

X. The arguments of opponents 1 and 2 (respondent 1 and 2 respectively), insofar as relevant to the present decision, may be summarised as follows:

Sufficiency of disclosure

- The patent in suit did not provide sufficient guidance as to the fulfilment of feature (d) relating to an equation involving the DDI for high values of density according to claim 1. In addition, for the copolymer of example 3 of the patent in suit (Table 3) with a density of 0.9327 g/cm^3, the DDI was not provided so that it was not possible to determine whether this example was according to operative claim 1 or not. Example 4 relied upon by the appellant to show sufficiency of disclosure could not make up for the missing guidance in the patent in suit relating to the preparation of a polymer satisfying feature (d).

- Furthermore, the opposed patent failed to provide guidance as to how the DDI and/or DRI could be adjusted by changing the polymer or by modifying the process parameters. The skilled person was therefore presented with an undue burden on how to obtain, throughout the breadth of the claim, copolymers which had the combination of properties required by claim 1.

- Examples 4-6 of the patent in suit that were relied upon by the appellant only allowed the production of a copolymer having densities between 0.9196-0.9227 g/cm^3, melt indexes MI_2 between 0.62-0.69 g/10 min, DRI between 9.2-13.6, and DRI/MI_2 between 14.4-19.8. This was not commensurate with the claimed scope. In particular, the ranges of the parameters disclosed in the examples only covered a very small part of the complete claimed range. There was no indication or information

disclosed in the patent in suit on how to modify one or more of the parameters into the broader range scope of protection and what was the influence of this modification on the other parameters.

- It was alleged that a broad MWD would give a high DRI value and hence good processability. However, the copolymer of example 3, with a MWD of 11.3 had a DRI of only 1.8 whereas the copolymer of example 4, with a MWD of only 4.8 had a DRI of 11.7. These examples contradicted the argument of the appellant.

- Furthermore, raising the melt index in example 4 to 0.8 g/10 min or more would bring the DRI outside the range of operative claim 1. Example 3 would not provide any relevant guidance since there was no disclosure of the DDI of the produced copolymer. Using the same methodology as proposed by the appellant for example 4, the copolymer of example 3 which had a DRI/MI_2 of 5.3 showed that only copolymers having melt indexes below 2.8 g/10min would ensure that the DRI was within the range of 1-15 according to operative claim 1.

- The equation in feature (d) had been devised by the authors of the patent in suit and could not be found in the literature. The representation of examples 4-6 of the patent in suit on a graph showed that they satisfied equation (d). It was apparent that these examples represented low values of density. There was no guidance in the patent in suit that for higher density values the DDI of the produced polymers would satisfy the equation defined in feature (d). In particular an

extrapolation of the available data clearly showed that at high densities the condition was not met. A steep decrease in DDI when increasing density was also confirmed by document D19. The patent in suit therefore did not provide a teaching of how to obtain the necessary DDI over the range of densities claimed. Even if lowering the melt index increased DDI, the skilled person could only reduce the melt index by 0.3 g/10min to ensure an appropriate DDI. However, small reductions of melt index was unlikely to be enough to overcome the trend. There was in that respect not enough guidance in the patent in suit.

- The claims according to all requests on file were thus not sufficiently disclosed. Indeed the same argumentation applied to all requests.

XI. The appellant requested that the decision under appeal be set aside and the case be remitted to the department of first instance for further prosecution on the basis of the main request or on the basis of the first auxiliary request both filed with letter dated 27 January 2021, or, if the main request and the first auxiliary request filed with letter dated 27 January 2021 were not admitted into the proceedings, on the basis of the main request or on the basis of the first auxiliary request both filed with the statement of grounds of appeal, or, in a further alternative, on the basis of the second auxiliary request filed with the statement of grounds of appeal.

XII. The respondents requested that the appeal be dismissed. In the alternative, should the Board come to the conclusion that the requirements of sufficiency of

disclosure were met, that the case be remitted to the department of first instance for further prosecution.

Reasons for the Decision

1. Preliminary remark

1.1 Out of the five requests defended by the appellant during the appeal proceedings four of them (the main and first auxiliary requests submitted with letter dated 27 January 2021 and the main request and first auxiliary requests filed with the statement of grounds of appeal) contain the same product claim 1, while the fifth (the second auxiliary request filed with the statement of grounds) is directed to a process for the preparation of a copolymer whose definition corresponds to that of claim 1 according to the other requests.

1.2 While the respondents objected to the admittance of some of the requests, it was not disputed that at least the second auxiliary request was in the proceedings as it corresponded to a request decided upon in opposition and its admittance was not objected to.

1.3 As the parties confirmed at the oral proceedings before the Board that the same objection of lack of sufficiency of disclosure with the same arguments applied both to process claim 1 of the second auxiliary request and to product claim 1 of the other requests, the Board for reasons of procedural economy found it not necessary to hear the parties on the issue of admittance of the disputed requests before having decided on the issue of sufficiency of disclosure. As the conclusion was reached that all requests do not meet the requirement of sufficiency of disclosure, there is no need to decide on the issue of admittance

of the disputed requests and that issue is not dealt with in any further detail in what follows.

1.4 For ease of explanation sufficiency of disclosure of product claim 1 according to the main and first auxiliary requests in both version is dealt with first (section 2, below) and then the validity of the same reasoning for process claim 1 of the second auxiliary request is analysed (section 3, below).

Sufficiency of disclosure

2. Product claim

2.1 Product claim 1 according to the main and first auxiliary requests in both versions (referred to as product claim 1 in what follows) defines a copolymer in terms of both structural features setting out the constituents of said copolymer and parametric requirements relating to the properties of the copolymer (features (a)-(c) and (e)) as well as the impact resistance of a film produced from that copolymer (feature (d)).

2.2 Structurally, the copolymer of product claim 1 is only defined in that it is made of ethylene and an α-olefin. There is no further structural definition in claim 1 relating to the choice of the α-olefin or to the amount of that comonomer. The claimed copolymer is thus mainly defined by a set of parametric requirements it must fulfill.

2.3 As to this set of parametric requirements, the copolymer of product claim 1 must be such that it has:
(a) a density D in the range 0.915-0.933 g/cm^3 measured in accordance with ISO 1183-1 (Method A), the sample

being prepared by the method disclosed in the examples section,
(b) a melt index MI_2 (2.16 kg, 190°C) in the range of 0.3-5 g/10min measured in accordance with ISO 1133,
(c) a melt index MI_2 (2.16 kg, 190°C) and Dow Rheology Index (DRI), determined by the method disclosed in the examples section, satisfying the equation $[DRI/MI_2]>2.65$,
(d) a Dart Drop Impact (DDI), as measured by ASTM D 1709-98 (Method A), in g of a blown film having a thickness of 25µm produced from the copolymer satisfying the equation
$DDI \geq 19000 \times \{1-Exp[-750(D-0.908)^2]\} \times \{Exp[(0.919-D)/0.0045]\}$,
and
(e) a Dow Rheology Index (DRI) in the range 1-15.

2.4 It was undisputed that not all copolymers of ethylene and an α-olefin necessarily fulfill the set of parametric requirements defined in that claim and that a number of parameters of the preparation process of the copolymers has to be purposely selected to obtain a copolymer satisfying the parametric requirements (a) to (e) set out in product claim 1. The question of sufficiency of disclosure in the present case is therefore whether the patent in suit provided sufficient guidance for the preparation of copolymers according to product claim 1.

2.5 In accordance with the established jurisprudence of the Boards of Appeal of the EPO, sufficiency of disclosure is to be acknowledged if a skilled person, on the basis of the information provided in the patent specification and, if necessary, using common general knowledge, is able without undue burden, i.e. with reasonable effort, to identify and prepare within the alternatives covered

by the very broad structural definition of operative claim 1 those copolymers that fulfill the set of parametric requirements within the whole breadth of the claim (Case Law of the Boards of Appeal, 9th Edition, July 2019, II.C.5.4, in particular decision T 435/91, OJ EPO 1995, 188, Reasons 2.2.1). This reflects the general legal principle whereby the protection sought must correspond to the technical contribution made by the disclosed invention to the state of the art, which excludes the patent monopoly from being extended to subject-matter which, after reading the patent specification, would still not be at the disposal of the skilled person.

2.6 Accordingly, the question to be answered in relation to sufficiency of disclosure is whether the skilled person would have been able to prepare copolymers of ethylene and α-olefins which fulfilled the parametric requirements set out in features (a) to (e) as defined in product claim 1 on the basis of the specification and common general knowledge.

2.7 It was not disputed that density and melt index are common properties of this kind of copolymers and that the skilled person would know how to independently vary these two parameters already on the basis of common general knowledge. This cannot however be considered to be the case for the parameters DRI and DDI and the conditions related to them. The conditions related to DRI will be dealt with first.

2.7.1 The meaning of the DRI parameter present in the definitions of features (c) and (e) in product claim 1 is discussed in paragraphs 15 and 99 of the specification. These passages in particular disclose the DRI as being a parameter used to express a

polymer's "normalized relaxation time as a result of long chain branching" and DRI is also defined therein as the extent to which the rheology of ethylene-octene copolymers known as ITP incorporating long chain branching into the polymer backbone deviated from the rheology of the conventional linear homogeneous polyolefins that are reported to have no long chain branches by the following normalized equation:
$DRI=[365000(\tau_0/\eta_0)-1]/10$
wherein τ_0 is the characteristic relaxation time of the material and η_0 is the zero shear viscosity of the material, the DRI being calculated by least squares fit of the rheological curve (dynamic complex viscosity versus applied frequency eg. 0.01- 100 rads/s) as described in U.S. Pat. No. 6 114 486 with the following generalized Cross equation, i.e.
$\eta(w)=\eta_0/[1+(w.\tau_0)^n]$
wherein n is the power law index of the material, $\eta(w)$ and w are the measured complex viscosity and applied frequency data respectively.

2.7.2 It is apparent from these passages of the specification that the patent in suit indicates a way of determining the DRI of a given ethylene copolymer on the basis of its rheological curve and selected indices. The specification however does not provide an explicit teaching on how an ethylene copolymer having a DRI according to feature (e) and fulfilling the condition set out in feature (c) at the same time must be prepared.

2.7.3 The appellant argued that, in line with paragraphs 15 and 18 of the specification, it was common general knowledge that the DRI was a rheological property related to the processability of the copolymer, meaning ultimately that the DRI could be varied by varying the

melt index of the copolymer. The appellant supported that argument by data on melt index and DRI reported in the examples of the patent in suit. In that regard, a comparison of examples 3-6 in Table 2 of the patent in suit shows that ethylene hexene copolymers of melt index (MI_2) increasing from 0.35 g/10 min to 0.69 g/10 min displayed a DRI which, in general, increased from 1.8 to 13.6. While that trend appears to be in line with the argument of the appellant, it is apparent that the range of melt indexes covered by the examples only represents a small portion of the range of melt indexes claimed (0.3-5 g/10 min) and there is no indication in the patent in suit that that trend would also be valid for the remainder and largest part of the range of melt index claimed.

2.7.4 Moreover, that consideration raises the question of whether there is sufficient guidance for the preparation of ethylene hexene copolymers having melt indexes chosen in that part of the claimed range (above 0.69 g/10 min and up to 5 g/10 min) and having a DRI that fulfills condition (e) (DRI in the range of 1-15). In particular, since the DRI of the copolymer of example 6 is already 13.6 for a melt index of 0.69 g/10 min, it appears legitimate to assume that following the position of the appellant an ethylene hexene copolymer having a DRI in the range of 1-15 (feature (e)) would not be achievable for a large part of the range of melt indexes.

2.7.5 The specification and the examples of the patent in suit are of little assistance when answering that question. The comparison of the preparation processes used in example 3 and in examples 4-6 relied upon by the appellant implies that the nature of the catalyst used to produce the copolymer may be a relevant factor

in adjusting the melt index and the DRI of the copolymer obtained. However, there is no guidance in the specification as to which catalyst must be chosen in the broad class of metallocene catalyst systems disclosed in paragraphs 31-68 of the specification and as to how this choice should be undertaken in order to prepare the copolymers with melt index and DRI in specific ranges. More specifically, the catalyst involved in example 3 (catalyst A) and that used in examples 4-6 (catalyst B) seem to have a significant influence on the DRI of the copolymer (1.8 in example 3 and 9.2-13.6 in examples 4-6). It is however apparent from the description of the preparations of catalysts A and B that they are very similar to one another, the metallocene being the same in both catalyst systems ("complex A", i.e. $(C_5Me_4SiMe_2NtBu)Ti(\eta^4$-1,3-pentadiene)), the ionic compound A also being the same and the preparation processes for the catalysts being very similar (paragraphs 88/89 for catalyst A and paragraphs 90/91 for catalyst B). It can only be derived from the description of their preparations in the patent in suit that catalyst A differs from catalyst B in the concentrations of Al and Ti. That alone however does not provide the skilled person with meaningful information as to which modifications of the catalyst are necessary to obtain a DRI and melt index according to operative claim 1. Whether that difference in the catalyst is the sole factor that must be adjusted to produce the significant differences in DRI of the copolymers of example 3 and examples 4-6 is also nowhere discussed in the specification nor derivable from it.

2.7.6 There is further no teaching in the rest of the specification on how to select the catalyst of the copolymerization in order to adjust the melt index and

the DRI of the copolymer. In that regard, the Board finds that the experimental evidence relating to the preparation of copolymers of ethylene and hexene present in the patent in suit does not make credible that the selection of the catalyst and/or the adjustment of the melt index of the copolymers would constitute suitable guidance generally applicable to the broad range of copolymers defined in product claim 1, in particular those having a melt index in the range identified above (above 0.69 g/10 min and up to 5 g/10 min) and meeting both conditions on the DRI. On the contrary, the considerations on the examples of the patent in suit constitute verifiable facts that support the existence of serious doubts as to the preparation of copolymers of ethylene and α-olefin over the whole scope of product claim 1.

2.7.7 A further parametric requirement of product claim 1 that limits the copolymer of ethylene and α-olefin concerns the Dart Drop Impact (DDI) and its relationship with density.

2.7.8 The DDI is, according to product claim 1 as well as paragraph 121 of the specification, a property of the copolymer that is measured on a blown film of a given thickness according to a known standard (ASTM D1709-98 (Method A)). The examples of the patent in suit all show, apart from example 3, the values of DDI (in g) relating to copolymers of ethylene and hexene produced (Table 2). Aside from the examples, the specification does not provide a teaching as to how the DDI characterizing a given ethylene α-olefin copolymer can be adjusted. Paragraph 26 of the specification seems to imply that the density of a given copolymer would be a factor when adjusting the DDI (films having a DDI≥1000 g would be obtained for copolymers of densities in the

range of 0.9118-0.9248 g/cm^3). However, since the range of densities described therein only partially overlaps with the range defined in product claim 1 (0.915-0.933 g/cm^3), the Board does not see how that teaching could be of assistance to show that the claimed subject matter was sufficiently disclosed over the whole scope of the claim.

2.7.9 Even if one considers, as it was argued by the appellant on the basis of D19, that the density and the melt index of an ethylene copolymer were known to the skilled person to be the main factors in adjusting the mechanical properties of the copolymer and in some ways therefore the DDI (marked passages in pages 450 and 452 of D19), there is still no guidance on how these parameters of the copolymer can be adjusted such that feature (d) of product claim 1 is fulfilled.

2.7.10 Feature (d) is in the form of a mathematical condition that must be fulfilled and is defined as:

$$DDI \geq 19000 \times \{1 - Exp[-750(D-0.908)^2]\} \times \{Exp[(0.919-D)/0.0045]\}$$

wherein D is the density of the copolymer. The part of the condition that sets out the threshold of DDI as a function of the density of the copolymer can be calculated over the range of densities defined in product claim 1 and has a profile shown as a graph in the figures provided by the appellant (page 3 of the letter of 7 June 2019) and by respondent 2 (page 3 of their rejoinder). The DDI of copolymers of ethylene and hexene are only provided for three examples (examples 4-6) in the patent in suit and the corresponding values are indicated in the figures of the appellant and respondent 2. While the conditions set out in (d) is

fulfilled for these examples, the examples cover a small range of densities between 0.9196 and 0.9227 g/cm^3 and there are no data for densities above that range that are still within the range defined in product claim 1 (0.915-0.933 g/cm^3). While the parties submitted different extrapolations as to how the DDI could vary as a function of density for densities in the range of 0.9227 to 0.933 g/cm^3, these extrapolations do not seem to be based on an established mathematical model and none was provided. What both figures show, however, is that according to the data of the examples a steep decrease of DDI takes place with increasing density. This steep decrease is in accordance with the information available in D19 according to which a seemingly small decrease in density (e.g. 0.005 g/cm^3) can dramatically alter mechanical properties and in particular significantly reduce dart impact (page 450, first two sentences of the second full paragraph under "Mechanical Properties"). The data in the examples in the patent together with the information in D19 provide therefore verifiable facts which justify serious doubts on the possibility of meeting the required condition for values of density in the higher part of the range in product claim 1.

2.7.11 In this respect neither the patent in suit nor the common general knowledge made available by the parties provide a reliable teaching from which it could be derived how the skilled person should proceed when adjusting the density and melt index of ethylene α-olefin copolymers such that feature (d) could be fulfilled. In that regard, the Board finds that the skilled person did not have sufficient guidance on how to adjust the process of production of the copolymer such that feature (d) was satisfied in particular for

values of density in the higher part of the range in product claim 1.

2.7.12 The examples of the patent in suit are of little assistance in that respect. Indeed, while the examples for which a value of DDI was provided (examples 4-6) show that feature (d) was fulfilled, they refer only to the lower part of the density range (D varies between 0.9196 and 0.9227 g/cm^3 in these examples). No information is available for higher density values. On the contrary, the appellant deliberately decided not to provide neither in the patent, nor at a later stage with full knowledge of the objection of lack of sufficiency the DDI value for example 3 which has a value close to the upper limit of the range (0.9327 g/cm^3).

2.8 While the reasons provided in section 2.7 and subsections 2.7.1-2.7.12 above justify separately the presence of serious doubts that the copolymer of product claim 1 is sufficiently disclosed, the situation is exacerbated by the fact that conditions (c) and (e) related to DRI and condition (d) on DDI must be simultaneously fulfilled.

2.9 In the absence of indication of suitable common general knowledge which would allow the skilled person to fill the gap between the teaching of the patent and in suit and that which would be needed to prepare copolymers of ethylene and α-olefin over the whole scope for which protection is sought, the skilled person is left for a large part of those copolymers in the need to develop such missing methodology or to find out by trial and error which copolymers from the innumerable copolymers corresponding to the broad structural teaching of the patent in suit meet the parametric requirements set out

in product claim 1. This amount in both situations to an undue burden for the skilled person.

2.10 As to the appellant's argument that it was up to the respondents to show that the preparation of the copolymers in accordance with product claim 1 amounted to an undue burden for the skilled person, the Board observes that each of the parties to the proceedings carries the burden of proof for the facts it alleges (Case Law, supra, III.G.5.1 and III.G.5.2). Who bears the burden of proof may be determined by the legal cases which the respective parties are trying to make. Whether it is discharged or not is assessed by the Board based on all the relevant evidence put before them, including the teaching or lack of teaching in the patent in suit in relation to the choice of suitable components and conditions necessary to obtain a copolymer meeting the parametric requirements of product claim 1. In the present case the existence of an undue burden results from the almost infinite number of copolymers that fall under the structural definition given in product claim 1, the serious doubts resulting from the analysis of the evidence available and the above established absence of a teaching in the patent in suit as to how select in an appropriate and straightforward manner the process conditions and components of the copolymers so as to meet the unusual parametric requirement of product claim 1. As a consequence, the onus of proof to demonstrate that the preparation of the copolymer over the whole scope for which protection is sought does not necessitate an undue amount of work for the skilled person is shifted to the patent proprietor (here appellant).

2.11 Accordingly, the subject-matter of product claim 1 lacks sufficiency of disclosure and the ground of

opposition under Article 100(b) EPC prejudices the maintenance of the patent in the form of the main and first auxiliary requests in both forms.

3. Process claim

3.1 Claim 1 of the second auxiliary request filed with the statement of grounds of appeal concerns a process for the preparation of a copolymer of ethylene and an α-olefin, said copolymer being defined by the same set of parametric requirements (a) to (e) defining the copolymer of product claim 1 . The process of claim 1 of the second auxiliary request is further defined in that it comprises "polymerizing ethylene and an α-olefin in the presence of a metallocene catalyst system comprising a monocyclopentadienyl metallocene complex, said process being performed in the slurry phase in a multistage polymerisation process". The appellant did not provide a separate argumentation for claim 1 of the second auxiliary request and the features relating to the use of the metallocene catalyst system and process conditions during polymerization were not argued to change their position with regard to sufficiency of disclosure. Also, the Board does not find in the patent in suit any indication that the definition of the metallocene catalyst system as a catalyst comprising a monocyclopentadienyl metallocene complex and the fact that the process is performed in the slurry phase in a multistage polymerisation process would result in copolymers of ethylene and α-olefin fulfilling the set of parametric requirements (a) to (e) or would exclude that part of the claimed subject matter for which there is no sufficient guidance in that patent in suit.

3.2 Since the parametric requirements defining the ethylene α-olefin copolymer are identical in product claim 1 and

in claim 1 of the second auxiliary request, the Board arrives at the same conclusion of lack of sufficiency of disclosure for claim 1 of the second auxiliary request for the same reasons as discussed for product claim 1 in point 2 above.

4. As all requests on file do not meet the requirement of sufficiency of disclosure, the appeal is to be dismissed and there is no need to decide on any other issue.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

B. ter Heijden D. Semino

Decision electronically authenticated