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Language of the proceedings: EN

Title of invention:
PROCESS FOR POLYMERIZING OLEFINS IN THE GAS-PHASE

Patent Proprietor:
Basell Polyolefine GmbH

Opponents:
1.The Dow Chemical Company
2.W.R. Grace & Co.-Conn.
3.Borealis AG

Headword:
gas phase olefin polymerization process/Basell Polyolefine

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Amendment after summons - taken into account (no)

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T 1480/16, T 1857/19, T 0494/18, T 2295/19, T 1800/21, T 0042/22

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Case Number: T 2016/23 - 3.3.05

D E C I S I O N
of Technical Board of Appeal 3.3.05
of 19 May 2025

Appellant 1: (Opponent 1)	The Dow Chemical Company 2211 H.H. Dow Way Midland MI 48674 (US)
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Respondent: (Patent Proprietor)	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:	**Decision of the Opposition Division of the European Patent Office posted on 7 November 2023 rejecting the opposition filed against European patent No. 3723898 pursuant to Article 101(2) EPC.**

Composition of the Board:

Chairwoman	O. Loizou
Members:	S. Besselmann
	J. Roider

Summary of Facts and Submissions

I. The appeals by opponents 1 to 3 (now appellants 1 to 3) are against the opposition division's decision to reject the oppositions against European patent No. EP 3 723 898 B1.

II. The patent in suit concerns a process for polymerising olefins in the gas phase.

III. The independent claims of the **main request** (patent as granted) relate to a reactor and a process, respectively, and read as follows.

Claim 1: "*A gas-phase polymerization reactor for the gas-phase polymerization of olefins comprising at least one polymerization zone which is equipped with a recycle line for withdrawing reaction gas from the reactor, leading the reaction gas through a heat-exchanger for cooling and feeding the reaction gas back to the reactor, wherein the recycle line is equipped with the heat-exchanger, a centrifugal compressor comprising variable guide vanes, and a butterfly valve, and the variable guide vanes are arranged upstream of the centrifugal compressor and the butterfly valve is arranged downstream of the centrifugal compressor.*"

Claim 11: "*A process for preparing an olefin polymer comprising homopolymerizing an olefin or copolymerizing an olefin and one or more other olefins at temperatures of from 20 to 200°C and pressures of from 0.5 to 10 MPa in the presence of a polymerization catalyst, wherein the polymerization is carried out in the gas-phase polymerization reactor of any of claims 1 to 10.*"

IV. Claim 1 of **auxiliary request I** differs from claim 1 of the main request in that the following wording has been added at the end of the claim:
", *wherein the recycle line has one or more side lines and the side lines branch off the recycle line at a position between the centrifugal compressor and the butterfly valve and the one or more side lines are equipped with control valves for controlling the flow rate of the branched-off recycle gas in the side lines.*"

Claim 1 of **auxiliary request II** differs from claim 1 of auxiliary request I in that the following wording has been added at the end of the claim:
", *wherein the butterfly valve is arranged downstream of the heat-exchanger.*"

Claim 1 of **auxiliary request III** is identical to claim 1 of auxiliary request II.

Claim 1 of **auxiliary request IV** differs from claim 1 of the main request in that the following wording has been added at the end of the claim:
", *wherein the butterfly valve comprises a rotational disc which has a smaller area than the cross-section of the recycle line at the location of the butterfly valve.*"

Claim 1 of **auxiliary request V** is identical to claim 1 of auxiliary request IV.

Claim 1 of **auxiliary request VI** differs from claim 1 of the main request in that the following wording has been added at the end of the claim:
", *wherein the butterfly valve is arranged downstream of the heat exchanger.*"

Claim 1 of **auxiliary request VII** is a combination of claim 1 of auxiliary request II and claim 1 of auxiliary request IV.

In **auxiliary request VIII**, all apparatus (i.e. reactor) claims have been deleted, and claim 1 reads as follows:
"*A process for preparing an olefin polymer comprising homopolymerizing an olefin or copolymerizing an olefin and one or more other olefins at temperatures of from 20 to 200°C and pressures of from 0.5 to 10 MPa in the presence of a polymerization catalyst, wherein the polymerization is carried out in a gas-phase polymerization reactor, which is equipped with a recycle line for withdrawing reaction gas from the reactor, leading the reaction gas through a heat-exchanger for cooling and feeding the reaction gas back to the reactor, wherein the recycle line is equipped with the heat-exchanger, a centrifugal compressor comprising variable guide vanes, and a butterfly valve, and the variable guide vanes are arranged upstream of the centrifugal compressor and the butterfly valve is arranged downstream of the centrifugal compressor, wherein the polymerization is carried out at a pre-determined pressure differential across the centrifugal compressor and variations of the recycle gas flow rate are carried out by both varying the position of the guide vanes and the position of the butterfly valve.*"

Claim 1 of **auxiliary request IX** differs from claim 1 of auxiliary request VIII in that the following wording has been added at the end of the claim:
"*, wherein the recycle line has one or more side lines and the side lines branch off the recycle line at a position between the centrifugal compressor and the butterfly valve and the one or more side lines are*

equipped with control valves for controlling the flow rate of the branched-off recycle gas in the side lines and the pressure in the one or more side lines upstream of the control valves is from 0.01 MPa to 0.2 MPa higher than the pressure in the recycle line downstream of the butterfly valve."

Claim 1 of **auxiliary request X** differs from claim 1 of auxiliary request I in that the following wording has been added at the end of the claim:
"*, and wherein one of the following applies:*
a) wherein the reactor is part of a reactor cascade and the reactor cascade comprises a first gas-phase reactor and a subsequent second gas-phase reactor and a side line, which branches off the recycle line of the second gas-phase reactor, is the transfer line for transferring polyolefin particles from the first gas-phase reactor to the second gas-phase reactor; or
b) the gas-phase polymerization reactor is a fluidized-bed reactor equipped with a circulation loop connected to the gas distribution grid for recycling polyolefin particles from the gas distribution grid to the upper region of the fluidized-bed reactor, wherein carrier gas for conveying the polyolefin particles through the circulation loop is recycle gas which is provided by a side line which branches off the recycle line."

Auxiliary requests XI to XX differ from auxiliary requests I to X, respectively, in that a dependent process claim has been deleted. Claim 1 of auxiliary requests XI to XX is in each case identical to claim 1 of auxiliary requests I to X, respectively.

Claim 1 of each of **auxiliary requests XXI to XXIII** is the same as claim 1 of auxiliary request X.

V. The following documents are of relevance here:

D4 CN 105254782 A, (20 January 2016)

D4b English translation of D4

D11 Web article: http://www.chemicalprocessing.com/articles/1998/review-of-butterfly-valve-components-operation (published 1998)

D21 T. Giampaolo, "Compressor Handbook: Principles and Practice", The Fairmont Press, 2010

D22 G.K. McMillan, "Centrifugal and Axial Compressor Control", Instrument Society of America, 1983

D29 G.B. Meier, "Fluidized Bed Reactor for Catalytic Olefin Polymerization", Kinetics and Fluidization, Proefschrift, University Twente, 2000

D31 WO 2013/083548 A2

D33 Declaration by Mika Kuusisto

D36 S. Matar and L.F. Hatch, "Chemistry of Petrochemical Processes", 2nd edn., Gulf Publishing Company, 2000, pages v to x and 323 to 373

D37 R. Thomason, "Real-time Observer Modelling of a Gas-phase Ethylene Polymerisation Reactor", Master's Thesis, University of Natal, Durban, 2000

D39 M.P. Boyce, "Centrifugal compressors: a basic guide", PennWell Corporation, 2003, chapter 12

D41 H.P. Bloch, "Compressors and Modern Process Applications", Part II, Segment 3: Petrochemical Processes, John Wiley & Sons, 2006, pages 310 to 318

D44 R.A. Parisher et al., "Pipe Drafting and Design", 2nd edn., Gulf Professional Publishing, 2002

VI. The respondent's arguments, where relevant to the present decision, can be summarised as follows.

The main request was novel over D4. Starting from D4, it solved the technical problem of providing increased flexibility of the apparatus with a reduced risk of fouling, and thus involved an inventive step.

Auxiliary requests I to III were further distinguished from D4 because claim 1 thereof required a side line which branched off the recycle line. The reactor known from D4 merely included a bypass line, which did not constitute such a side line. The technical effect sought in the patent in suit, i.e. the ability to vary the flow rate while maintaining a constant pressure differential across the compressor (or *vice versa*), could not be obtained with the bypass line.

Auxiliary requests IV and V specified that the butterfly valve has a rotational disc with a smaller area than the cross-section of the recycle line. This was advantageous because even in a fully closed position, the gas flow was not fully blocked.

Claim 1 of auxiliary request VI was a combination of claims 1 and 4 as granted.

With regard to auxiliary request VII, the respondent initially submitted that claim 1 was a combination of the additional features of claim 1 of auxiliary request III and claim 1 of auxiliary request VI, but did not contest the board's conclusion in its preliminary opinion that claim 1 was a combination of claim 1 of auxiliary request II and claim 1 of

auxiliary request IV (claim 1 of each of auxiliary requests II and III are identical).

Claim 1 of auxiliary request VIII was a combination of process claims 11 and 12 as granted. None of the prior-art documents suggested keeping a predetermined pressure differential across the compressor. This could not be achieved in D4.

Claim 1 of auxiliary request IX was not obvious for the additional reason that none of the prior-art documents specified a predetermined higher pressure in the side lines compared to that in the recycle line downstream of the butterfly valve.

Auxiliary request X was a fall-back position, should the bypass line of D4 be considered to correspond to the claimed side line. The bypass line and valves A and B in D4 served an entirely different purpose from the configuration of the side line in the claim. The claimed reactor allowed the side lines to be operated at a predetermined differential pressure across the control valve, independently from the recycle gas flow rate. The skilled person starting from D4 would not and could not arrive at the claimed reactor without the benefit of hindsight.

Auxiliary requests XXI to XXIII did not lead to a fresh case and should be admitted into the proceedings.

VII. The arguments of appellants 1 to 3 are reflected in the reasons for the decision set out below.

VIII. Appellants 1-3 requested that the decision under appeal be set aside and that the patent be revoked.

The respondent requested that the appeals be dismissed (main request) or, alternatively, that the patent be maintained in amended form on the basis of one of auxiliary requests I to XX as filed with the reply to the appeals, or one of auxiliary requests XXI to XXIII as filed with letter dated 6 March 2025 (date of receipt).

Reasons for the Decision

Main request

1. Article 100(a) EPC in conjunction with Article 54 EPC

1.1 The subject-matter of claim 1 differs from D4 (seen in conjunction with the English translation thereof, D4b) at least in that the valve is a butterfly valve.

D4 does not mention this valve type, nor has it been shown that the relevant valve of D4 (i.e. the flow-adjusting valve B8 in Figure 1) is inevitably a butterfly valve. The board does not agree that the reference to a UCC (Union Carbide Company) gas-phase fluidised bed process in D4 (page 7 of the translation, third full paragraph), i.e. a Unipol process, necessarily implies this type of valve. There is no evidence that *all* the possible variants and implementations of a UCC gas-phase fluidised bed process have a butterfly valve in the recycle line. It is not enough to demonstrate that a butterfly valve might be conventional.

1.2 The objection of a lack of novelty is therefore not convincing.

2. Article 100(a) EPC in conjunction with Article 56 EPC

2.1 It was common ground that D4 (with reference to the translation D4b) is a suitable starting point for assessing inventive step.

2.2 The patent in suit addresses the technical problem of providing a reactor which allows the manipulation of the gas flow rate in a simple manner, while keeping constant the differential pressure across the compressor, or the variation of the differential pressure across the compressor while keeping the gas flow rate constant (paragraphs [0007] and [0029]). Additionally, the patent seeks to reduce the risk of fouling (paragraph [0030]). In line with the respondent's view, the problem addressed in the patent in suit is thus in more general terms to provide increased flexibility of the apparatus (paragraph [0006]) with a reduced risk of fouling.

2.3 The reactor according to claim 1, in which the compressor in the recycle line is a centrifugal compressor and the valve in the recycle line is a butterfly valve, is proposed as the solution to this problem.

This assumes, in the respondent's favour, that the compressor of D4 is not inevitably a centrifugal compressor.

2.4 However, it cannot be derived from the patent in suit that these distinguishing features, i.e. the selected

compressor and valve types, provide a solution to the problem posed (see point 2.2) over other applicable compressor and valve types.

In particular, no such conclusion can be drawn from the examples, because the comparative examples do not relate to the presence of different compressor or valve types; rather, they relate to the absence of a flow-control valve. This conclusion cannot be derived from the general explanations provided in the patent in suit, either. It is explained how the presence of both a centrifugal compressor comprising variable guide vanes and a butterfly valve in the recycle line makes it possible, for example, to achieve an increased fluidisation gas flow rate while maintaining the same differential pressure across the compressor (paragraph [0029]). However, the same principal considerations, namely how variable guide vanes upstream of the compressor - which do not constitute a distinguishing feature in any case (see D4b, page 5, first paragraph; page 10, second paragraph; claim 10) - and a downstream butterfly valve, i.e. a downstream resistance, affect the differential pressure across the compressor, apply irrespective of the dynamic compressor type and the flow-control valve type. Only dynamic compressors are relevant in view of the presence of variable guide vanes (see, for example, D21, page 74, last paragraph, reflecting common general knowledge). As regards the flow-control valve, even the patent itself suggests that other control valves could be used for controlling the pressure differential across the compressor (paragraph [0033], "such as" a butterfly valve).

In light of the above, the board cannot conclude that the distinguishing features provide increased

flexibility of the apparatus. The technical problem thus needs to be reformulated. It remains to be assessed whether the remaining part of the technical problem, namely a reduction in the risk of fouling, can be regarded as solved.

This part of the technical problem is associated with the choice of the butterfly valve. According to the patent in suit, a butterfly valve has the advantage over other types of control valves of having a low risk of fouling (paragraph [0030]). Even without experimental evidence, it is credible that this advantage is achieved because butterfly valves are known to have low resistance to flow (D11, page 1), that is to say they have minimal turbulence and pressure drop (D44, page 77, right-hand column). However, on this same basis, this advantage can be seen to be predictable.

2.5 In summary, there is no combined effect of the compressor and valve types, and therefore partial technical problems need to be formulated. In relation to the compressor being a centrifugal compressor, the technical problem is that of implementing the process known from D4. In relation to the flow-control valve being a butterfly valve, the technical problem is that of providing an implementation of the process in which the flow-control valve has a low risk of fouling.

Centrifugal compressor

Even if it is thus assumed, in the respondent's favour, that the compressor of D4 is not *inevitably* a centrifugal compressor, the skilled person would be aware that a centrifugal compressor is conventionally used in the recycle line of a UCC Unipol gas-phase

fluidised bed process, i.e. the process mentioned in D4 (D4b, page 7, third full paragraph); see, for example, D36 (page 327, Fig. 12-1) and D41 (page 312, right-hand column, and page 317, left-hand column). This has even been acknowledged in the patent in suit (paragraph [0003]). D29, which was referred to by the respondent, does not relate to the UCC process (or another industrial process) but to a mini-plant. At the same time, the skilled person would be aware that a centrifugal compressor is suitable for use with guide vanes as required in D4 (see D39, page 504, fourth paragraph, reflecting common general knowledge). A centrifugal compressor would therefore be a straightforward and obvious choice for the skilled person wishing to implement the process of D4.

Insofar as it is argued that a centrifugal compressor was in fact the only viable choice because it was the only compressor type that inlet guide vanes could impact in terms of performance (declaration D33), the board is not convinced. As argued by the respondent, D22 shows that axial compressors may also comprise variable inlet guide vanes (D22, page 44, "key concepts"). However, as indicated, the choice is obvious.

Butterfly valve

The skilled person wishing to implement the reactor of D4 and seeking to use a valve having a low risk of fouling would use in a straightforward manner a butterfly valve as the flow-control valve B8. This type of valve has already proven suitable for flow control in the recycle line of a UCC (Unipol) gas-phase polymerisation process. Specifically, such a valve has been used commercially in the recycle line of a

"Poly-2" process (D37, title of chapter 4 and point 4.1.5 on page 30), the Poly-2 process being a Unipol process (D37, Figure 1.4 on page 4 and the two lines above the figure), as generally considered in D4. Moreover, as indicated, butterfly valves are known to have low resistance to flow (D11, page 1), that is to say they have minimal turbulence and pressure drop (D44, page 77, right-hand column). The skilled person would thus not expect these to be prone to deposits of entrained particles, i.e. fouling.

The skilled person selecting a flow-control valve B8 to implement the process of D4, and aiming at low fouling, would thus readily use a butterfly valve.

2.6 For these reasons, the subject-matter of claim 1 does not involve an inventive step.

2.7 Claim 11

The same considerations apply to process claim 11, which relates to a process for preparing an olefin polymer in the presence of a polymerisation catalyst, which is carried out in the gas-phase polymerisation reactor of claim 1. The broad ranges of temperature and pressure encompass the usual conditions of a Unipol process (e.g. approximately 100°C and 20 atm for HDPE production according to D36, page 327).

The process of claim 11 thus also lacks an inventive step.

Auxiliary request I

3. Inventive step

3.1 Compared with the main request, claim 1 of auxiliary request I additionally specifies that the recycle line has one or more side lines which branch off the recycle line at a position between the centrifugal compressor and the butterfly valve, and the one or more side lines are equipped with flow-control valves for controlling the flow rate.

3.2 According to the respondent, claim 1 was now further distinguished from D4 because it required a side line which branched off the recycle line. In their view, this feature was not anticipated by the bypass line depicted in Figure 1 of D4. A side line had to be distinguished from a bypass line because a side line generally had a different destination and served a different purpose from the main line, whereas a bypass line merely circumvented specific units but was rerouted back into the main line and thus effectively went in the same direction. In D4, the bypass line joined the recycle line again, whereas this was excluded in the case of a side line branching off the recycle line. In support of their view, the respondent referred to the common meaning of the term "branched off" as being "to separate from something and move in a different direction" (see the dictionary excerpt provided by the respondent with the reply to the appeals). They also referred to the fact that a branch of a tree never came back to the trunk. This was also the case for a branched structure in chemistry, in which the side chain did not join the main chain again because otherwise it would no longer form a branched but a cyclic structure. The respondent also submitted

that the technical effect of being able to vary the flow rate while maintaining a constant pressure differential across the compressor (or *vice versa*) could not be obtained with a bypass line.

3.3 However, the claim specifies neither the purpose of the side line nor the desired technical effect thereof. The feature according to which the one or more "side lines branch off the recycle line" in the context of the claim merely describes the position of the branching point; it does not imply anything about the end point or function of the one or more side lines. Nor can this be derived from the common meaning of the term "to branch off". The terminology relating to molecular structures in chemistry is not applicable here. A "bypass line" and "a side line which branches off (a main line)" are not seen as two mutually exclusive alternatives. Rather, a bypass line constitutes a specific type of side line. There is nothing in the claim that would exclude the side line from being reintroduced into the recycle line further downstream. As is seen in Figure 1 of D4, bypass line 6 clearly branches off the recycle line, and this at the required position (i.e. between compressor 4 and flow adjusting valve B8, as was not contested). Bypass line 6 is equipped with a flow-adjusting valve A7.

3.4 For these reasons, the additional features in claim 1 of auxiliary request I do not provide any further delimitation from D4. The considerations of a lack of inventive step as set out with respect to the main request also apply here.

3.5 The subject-matter of claim 1 of auxiliary request I does not involve an inventive step.

Auxiliary requests II and III

4. Inventive step

4.1 Compared with claim 1 of auxiliary request I, it is additionally specified in claim 1 of these requests that the butterfly valve is arranged downstream of the heat-exchanger.

4.2 However, this feature does not provide any additional delimitation from D4 (see Figure 1, which shows the position of valve B8 downstream of heat-exchanger 5).

4.3 The subject-matter of claim 1 of each of auxiliary requests II and III does not involve an inventive step, for the same reasons as those set out with respect to auxiliary request I.

Auxiliary requests IV and V

5. Inventive step

5.1 Reference is made to the considerations above regarding the main request (see point 2.).

5.2 Claim 1 of each of auxiliary requests IV and V additionally specifies that the butterfly valve comprises a rotational disc which has a smaller area than the cross-section of the recycle line at the location of the butterfly valve.

5.3 As argued by the respondent, the effect of this difference is that even in a fully closed position, the

gas flow is not fully blocked (paragraph [0031] of the patent in suit).

However, any flow-control valve will naturally have a position in which the gas flow is not fully blocked. At the same time, measures to fully block the flow in the recycle line (e.g. a shut-off valve) are not excluded in the claim. It is therefore not apparent that the feature relating to the area of the rotational disc of the butterfly valve provides any effect or functionality that could not be obtained in D4.

5.4 The additional partial technical problem relating to the additional feature contained in claim 1 of these requests is thus merely the provision of an alternative.

5.5 It would be a normal design choice for the skilled person to select a suitable area of the rotational disc of the butterfly valve. Moreover, it is immediately apparent to the skilled person that there is no need for the flow-control valve B8 in D4 to allow to fully block the gas flow, because otherwise there would be no cooling. The skilled person would thus readily select a butterfly valve in which the rotational disc has a smaller area than the relevant cross-section of the recycle line, without needing to involve an inventive step.

5.6 Hence, the subject-matter of claim 1 of each of auxiliary requests IV and V lacks an inventive step.

Auxiliary request VI

6. Claim 1 of auxiliary request VI differs from that of the main request in that it additionally specifies that the butterfly valve is arranged downstream of the heat-exchanger.

This feature does not provide any further delimitation from D4, see Figure 1. Hence, the subject-matter of claim 1 of auxiliary request VI lacks an inventive step, irrespective of the question of the admissibility of the request, which is contested by the appellants.

Auxiliary request VII

7. Claim 1 of auxiliary request VII combines the additional features of claim 1 of each of auxiliary requests II and IV and thus lacks an inventive step for the same reasons as those set out above.

Auxiliary request VIII

8. Inventive step

8.1 Reference is made to the comments regarding claim 11 of the main request, from which current claim 1 of auxiliary request VIII is derived.

8.2 Claim 1 additionally specifies that the polymerisation is carried out at a pre-determined pressure differential across the centrifugal compressor and variations of the recycle-gas flow rate are carried out by varying both the position of the guide vanes and the position of the butterfly valve.

8.3 The respondent asserted that none of the prior-art documents suggested this additional feature. In their view, this feature (i.e. the variation of the recycle-gas flow rate) was not realised in D4 because any variation of the opening of flow-control valve B8 was counteracted by a corresponding variation of flow-control valve A7, the sum of their openings always being 100%, i.e. the total circulating gas flow was not altered. The guide vanes only served to increase the circulating gas flow rate during the decondensation operation. The respondent also submitted that the claim required that the pressure differential across the compressor was a control parameter which had to be set to run the process.

8.4 However, as submitted by appellant 3 (submission of 4 April 2025, point 3.2), the definitions in claim 1 are very broad. The claim does not specify further the *predetermined* pressure differential across the compressor, nor how the position of the guide vanes and the position of the butterfly valve should be varied. In particular, it is not specified how these measures should interact. Moreover, as argued by appellant 2 (submission received 29 April 2025, page 6), the claim does not link the term "recycle gas flow rate" to a specific position along the recycle line.

In light of the above, and as further detailed below, the indicated features (see point 8.2 above) are already realised in the process known from D4.

8.4.1 While it is indeed taught in D4 that the sum of the openings of valves A and B is 100% (i.e. these valves determine the fractions of the total circulation gas flow in line 3 which are led through heat-exchanger 5

and bypass line 6, respectively), as argued by the respondent, this is not decisive. The claim under consideration refers to variations of *the recycle gas flow rate,* the recycle line being the line equipped with, *inter alia*, the heat-exchanger. The recycle line does not include the side line which branches off the recycle line (and through which the "branched-off recycle gas" flows, see claim 2). Comparing the definitions of the claim with D4, the recycle gas flow rate thus refers to the flow rate through heat exchanger 5 and does not include bypass line 6 shown in Figure 1 of D4. In D4, the flow rate *through the recycle line including the heat exchanger 5* is controlled by flow-adjusting (i.e. flow-control) valve B8 in conjunction with the compressor equipped with guide vanes. A variation of the recycle-gas flow rate is thus carried out by varying the positions of the guide vanes (which are variable, as indicated under point 2.4 above with reference to D4b, first paragraph on page 5, second paragraph on page 10, and claim 10) and the flow-adjusting (i.e. flow-control) valve, it being the very purpose of each of these instruments to provide for a variation of flow rate through a variation of the position. The claim does not state that the positions of the guide vanes and the butterfly valve would need to be varied simultaneously.

8.4.2 The claim additionally requires the polymerisation to be carried out at a *pre-determined pressure differential across the centrifugal compressor*. However, the polymerisation is necessarily carried out at a pressure differential across the compressor. In this context, specifying that the pressure differential is *pre-determined* does not provide any additional clear delimitation. The mere reference to a *pre-determined* pressure differential in the context of claim 1 does

not imply any specific process control step. As convincingly argued by appellant 3 (letter of 28 October 2024, point 8.9), this wording - when interpreted with the broadest technically sensible meaning - rather encompasses any pressure differential that a person skilled in the art considers applicable. In particular, in line with the appellants' view, the reference to a *pre-determined* pressure differential does not imply that it is kept constant. For instance, it may still be regarded as pre-determined in the sense that the compressor compensates the pressure loss in the cycle to maintain the reaction pressure. While this may imply that the reaction pressure is (also) pre-determined, as argued by the respondent, this nevertheless imposes a limitation on - and thus pre-determines - the applicable range of values of the pressure differential.

8.5 For these reasons, the subject-matter of claim 1 of auxiliary request VIII lacks an inventive step.

Auxiliary request IX

9. Inventive step

9.1 Reference is made to the comments regarding claim 1 of auxiliary request VIII.

9.2 Claim 1 of auxiliary request IX additionally defines that the recycle line has one or more side lines and the side lines branch off the recycle line at a position between the centrifugal compressor and the butterfly valve and the one or more side lines are equipped with control valves for controlling the flow rate of the branched-off recycle gas in the side lines

and the pressure in the one or more side lines upstream of the control valves is from 0.01 MPa to 0.2 MPa higher than the pressure in the recycle line downstream of the butterfly valve.

9.3 As set out in relation to auxiliary request I, line 6 in D4 constitutes a relevant side line and is equipped with a flow-control valve A (see point 3. above).

9.4 The respondent asserted that none of the prior-art documents specified a predetermined higher pressure in the side lines compared to the recycle line downstream of the butterfly valve. In their view, having a higher pressure in the side lines allowed the control valve to be operated at an optimal control range which included a wide valve opening to minimise the risk of fouling.

9.5 However, considering that a flow-control valve induces a pressure loss, the pressure upstream of control valve A in line 6 of D4 (Figure 1) is inevitably higher than the pressure downstream of control valve B, i.e. the butterfly valve.

The additional difference thus merely lies in the *value* of the pressure difference. However, a technical effect of the claimed range of values cannot be derived from the patent in suit, nor has one been shown. It it thus arbitrary.

The skilled person would readily select a flow-control valve having a suitable pressure loss.

9.6 For these reasons, the subject-matter of claim 1 of auxiliary request IX lacks an inventive step.

Auxiliary request X

10. Inventive step - claim 1

10.1 Reference is made to the comments regarding claim 1 of auxiliary request I (see point 3.).

10.2 Claim 1 of auxiliary request X has been limited to alternative embodiments in which the reactor is part of a reactor cascade as specified in point a), or in which the reactor is a fluidised bed reactor equipped with a circulation loop as specified in point b) of the claim.

In the following, the alternative according to a) will be addressed.

10.3 In the respondent's favour, all of their arguments relevant to the question of inventive step of this claim are considered, irrespective of whether or not they should have been presented at an earlier stage of the appeal proceedings, i.e. whether auxiliary request X was sufficiently substantiated in the reply to the appeal.

10.4 The respondent submitted that auxiliary request X was filed as a fall-back position, should the bypass line of D4 be considered to correspond to the claimed side line. The patent in suit taught the advantages of the combination of the side lines having control valves, the butterfly valve in the recycle line and the centrifugal compressor having variable inlet guide vanes, namely the advantages of being able to operate the side lines with a predetermined differential pressure across the control valve *independently* from the recycle gas flow rate, so that the control valve could be operated in a predetermined optimal control

(opening) range which was optimised to minimise the risk of fouling (paragraphs [0034] to [0036] of the international application as published; see also paragraphs [0032] to [0034] of the patent in suit). These advantages were supported by the examples. According to the respondent, the skilled person starting from D4 would not and could not implement the side lines with a control valve in order to obtain these advantages without the benefit of hindsight, because the flow-regulating valves A and B in D4 served an entirely different purpose. The bypass line in D4 was not suitable for providing the advantage sought. Nor would the skilled person implement the side lines as discussed in D31 in D4 to solve the problem of regulating the flow rate of the recycle gas while keeping a sufficiently high differential pressure across the side line.

10.5 However, as discussed with regard to auxiliary request I, bypass line 6 of D4 - equipped with flow-control valve A7 - constitutes a side line within the meaning of claim 1 of that request (point 3.3), i.e. a side line which branches off the recycle line at a position between the (centrifugal) compressor and the (butterfly) valve (valve B8 in D4) and is equipped with a control valve (valve A7 in D4) for controlling the flow rate of the branched-off recycle gas in the side line. There is no reason why this consideration should not apply to the corresponding feature in claim 1 of auxiliary request X, which is identical to the respective part of claim 1 of auxiliary request I. In particular, this feature is not altered by the additional requirements of claim 1 of auxiliary request X, i.e. the features according to point a) of claim 1.

According to these requirements, "*the reactor is part of a reactor cascade and the reactor cascade comprises a first gas-phase reactor and a subsequent second gas-phase reactor and a side line, which branches off the recycle line of the second gas-phase reactor, is the transfer line for transferring polyolefin particles from the first gas-phase reactor to the second gas-phase reactor*".

While point a) thus also specifies "a side line", this feature does not refer back to the previous mention of the "one or more side lines". Instead, it is clear that each of the - now at least two - reactors may have a side line, but it is not necessary that they both be configured in the same way as the side line mentioned in the initial part of the claim (i.e. the part corresponding to claim 1 of auxiliary request I). While this might be preferred and is shown in the embodiment according to Figure 3 of the patent in suit, this is not specified in the claim. Instead, it is explicitly taught in the patent in suit (paragraph [0072]) that *one or more* polymerisations in other gas-phase reactors of the cascade of polymerisation reactors may be polymerisations according to the present disclosure. The respondent confirmed that it was not necessary that the first reactor had this side line. However, the claim leaves open which of the reactors of the cascade corresponds to the reactor defined in the initial part of the claim.

10.6 Starting from D4, and bearing in mind the comments made in view of claim 1 of auxiliary request I, the additional distinguishing features are those of point a) of claim 1.

10.7 The respondent's arguments (see point 10.4) do not specifically concern the possible contribution of these features to an inventive step.

10.8 The associated (partial) technical problem is thus merely seen as being to provide an alternative.

10.9 It can be derived from the patent in suit itself that the alternative reactor type according to point a) is known (paragraph [0055] with regard to D31).

The skilled person wishing to provide an alternative would readily add a subsequent fluidised bed reactor as known from D31, for example to provide further polymerisation. Accordingly, they would provide a line to transfer the product of the known fluidised bed reactor (see D4) into a subsequent reactor for further polymerisation, as shown in Figure 1 of D31, for example, and would use a side line (side line 20) which branches off the recycle gas line (line 25 leading to position 28) as the transfer line, as also shown in Figure 1 of D31. They would thereby implement the additional features in point a) without needing to involve an inventive step.

10.10 The amendments in claim 1 of auxiliary request X therefore do not support an inventive step.

11. Inventive step - claim 7

11.1 Independent process claim 7 is the same as claim 1 of auxiliary request VIII.

11.2 Claim 7 thus lacks an inventive step for the same reasons as those outlined above with respect to claim 1 of auxiliary request VIII (see point 8.).

Auxiliary requests XI to XX

12. The independent claims of auxiliary requests XI to XX are the same as those of auxiliary requests I to X, and therefore the same considerations as those set out above apply.

Auxiliary requests XI to XX are therefore not allowable for the same reasons as those set out above, i.e. for lack of an inventive step.

Auxiliary requests XXI to XXIII

13. Article 13(2) RPBA

13.1 Auxiliary requests XXI to XXIII were filed after notification of the board's communication under Article 15(1) RPBA.

13.2 The respondent took the view that these auxiliary requests did not constitute an amendment of their case because the process claims now referred back to the reactor of claim 1 (auxiliary requests XXI and XXII) or had been deleted entirely (auxiliary request XXIII). They thus did not not entail re-evaluating the matters at issue, nor did they alter the factual and legal scope of the proceedings. According to the respondent, the deletions did not lead to a fresh case and thus should not be considered to be an amendment to their case, in line with T 1480/16 or T 1857/19.

13.3 However, auxiliary requests XXI and XXII contain a fresh version of the process claim and thus do constitute an amendment of the respondent's case. In auxiliary request XXIII, all the process claims have been deleted. In this board's view, this also constitutes an amendment of the case (see T 494/18, Reasons 1.4; T 2295/19, Reasons 3.4.2-3.4.5; T 1800/21, Reasons 3.3; or T 42/22, Reasons 22). Consequently, the provisions of Article 13(2) RPBA apply.

13.4 Not only can no exceptional circumstances be recognised in this case, but these auxiliary requests also serve no useful purpose, considering that they all contain the same claim 1 as auxiliary request X, which was found to lack an inventive step for the reasons set out above.

13.5 Auxiliary requests XXI to XXIII cannot be taken into account.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The patent is revoked.

The Registrar: The Chairwoman:

C. Vodz O. Loizou

Decision electronically authenticated