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Datasheet for the decision of 15 June 2021

Case Number: T 0168/18 - 3.3.03

Application Number: 09783236.4

Publication Number: 2344548

IPC: C08F6/00, B01J8/00, G05B17/00

Language of the proceedings: EN

Title of invention:
PROCESS FOR THE DEGASSING OF POLYMER POWDER

Patent Proprietor:
Ineos Sales (UK) Limited

Opponents:
Total Research & Technology Feluy
Basell Polyolefine GmbH

Relevant legal provisions:
EPC Art. 56

Keyword:
Inventive step - (all requests: no)

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Case Number: T 0168/18 - 3.3.03

D E C I S I O N
of Technical Board of Appeal 3.3.03
of 15 June 2021

Appellant 1: (Patent Proprietor)	Ineos Sales (UK) Limited Hawkslease Chapel Lane Lyndhurst Hampshire SO43 7FG (GB)
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Appellant 3: (Opponent 2)	Basell Polyolefine GmbH Brühler Strasse 60 50389 Wesseling (DE)
Representative:	LyondellBasell c/o Basell Polyolefine GmbH Industriepark Hoechst, Bldg. E413 65926 Frankfurt am Main (DE)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 28 November 2017 concerning maintenance of the European Patent No. 2344548 in amended form.**

Composition of the Board:

Chairman	D. Semino
Members:	O. Dury
	C. Brandt

Summary of Facts and Submissions

I. The appeals by the patent proprietor and opponents 1 and 2 lie from the interlocutory decision of the opposition division posted on 28 November 2017 concerning maintenance of European Patent No. 2 344 548 in amended form according to the claims of the fifth auxiliary request filed with letter of 18 August 2017 and an amended description.

II. Two notices of opposition to the patent were filed requesting revocation of the patent in its entirety.

III. In the decision under appeal the following documents were *inter alia* cited:

D7: WO 2008/015228
D15: EP-A1-0 683 176

IV. The decision under appeal was based on the main request and on the first auxiliary request filed with letter of 20 May 2016 and on the second to fifth auxiliary requests filed with letter of 18 August 2017.

Claim 1 of the **main request** read as follows:

"1. A process for the production of a degassed polymer powder, which process comprises

a) feeding;

i) a principal monomer, and

ii) one or more comonomers fed in an amount of at least 5000 parts per million by weight (ppmw)

relative to the principal monomer feed rate, and

iii) optionally one or more added alkanes having 2 to 10 carbon atoms, fed in an amount of at least 1000 parts per million by weight (ppmw) relative to the principal monomer feed rate;

into a polymerisation reactor wherein the monomer and comonomers react to form a polymer comprising residual hydrocarbons comprising one or more hydrocarbons having 3 to 10 carbon atoms

b) passing the polymer to a first degassing step wherein, at a temperature, T_1 in range 50 to 110°C, it is contacted with a first purge gas to remove at least some of the residual hydrocarbons as a first gaseous phase and give a polymer with a reduced content of residual hydrocarbon, which is passed to a second degassing step,

c) in a second degassing step, at a temperature, T_2, in the range 50 to 110°C, contacting the polymer removed from the first degassing step with a second purge gas to produce a degassed polymer powder with a concentration of critical hydrocarbon component less than Z_f ppmw and a second gaseous phase,

characterised in that:

1) the first gaseous phase from the first degassing step is treated to remove hydrocarbons having greater than 3 carbon atoms and leave a third gaseous phase comprising predominantly inert gas and hydrocarbons having 3 or less carbon atoms, at least a portion of which is recycled to the first degassing step as at least a portion of the first purge gas,

2) the G/P ratio in the first degassing step is greater than the G/P ratio in the second degassing step, and is between $1.25*X_1$ and $10*X_1$ where:

$X_1 = 28/Mw/100*Kh*Ptot1/Psat(T_1)$,

3) the concentration of the critical hydrocarbon component in parts per million by weight in the first purge gas is less than Y_1, where:

$Y_1 = 100*(Psat(T_1)/Ptot1/Kh)*2000$, and

4) the second purge gas is an inert gas and/or the concentration of the critical hydrocarbon component in parts per million by volume in the second purge gas is less than Y_2, where $Y_2 = 100*(Psat(T_2)/Ptot2/Kh)*Z_f$,

wherein:

G is the purge gas mass flow rate in the respective degassing step,

P is the polymer throughput in the respective degassing step,

Kh is the absorption coefficient for the polymer powder to be degassed,

the "critical hydrocarbon component" being the heaviest hydrocarbon component selected from (i), (ii) and (iii) fed in step (a),

Mw, $Psat(T_1)$ and $Psat(T_2)$ are, respectively, the molecular weight, the hydrocarbon saturated vapour pressure above liquid at the temperature T_1, and the

hydrocarbon saturated vapour pressure above liquid at the temperature T_2, all being of the critical hydrocarbon component, and

Ptot1 and Ptot2 are, respectively, the total pressures in the first and second degassing steps,

and with the proviso that where the critical hydrocarbon component has 6 or more carbon atoms, but there is also fed to the reaction of step (a) one or more components selected from (ii) and (iii) having 4 or 5 carbon atoms, then the second degassing step is operated such that

I. the degassed polymer powder also has a concentration of the heaviest hydrocarbon component selected from the one or more components selected from (ii) and (iii) in step (a) having 4 or 5 carbon atoms of less than zf ppmw, and

II. the second purge gas is fresh inert gas or the concentration of the heaviest hydrocarbon component selected from the one or more components selected from (ii) and (iii) in step (a) having 4 or 5 carbon atoms in the second purge gas is less than y2, where

$y2 = 100*(psat(T_2)/Ptot2/Kh)*zf$,

where $psat(T_2)$ is the hydrocarbon saturated vapour pressure above liquid at the temperature T_2, of the heaviest hydrocarbon component selected from the one or more components selected from (ii) and (iii) in step (a) having 4 or 5 carbon atoms."

The first auxiliary request is not relevant to the present decision.

Claim 1 of the **second auxiliary request** differed from claim 1 of the main request in that

- feature 4) was amended as follows (additions in **bold,** deletions in ~~strikethrough~~):

  "4) the second purge gas is **nitrogen** ~~an inert gas~~ and~~/or~~ the concentration of the critical hydrocarbon component in parts per million by volume in the second purge gas is less than Y_2, where Y_2 = 100*(Psat(T_2)/Ptot2/Kh)*Zf," and

- the definition of the second purge gas in the first embodiment of feature II of the proviso was amended as follows:

  "the second purge gas is fresh ~~inert gas~~ **nitrogen**".

  The second embodiment of feature II of the proviso ("or the concentration ...") remained unamended.

Claim 1 of the **third auxiliary request** differed from claim 1 of the second auxiliary request in that the second embodiment in feature II of the proviso ("or the concentration ...") was deleted.

Claim 1 of the **fourth auxiliary request** differed from claim 1 of the main request in that the definition of the proviso was amended as follows:

"and ~~with the proviso that where~~ **further** the critical hydrocarbon component has 6 or more carbon atoms, ~~but~~ **and** there is also fed to the reaction of step (a) one or more components selected from (ii) and (iii) having 4 or 5 carbon atoms, ~~then~~ **and** the second degassing step

is operated such that ...".

Claim 1 of the **fifth auxiliary request** differed from claim 1 of the main request in that feature 2) was amended as follows:

"2) the G/P ratio in the first degassing step is greater than the G/P ratio in the second degassing step, and is between 1.25*X_1 and ~~10~~**2.5***X_1 where:

X_1 = 28/Mw/100*Kh*Ptot1/Psat(T_1),"

V. The opposition division's decision, as far as relevant to the present decision, can be summarised as follows:

- The main request met the requirements of sufficiency of disclosure, was novel over D15, but the subject-matter of claim 1 thereof was not inventive starting from example 1 of D15 as closest prior art;

- The subject-matter of claim 1 of the first auxiliary request was not novel over example 1 of D15;

- None of the subject-matters of claim 1 according to the second to the fourth auxiliary requests was inventive starting from example 1 of D15 as closest prior art;

- The subject-matter of the fifth auxiliary request was inventive starting from example 1 of D15 as closest prior art and the opponents had no objections pursuant Article 123(2) and 84 EPC.

  Regarding inventive step, the opposition division

in particular held that the amendment made in claim 1 of the fifth auxiliary request meant that the subject-matter being claimed was now sufficiently remote from the examples of D15 to be seen as an inventive solution to the provision of providing an alternative process. In particular, the skilled person starting from D15 and having in mind the technical problem of providing a further degassing treatment for the removal of volatiles from polymers for obtaining a desired maximal residual hydrocarbon content of the critical hydrocarbon component would not consider to work in the present claimed range for the G/P ratio and use a purge gas in the first phase with a critical concentration for hydrocarbon component less than Y_1. The use of this combination between the G/P ratio and Y_1 led to a reduced residual critical hydrocarbon content after the second degassing step compared to the first degassing step as shown by the examples from page 13 of the patent.

In view of the above, the patent as amended according to the fifth auxiliary request was found to meet the requirements of the EPC.

VI. The patent proprietor (appellant 1) lodged an appeal against the above decision and, in its statement of grounds of appeal, requested that the decision of the opposition division be set aside and the patent be maintained in amended form on the basis of any of the main request or of the first to fifth auxiliary requests filed therewith.

The main request was indicated by appellant 1 to correspond to the main request dealt with in the decision under appeal.

Claim 1 of the **first auxiliary request** differed from claim 1 of the main request in that the process being claimed was further defined by the following feature:

"and 5) the G/P in the second degassing step is between 0.005 and 0.05".

Claim 1 of the second to fifth auxiliary requests was identical to claim 1 of the second to fifth auxiliary requests dealt with in the decision under appeal, respectively.

VII. Opponents 1 and 2 (appellants 2 and 3) both lodged an appeal against the above decision and requested in their statement of grounds of appeal that the decision of the opposition division be set aside and the patent be revoked.

VIII. Together with the summons to oral proceedings, a communication was issued by the Board in preparation of the oral proceedings. It was in particular indicated therein that the second page of the main request filed with the statement of grounds of appeal appeared to be missing. Also, it was explained why the arguments put forward by appellant 2 in appeal did not appear to justify that the Board overturned the opposition division's decision regarding novelty over D15.

IX. With letter of 16 November 2020 appellant 1 submitted a new version of the main request, of which claim 1 was identical to claim 1 of the main request dealt with in the decision under appeal.

X. With the explicit agreement of all parties, oral proceedings were held on 15 June 2021 in the form of a

videoconference (the Board was at the premises in Haar and the parties were connected via video link). The novelty objection put forward in writing by appellant 2 in view of D15 was not pursued any longer.

XI. The arguments of appellant 1, as far as relevant to the present decision, were essentially as follows:

Main request - Inventive step

(a) Example 1 of D15 was suitable as the closest prior art.

(b) The process according to operative claim 1 differed from the one of example 1 of D15 in that:

- feature 3) defined that the concentration of the critical hydrocarbon component in parts per million by weight in the first purge gas be less than Y_1, which was not the case in example 1 of D15;

- the purge gas in the non-deactivating flushing, which corresponded to the first degassing step according to claim 1 of the main request, did not contain any recycled portion as defined in feature 1) of operative claim 1;

- even if the process of example 1 of D15 were to be modified according to the passage on page 5, lines 31-37 of D15, neither would feature 3) as defined in operative claim 1 be mandatorily satisfied, nor would D15 directly and unambiguously disclose a third gaseous phase having a composition as defined in feature 1) of

operative claim 1.

(c) At the oral proceedings before the Board, the problem effectively solved over example 1 of D15 was seen as residing in the provision of a more efficient degassing process, which used less purge gas overall and in particular in the second degassing step. In that respect, the comparison of the example of the patent in suit carried out with 1-hexene as comonomer with example 1 of D15 showed that said problem was effectively solved. That conclusion was confirmed by the fact that it was disclosed in D7 that the process of D15 used high amounts of nitrogen.

(d) Neither D15, nor any of the documents cited in the proceedings provided a hint to solve the above problem by modifying the process of example 1 of D15 according to operative claim 1. Even if the problem effectively solved over example 1 of D15 were to be held to reside in the provision of a mere alternative, the subject-matter of operative claim 1 constituted a non-obvious alternative to the process taught in D15. The modifications of the process of example 1 of D15 contemplated by appellants 2 and 3 in order to arrive at a process according to operative claim 1 relied on hindsight, which was not allowable.

(e) For these reasons, the subject-matter of claim 1 of the main request was inventive in view of D15 as closest prior art.

First to fifth auxiliary requests - Inventive step

(f) Regarding the first auxiliary request, the amendment made in claim 1 imposed a low G/P ratio in the second degassing step, which was economically advantageous. That requirement was met in all the examples of the patent in suit and derived from the fact that the critical hydrocarbon monomer was removed to a higher degree after the first degassing step.

The second degassing step in example 1 of D15 was indicated therein as being a deactivating step, which was required to deactivate the remaining catalyst. In light of that purpose, the skilled person would not decrease the G/P ratio in said second degassing step.

Such a low G/P was furthermore unusual in the art and not disclosed in any of the documents cited in the proceedings.

The series of modifications contemplated by appellants 2 and 3 was even more based on hindsight than the one identified for the main request.

Therefore, the subject-matter of claim 1 of the first auxiliary request was inventive starting from example 1 of D15 as closest prior art.

(g) Regarding the inventive step of the second and third auxiliary requests starting from example 1 of D15 as closest prior art, no further arguments as compared to the main request were put forward. At the oral proceedings before the Board, appellant 2's view according to which the amendments made in feature 4) of claim 1 of each of the second and third auxiliary requests did not

distinguish further the subject-matter being claimed from the process according to example 1 of D15 was not contested.

(h) Regarding the fourth auxiliary request, the amendments made added, as compared to the main request, further distinguishing features over the process of example 1 of D15 by requiring that a further component having 4 or 5 carbon atoms be used as comonomer in addition to 1-hexene (already used in said example 1) and in requiring that features I and II as defined therein be met.

As explained in paragraphs 75-77 of the patent in suit, the process so claimed provided a first degassing step which was particularly efficient at removing heavier hydrocarbons while the second degassing step was particularly efficient at removing lighter hydrocarbons. Therefore, the process claimed was very efficient for degassing polymers comprising a mixture of heavier and lighter residual hydrocarbon components. Considering that D15 did no teach multiple comonomers, it could not hint in an obvious manner to the subject-matter of operative claim 1.

For these reasons, the subject-matter of claim 1 of the fourth auxiliary request was inventive.

(i) Regarding the fifth auxiliary request, the amendments made added, as compared to the main request, the further distinguishing feature that the G/P ratio in the first degassing step should be smaller than in example 1 of D15.

The problem to be solved remained the same as for

the main request.

The subject-matter now being defined could only be arrived at after performing an additional modification of the process according to example 1 of D15, which required even more hindsight than for the main request. In addition, the skilled person would have no motivation to decrease the G/P ratio in the first degassing step of D15. By doing so, he would expect a less efficient degassing, which was not wanted, in particular in view of the very high amounts of residual components after the first degassing step indicated in D15.

For these reasons, the subject-matter of claim 1 of the fifth auxiliary request was inventive.

XII. The arguments of appellants 2 and 3 and of the respondent, as far as relevant to the present decision, may be summarised as follows:

Main request - Inventive step

(a) Example 1 of D15 was suitable as the closest prior art.

(b) At the oral proceedings before the Board, appellants 2 and 3 both agreed that the subject-matter of claim 1 of the main request differed from the process according to example 1 of D15 in the features identified above by appellant 1.

(c) In the absence of any comparison between a process according to operative claim 1 and the one according to example 1 of D15 and of any evidence showing that any of the distinguishing features

relied upon by appellant 1 was related to any technical effect, the problem effectively solved over the closest prior art could only reside in the provision of a further, alternative degassing process.

(d) Although in the process according to example 1 of D15 the purge gas in the non-deactivating flushing, which corresponded to the first degassing step according to claim 1 of the main request, did not contain any recycled portion, such an embodiment was explicitly disclosed at page 5, lines 31-37 of D15.

D15 further taught that the gas resulting from such a recycling step was a "light fraction", which was used as flushing gas in the non-deactivating flushing. Therefore, D15 also disclosed or at least hinted to a third gaseous phase having a composition as defined in feature 1) of operative claim 1.

It was further known in the art that controlling to a low level the amount of critical hydrocarbon present in the purge gas improved the efficiency of degassing. That conclusion was further taught both in D15 and D7.

Although D7 disclosed that the process of D15 was known to use high amounts of nitrogen, it was not shown that the amounts of nitrogen taught in D15 were excluded by the definition of the process of operative claim 1. Therefore, D15, even in combination with D7, did not teach away from the subject-matter being claimed.

(e) For these reasons, the subject-matter of claim 1 of the main request was obvious and therefore not inventive in view of D15 as closest prior art.

First to fifth auxiliary requests - Inventive step

(f) Regarding the first auxiliary request, no effect was shown in relation to the amendment made in claim 1, which imposed that the G/P ratio in the second degassing step should be within a specific range. Therefore, the definition of said range was arbitrary.

When carrying out a two-step degassing effect, the ratio G/P in the first and second degassing steps were usually set as the result of a compromise of targeted level of the residual hydrocarbon after the final degassing step, capital costs for the construction of the degassing apparatuses and operational cost for running the degassing process. The optimisation of said features, in particular setting a suitable G/P ratio in the first and/or second degassing step(s), constituted usual measured taken when designing such processes.

Contrary to appellant 1's view, the second degassing step in example 1 of D15 was not only a deactivating step (due to the presence of water and oxygen in the purge gas) but also a degassing step (due to the presence of nitrogen in the purge gas), as shown in the examples of D15. To provide a mere alternative process, the skilled person would contemplate decreasing the G/P ratio in order to reduce the consumption of nitrogen while maintaining sufficient amounts of water and oxygen (necessary to deactivate the catalyst). Therefore,

the skilled person would contemplate decreasing that ratio G/P in the second degassing step for economic reasons.

The range of G/P ratio defined in claim 1 of the first auxiliary request was not only arbitrary but also usual in the art. In any case, that range would be arrived at by routine optimisation. In addition, following the use of a first purge gas containing a low amount of critical hydrocarbon component (which was obvious as outlined above for the main request), it was to be expected that a large quantity of said critical component was degassed after the first step: under such circumstances, it was obvious that a lower amount of stripping gas, i.e. a lower G/P ratio, was necessary in the second degassing step.

For these reasons, it was obvious to reduce the G/P ratio in the second degassing step so as to arrive at the subject-matter of claim 1 of the first auxiliary request.

(g) Regarding the inventive step of the second and third auxiliary requests starting from example 1 of D15 as closest prior art, appellant 2 argued at the oral proceedings before the Board that the amendments made in feature 4) of claim 1 of each of these requests did not distinguish further the subject-matter being claimed from the process according to example 1 of D15, which was not contested by appellant 1. Therefore, these auxiliary requests lacked inventive step for the same reasons as the main request.

(h) The amendments made in claim 1 of the fourth auxiliary request only added as further limitation that in addition to a critical hydrocarbon component having 6 or more carbon atoms which was already present in example 1 of D15 (1-hexene), one or more additional comonomer(s) (ii) and (iii) having 4 or 5 carbon atoms should be used.

In addition, no effect had been shown in relation to any of the differences relied upon by appellant 1.

The use of a combination of comonomers, including those having 4 to 6 carbon atoms was already taught in D15. Features I and II according to operative claim 1 were further either known from D15 or obvious in view of common general knowledge.

For these reasons, the subject-matter of claim 1 of the fourth auxiliary request was not inventive.

(i) The amendments made in claim 1 of the fifth auxiliary request added as further limitation that a lower G/P ratio in the first degassing step should be used than was the case in example 1 of D15.

However, no effect had been shown in relation to that difference.

As explained in respect of the first auxiliary request, in a two-step degassing process, the ratio G/P in both degassing steps were the result of a compromise between targeted level of the residual hydrocarbon after the final degassing step, capital costs and operational cost. When designing/

optimising such a process, the skilled person would obviously reduce the G/P ratio in the first degassing step as much as possible, for economic reasons.

For these reasons, the subject-matter of claim 1 of the fifth auxiliary request was not inventive.

XIII. Appellant 1 requested that the decision under appeal be set aside and that the patent be maintained in amended form according to any of the main request filed in a complete form with letter of 16 November 2020 or of the first to fifth auxiliary requests filed with the statement of grounds of appeal.

Appellants 2 and 3 both requested that the decision under appeal be set aside and that the patent be revoked.

Reasons for the Decision

Main request

1. Inventive step

1.1 Closest prior art

Both parties, as the opposition division, considered that D15 was suitable as the closest prior art document and that example 1 thereof was an appropriate starting point for the assessment of inventive step. The Board sees no reason to deviate from that view.

1.2 Distinguishing feature(s) over example 1 of D15

1.2.1 Example 1 of D15 (page 7, line 23 to page 9, line 14) discloses a degassing process for a low-density polyethylene powder obtained by copolymerisation of 30 % ethylene, 5% 1-hexene (50000 ppmw), 9% hydrogen and 56% nitrogen (page 7, lines 25-36). The polymer powder thereby obtained contains 6% by weight of unconverted 1-hexene. The degassing process comprises the following step:

(a) The polymer powder is first degassed in a so-called non-deactivation flushing (page 7, lines 26-46) - corresponding to the first degassing step according to operative claim 1 - at 80°C and at a pressure of 1.27 bar (0.127 MPa). It was not contested during the appeal proceedings that, as already put forward during the opposition proceedings, the concentration of the critical hydrocarbon component in the first purge gas is higher than Y_1, i.e. not according to feature 3) of operative claim 1. Considering that the polymer throughput P is 60 kg/h and the purge gas flow rate 10 Nm^3/h, it was also undisputed that the G/P ratio for this first degassing step is 0.918, which amounts to $6.2*X_1$, i.e. G/P is within the range defined for the first degassing step in operative claim 1. Finally, the purge gas used in this first degassing step is a part of the gaseous reaction mixture (page 7, lines 41-43).

(b) The gaseous phase resulting from the separation and from the non-deactivating flushing is recycled and sent to the polymerisation reactor (D15: page 7, lines 47-50).

(c) The powder is further subjected to a so-called deactivation flushing (D15: page 7, line 51 -

page 8, line 4; that step corresponds to the second degassing step according to operative claim 1) at 65°C and at a pressure of 0.115 MPa. It remained also undisputed that the G/P in the second degassing step is 0.167, i.e. it is lower than in the first degassing step. The purge gas used in this second degassing step is a gaseous mixture consisting of nitrogen and small amounts of water and oxygen (page 7, lines 56-58).

1.2.2 In view of the above, there is no reason to deviate from the parties' view that the subject-matter of claim 1 of the main request differs from the process of example 1 of D15 in the following features:

(a) The purge gas in the the first degassing step according to claim 1 of the main request has to contain a recycled portion as defined in feature 1) of said claim 1. This is not the case in the non-deactivating flushing (i.e. first degassing step) of example 1 of D15, in which the first purge gas consists of the gaseous reaction mixture passing through the polymerisation, i.e. the gaseous mixture used for the polymerisation, which does not contain any recycled portion;

(b) D15 further fails to disclose a third gaseous phase having a composition as defined in feature 1) of operative claim 1;

(c) The concentration of the critical hydrocarbon component is not less than Y_1 as defined in feature 3) of operative claim 1 (whereby the calculation by appellant 3 in that respect for example 1 of D15 remained undisputed).

1.3 Problem effectively solved over the closest prior art

1.3.1 At the oral proceedings before the Board, appellant 1 held that the problem effectively solved over example 1 of D15 resided in the provision of a more efficient degassing process, which uses - overall - less purge gas per unit of polymer being degassed, and in particular in the second degassing step. Appellant 1 further argued that the comparison of the example of the patent in suit carried out with 1-hexene as comonomer with example 1 of D15 showed that said problem was effectively solved.

1.3.2 However, essential information regarding the preparation process of the examples of the patent in suit are not indicated (see paragraphs 127-130 of the patent in suit, in which no indication is given regarding e.g. the amounts of (co)monomers, the nature of the catalyst, properties such as density, molecular weight, MI, particle size, amount of residual hydrocarbon of the polymer produced and to be degassed). In particular, it was not shown that the starting materials, namely the copolymer particles to be degassed, were identical or at least comparable in the example of the patent in suit relied upon by appellant 1 (paragraph 130: example carried out with 1-hexene) and in example 1 of D15. Under such circumstances, it cannot be concluded that the example of the patent in suit carried out with 1-hexene may be fairly compared with example 1 of D15. It is in particular noted that neither evidence, nor arguments in that respect were submitted by appellant 1 in appeal, although said objection was already retained by the opposition division in the decision under appeal (reasons: section 4.5.5, last paragraph) and indicated in the Board's communication (section 9.3.2: first

paragraph).

In that respect, the fact that D7 discloses that the process of D15 uses large amounts of nitrogen (page 4, end of second paragraph) is, in the absence of a fair comparison between a process illustrative of the subject-matter being claimed with a process according to example 1 of D15, not relevant and cannot be taken into account for formulating the technical problem solved over example 1 of D15.

For these reasons, appellant 1's arguments that the comparison of an example of the patent in suit with example 1 of D15 shows that the process being claimed is more efficient and uses less purge gas overall or in particular in the second degassing step did not convince.

1.3.3 Appellant 1 argued that appellant 2 indicated in section 2.3 (last paragraph), section 2.4 (second paragraph) and section 2.5 (second paragraph) of its letter of 21 August 2018 that the improvements relied upon in the formulation of the problem solved proposed by appellant 1 were credible. Therefore, said formulation was allowable, even in the absence of a fair comparison with the closest prior art.

However, it is derivable from the titles of said sections 2.3, 2.4 and 2.5 that appellant 2 did not agree that an improvement over the closest prior art was indeed achieved (all titles read "No proof has been submitted for the ... effect"). The Board further considers that the statement made by appellant 2 in the above indicated sections 2.3, 2.4 and 2.5 may be read as meaning that in case an improvement relied upon by appellant 1 were to be held credible, then it would be

obvious, i.e. these considerations are based on an assumption that an effect would be acknowledged, in particular the first of the effects relied upon by appellant (as addressed in said section 2.3), which does not mean that appellant 2 agreed that these effects were effectively obtained. That conclusion is further confirmed by the fact that appellant 2 made it clear at the oral proceedings before the Board that he did not accept that the problem effectively solved over the closest prior art resided in an improvement. For that reason, and further considering the Board's conclusion drawn in above section 1.3.2, appellant 1's argument is rejected.

1.3.4 In view of the above, the problem effectively solved over example 1 of D15 resides in the provision of a further process for the production of a degassed polymer powder, in alternative to the one of D15.

1.4 Obviousness

1.4.1 The question has to be answered if the skilled person, desiring to solve the problem identified as indicated above, would, in view of the closest prior art, possibly in combination with other prior art documents or with common general knowledge, have modified the disclosure of the closest prior art in such a way as to arrive at the claimed subject matter.
In the present case, this means that it has to be assessed whether or not it is obvious to provide an alternative process to the one according to example 1 of D15 by modifying it according to the distinguishing features identified in section 1.2.2 above.

1.4.2 Regarding feature a)

It was undisputed that D15 (page 5, lines 31-37) discloses as a suitable embodiment of the process claimed therein (see e.g. claim 1 of D15) the possibility to recycle the gaseous phase resulting from the non-deactivating flushing (i.e. the first degassing step) and use it, possibly after fractionation, as a flushing gas in said non-deactivating flushing.

Appellant 1 argued that such a modification of example 1 of D15 was based on hindsight because the skilled person would have no reason to modify example 1 of D15, which was carried out according to the most preferred embodiment taught in D15. However, the embodiment disclosed at page 5, lines 31-37 of D15 is disclosed therein as being "a second advantageous variant of the process", whereby general information regarding said process and how to carry out the first degassing step ("non-deactivating flushing" of D15) is disclosed at page 5, lines 2-25 and a first advantageous variant is indicated at page 5, lines 26-30. Therefore, although it is correct that the first degassing step of example 1 of D15 is carried out according to a preferred embodiment indicated at page 5, lines 10-12 of D15, modifying example 1 of D15 according to page 5, lines 31-37 is an obvious measure based on the teaching of D15 itself, in particular in order to solve the problem identified above, which resides in the provision of a mere alternative process. It is further noted that another "preferred embodiment" of the processes according to D15 is also specified in the same paragraph of D15 (page 5, line 15ff) and two further "advantageous" modifications or "variants" of the first degassing step of the process according to D15 are further indicated in the same passage of the description (page 5: starting at lines 20, 26, 31 and 38). Under these circumstances, it cannot be concluded

that carrying out the first degassing step with the gaseous reaction mixture is "the most preferred" embodiment of D15, as was put forward by appellant 1. Therefore, appellant 1's argument that the modification of example 1 of D15 based on page 5, lines 31-37 of D15 contemplated by appellants 2 and 3 was not allowable because it was based on hindsight is rejected.

For these reasons, above feature a) is obvious in the light of D15 itself.

1.4.3 Regarding feature b)

It is indicated in the passage at page 5, lines 31-37 of D15 that the recycling of the gaseous phase resulting from the non-deactivating flushing (i.e. the first degassing step) may include a fractionation of said gaseous phase, which allows the separation of a light fraction in the gaseous state which is recycled as a flushing gas in the non-deactivating flushing and a heavy fraction in the liquid state which can be sent into the polymerisation zone. Although no definition is given in D15 regarding the nature of said "light fraction" and "heavy fraction", it is in the Board's view known in the art that the skilled person aiming at producing a degassed copolymer powder (as in D15 or as defined in operative claim 1) wants to remove from the copolymer particles the unconverted comonomers, i.e. hydrocarbons having for instance four to twelve carbon atoms (see background information provided in D15: page 2, lines 3-20). Therefore, the skilled person would obviously avoid treating said copolymer particles with such unwanted components. This is all the more true regarding the composition of the purge gas used for the degassing steps, since it is also known in the art (based on thermodynamic considerations) that, in

order to obtain upon degassing low residual amounts of any unwanted components, the purge gas should contain a low amount of any component which is to be stripped out of the copolymer particles (as reflected e.g. by the general statement in the paragraph at page 14 of D7 starting with "The low content of hexene ...").

Therefore, above distinguishing feature b) is obvious in light of D15 itself read by the skilled person with the common general knowledge in mind.

1.4.4 Regarding feature c)

i) Appellant 1 argued that modifying the process of example 1 of D15 according to above feature c) was based on hindsight because D15 was not directed to consideration of the "critical hydrocarbon component" at all (letter of 16 November 2020: page 4, penultimate paragraph, which was also put forward at the oral proceedings before the Board).

However, the critical monomer is defined in operative claim 1 as the heaviest hydrocarbon fed into the polymerisation reactor, which is 1-hexene in the process according to example 1 of D15. In addition, D15 is directed to an optimisation of a "process for the manufacture of polyolefins by a suitable post-treatment in order to improve the reduction in the residual contents of unconverted (co)monomers and of organic compounds and alkanes of low volatility which are occluded and dissolved in the polyolefin particles" (D15, page 2, lines 26-28). Example 1 of D15 further undoubtedly shows a reduction of 1-hexene to a content of 5 ppm after the deactivating flushing (see Table 2), i.e. a reduction of the "critical hydrocarbon component" in the degassed polymer particles.

Therefore, it makes no doubt for the Board that D15 is effectively directed to controlling the amount of the "critical hydrocarbon component", contrary to appellant 1's view.

ii) The question remains to be answered if it was obvious for the skilled person aiming at providing an alternative process to control the amount of 1-hexene used in the purge gas of the first degassing step as defined in feature 1) of operative claim 1.

In that respect, as already explained in section 1.4.3 above, the skilled person knows that when a lower amount of a certain component is present in a degassing stream, this component will be removed more efficiently from the polymer particles to be degassed. Therefore, the skilled person is well aware that, in order to obtain a more efficient degassing process to remove the critical hydrocarbon component, the concentration of said critical hydrocarbon component in the degassing stream should be reduced as low as possible. This would in particular be taken into account when designing and optimising the first degassing step of the process of example 1 of D15 modified according to the teaching on page 5, lines 31-37 of D15. In addition, it is already taught in D15 (page 5, lines 8-12) that the first purge gas may be chosen from nitrogen, the gaseous reaction mixture and one or more of the constituents of the said reaction mixture, preferably mixed with nitrogen. Therefore, based on that teaching of D15, it is obvious to provide an alternative process to the one of example 1 of D15 by using e.g. nitrogen as a main component, which is for the embodiment according to page 5, lines 31-37 of D15 admixed with recycled nitrogen containing the light fraction of the fractionated gaseous phase resulting from the first

degassing step (non-deactivating flushing according to D15). Although it is correct that D15 provides no teaching regarding which value of G/P in the first degassing step would then be used, the selection of a specific range as defined in feature 2) of operative claim 1 was not shown to provide any effect. It is therefore obvious for the skilled person aiming at providing an alternative process to the one according to example 1 of D15 to use any suitable G/P ratio in the first degassing step, including one satisfying the requirements defined in operative claim 1.

iii) In view of the above, it is concluded that is is obvious to provide an alternative process to the one according to example 1 of D15, modified according to page 5, lines 31-37, by controlling to a low level the amount of critical hydrocarbon present in the first purge gas.

1.4.5 Appellant 1 argued in addition that D7 disclosed that the process of D15 was known to use high amounts of nitrogen. However, it was not shown that the amounts of nitrogen taught in D15 are excluded by the definition of the process of operative claim 1. Therefore, it cannot be concluded that the definition of the process according to operative claim 1 is incompatible with the teaching of D15, even in combination with D7.

1.4.6 Appellant 1 further argued that, in view of the above, a series of modifications of the process of example 1 of D15 was necessary in order to arrive at the subject-matter of operative claim 1. However, even if it were to be held that such modifications could be made, it was questionable whether these would be done (could/ would approach: appellant 1's letter of 16 November 2020, bottom of page 5).

However, in order to provide a mere alternative to the process according to the closest prior art, the skilled person would contemplate any variation of that embodiment, in particular a variation which is indicated as advantageous in that same document (D15: page 5, lines 31-37). Since in the present case none of the modifications made to that process were shown to be special and, to the contrary, are held to be obvious in the light of the prior art for the reasons indicated above, the subject-matter of operative claim 1 would be arrived at by routine optimisation experiments starting from example 1 of D15, modified according to page 5, lines 31-37 of D15. For these reasons, in the present case, the skilled person does not need a good reason to do these modifications because the mere fact that these modifications are disclosed in general terms in the description of the closest prior art document or are held to be obvious in view of common general knowledge or other prior art documents (here: general teaching indicated in D7) is sufficient to render the - alternative - process being claimed obvious.

1.4.7 In view of the above, the skilled person seeking a mere alternative to the process of example 1 of D15 would, on the basis of the teaching of D15 itself, in particular the embodiment taught at page 5, lines 31-37, and taking into account the general teaching of D15 itself, common general knowledge and/or D7, modify the process of said example 1 so as to arrive at a process as defined in operative claim 1.

1.5 For these reasons the subject-matter of operative claim 1 of the main request is not inventive.

2. First auxiliary request

2.1 It was undisputed that the amendments made in claim 1 of the first auxiliary request, which impose a G/P ratio of between 0.005 and 0.05 in the second degassing step, constitutes an additional distinguishing feature over example 1 of D15 as compared to claim 1 of the main request.

2.2 However, as outlined above for the main request, no effect may be held to have been shown to be achieved by the specific range of G/P in the second degassing step now indicated in claim 1. Also, the advantage relied upon by appellant 1 that the process being claimed did not require the use of a catalyst poison (statement of grounds of appeal: page 8, section 3.1.2 end of fourth paragraph) cannot be taken into account because operative claim 1 does not exclude the presence of such components. Finally, in the absence of a fair comparison between a process according to operative claim 1 and the one according to example 1 of D15, the formulation of the problem effectively solved over the closest prior art can only remain the same as for the main request.

2.3 Regarding obviousness, it is agreed with appellants 2 and 3 that in a two-steps degassing process, it is possible to arrive at the same final level of residual hydrocarbon in the degassed polymer with different levels of residual hydrocarbon after the first degassing step: when designing the first degassing step larger and the second degassing step smaller, lower levels of residual hydrocarbon after the first degassing step will be achieved than when designing the first degassing step smaller and the second degassing step larger, but finally the same level of residual

hydrocarbon in the degassed polymer may result after the two-step degassing. Designing a first step of a two-step degassing process larger or smaller may include varying the relation of the G/P ratio of the first degassing step and the G/P ratio of the second degassing step. In that respect, the final design of the process will always be a compromise of targeted level of the residual hydrocarbon after the final degassing step, capital costs for the construction of the degassing apparatuses and operational cost for running the degassing process (appellant 3's letter of 21 August 2018: page 2, last paragraph, which was adhered to by appellant 2 at the oral proceedings before the Board).

2.3.1 Therefore, considering that it was concluded in respect of the main request that it is obvious to reduce the concentration of the critical hydrocarbon component in the first purge gas, it is to be expected that when doing so, the first degassing step of the process being claimed leads to reduced amounts of residual critical hydrocarbon component after the first degassing step. Under such circumstances, the skilled person would understand that, as a consequence, a smaller degassing step is required in the second step of the degassing process, i.e. there would be good reasons to decrease the G/P ratio in the second degassing step.

2.3.2 In addition, the specific range of the G/P ratio in the second degassing step mentioned in operative claim 1 was not shown to be special, i.e. it was not shown to be related to any technical effect. Therefore, it can only be held to constitute an arbitrary measure, which would be arrived at by a usual optimisation of process conditions.

In that respect, it was in dispute between the parties whether or not the range of ratio G/P defined in operative claim 1 for the second degassing step was usual in the art. However, considering that the problem effectively solved resides in the provision of a mere alternative process, that issue is not relevant: when optimising the process conditions as explained above, the skilled person would try, e.g. for economic reasons, to decrease the ratio G/P in the second degassing step as much as possible and, in doing so, would arrive at the range now specified in operative claim 1.

2.4 For these reasons, the subject-matter of claim 1 of the first auxiliary request is not inventive.

3. Second and third auxiliary requests

3.1 As derivable from section 3.2.1 of appellant 1's statement of grounds of appeal, the second and third auxiliary requests were primarily filed in relation to objections based on document D7, not D15. No arguments regarding inventive step in view of example 1 of D15 as closest prior art were submitted in writing by appellant 1 in respect of these auxiliary requests.

3.2 At the oral proceedings before the Board appellant 1 did not contest appellant 2's view that the amendments made in feature 4) of claim 1 of each of the second and third auxiliary requests did not distinguish further the subject-matter being claimed from the process according to example 1 of D15 (letter of 21 August 2018: section 3.2, first paragraph, which was repeated at the oral proceedings). No arguments were further provided in reply to the Board's communication in which that issue was explicitly identified

(section 10.2), although other issues were dealt with in details (appellant 1's letter of 16 November 2020: section 3). Therefore, the Board has no reason to deviate from appellant 2's view.

3.3 As put forward by appellant 2 (letter of 21 August 2018: section 3.3, first paragraph), the amendments made in feature II of the proviso present at the end of claim 1 of each of the second and third auxiliary request only limit the subject-matter being claimed when the proviso applies, i.e. when a critical hydrocarbon component having 6 or more carbon atoms and a further component having 4 or 5 carbon atoms are used as comonomers. Since said requirement is not met in example 1 of D15, the amendments made in feature II of said proviso provide no additional difference over the closest prior art.

3.4 In view of the above, auxiliary requests 2 and 3 can only share the same fate as the main request.

4. Fourth auxiliary request

4.1 As compared to claim 1 of the main request, the amendments made in claim 1 of the fourth auxiliary request add the following additional requirements:

(a) In addition to the use of a critical hydrocarbon component having 6 or more carbon atoms, which is present in example 1 of D15 in which 1-hexene is used, one or more additional component(s) (ii) and (iii) having 4 or 5 carbon atoms must be used as comonomer(s);

(b) Feature I, which requires a maximum residual concentration in the degassed polymer powder of the

heaviest component selected from said components (ii) and (iii), should be met;

(c) Feature II, which limits the definition of the second purge gas to two alternatives, should be met.

It is agreed that above amendment (a) constitutes a further distinguishing features for the process being claimed over the one according to example 1 of D15, which is carried out using ethylene and 1-hexene as comonomers but no further component having 4 or 5 carbon atoms. As a consequence, the same is valid for amendment (b) (which does not even apply to the process of example 1 of D15).

However, the second alternative of amendment (c) ("or the concentration of the heaviest ..."), merely requires that the second purge gas does not contain a too large amount of components (ii) and (iii), which is already the case in example 1 of D15 (wherein the second purge gas is nitrogen with low amounts of water and oxygen). Therefore, it is agreed with appellant 2 that above amendment (c) does not provide any further difference (letter of 21 August 2018: section 3.4).

4.2 Regarding the formulation of the problem effectively solved, no effect was shown to be achieved by the specific use of additional comonomers (components (ii) and (iii)) as now being defined in operative claim 1. In addition, as outlined above for the main request, in the absence of a fair comparison between a process according to operative claim 1 and the one according to example 1 of D1, the formulation of the problem effectively solved over the closest prior art can only

remain the same as for the main request.

4.3 Regarding obviousness, D15 already teaches the use of a combination of comonomers, including hydrocarbons having 4, 5 or 6 carbon atoms (page 3, lines 28-35). It is therefore obvious to provide a mere alternative to the process of example 1 of D15 by using a combination of comonomers as now defined in operative claim 1.

The fact that the degassed polymer powder should further contain a low residual amount of the heaviest of components (ii) and (iii) is also obvious in view of common general knowledge according to which degassing processes should eliminate organic compounds having from 4 to 12 carbon atoms originating from secondary hydrogenation reactions (see D15: page 2, lines 3-15). In that respect, D15 in particular already shows that the process claimed therein decreases the amount of any residual hydrocarbon below a certain threshold (D15: Table 2).

4.4 For these reasons, the subject-matter of claim 1 of the fourth auxiliary request is not inventive starting from example 1 of D15 as closest prior art.

5. Fifth auxiliary request

5.1 It was undisputed that the amendment made in claim 1 of the fifth auxiliary request, which imposes a maximum G/P ratio of $2.5*X_1$ in the first degassing step, constitutes an additional distinguishing feature over example 1 of D15 (for which G/P was calculated to be $6.2*X_1$) as compared to claim 1 of the main request.

5.2 However, no effect was shown to be achieved by the lower G/P in the first degassing step now indicated in

claim 1. In particular, in the absence of any evidence supporting the advantage relied upon by appellant 1 that the process being claimed allowed a more efficient removal of heavier and lighter hydrocarbon components in each step, that effect cannot be retained. In addition, as outlined above for the main request, in the absence of a fair comparison between a process according to operative claim 1 and the one according to example 1 of D1, the formulation of the problem effectively solved over the closest prior art can only remain the same as for the main request.

5.3 Regarding obviousness, it is agreed with appellants 2 and 3 that, as already outlined above in respect of the first auxiliary request, the G/P ratio in the first (and second) degassing step(s) are set by the skilled person as result of a compromise and usual optimisation measures. Among these measures, the skilled person would try to operate with G/P ratios as low as possible in both degassing steps, at least for economic reasons. Since the range of G/P now defined in operative claim 1 was not shown to be special and the problem to be solved resides in the provision of a mere alternative process to the one of example 1 of D15, it is obvious to solve that problem by decreasing the G/P ratio in the first step of the process of example 1 of D15, also in the variant modified according to page 5, lines 31-37 already considered for the main request, in particular to do so and to arrive at the range of G/P in the first degassing step defined in operative claim 1.

5.4 For these reasons, the subject-matter of claim 1 of the fifth auxiliary request is not inventive.

6. Since none of appellant 1's requests is allowable, there is no need to deal with any other issue and the patent is to be revoked.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

The Registrar: The Chairman:

K. Götz-Wein D. Semino

Decision electronically authenticated