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**Datasheet for the decision
of 27 May 2021**

Case Number: T 1509/17 - 3.3.03

Application Number: 10798895.8

Publication Number: 2516489

IPC: C08F10/06

Language of the proceedings: EN

Title of invention:

GAS-PHASE POLYMERIZATION PROCESS HAVING MULTIPLE FLOW REGIMES

Patent Proprietor:

W.R. Grace & Co.-Conn.

Opponent:

Basell Poliolefine Italia S.r.l.

Relevant legal provisions:

EPC Art. 56

Keyword:

Inventive step (no) - obvious combination of features (all requests)

Decisions cited:

T 0939/92



Beschwerdekammern

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Case Number: T 1509/17 - 3.3.03

D E C I S I O N
of Technical Board of Appeal 3.3.03
of 27 May 2021

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Decision under appeal: **Decision of the Opposition Division of the
European Patent Office posted on 2 May 2017
revoking European patent No. 2516489 pursuant to
Article 101(3) (b) EPC.**

Composition of the Board:

Chairman D. Semino
Members: F. Rousseau
C. Brandt

Summary of Facts and Submissions

- I. The appeal lies from the decision of the opposition division posted on 2 May 2017 revoking European patent No. 2 516 489.
- II. The contested decision was based on the documents of the patent as granted as the main request, on a First Auxiliary Request submitted during the oral proceedings on 30 March 2017, an additional First Auxiliary Request submitted with letter of 30 January 2017, Second and Fourth Auxiliary Requests submitted with letter of 28 March 2017, Third and Fifth Auxiliary Requests submitted with letter of 30 January 2017, Sixth and Seventh Auxiliary Requests submitted during the oral proceedings.
- III. Claims 1 of the patent as granted read as follows:
- "1. A process to make polypropylyene or propylene copolymer comprising:
- a. polymerizing propylene in a reactor having two or more different flow regimes;
 - b. adding a mixed electron donor system to the reactor, wherein the mixed electron donor system comprises at least one selectivity control agent and at least one activity limiting agent."

Claim 1 of the Seventh Auxiliary Request differed from claim 1 as granted in that it contained the additional wording at the end of the claim:

", wherein the reactor operates under two flow regimes; one is fast fluidization, and the other is packed moving bed, and wherein the activity limiting agent is isopropyl myristate or di-n-butyl sebacate."

IV. The following documents were inter alia cited in support of the opposition :

D1: WO 2009/029486 A2
D2: WO 2011/029735 A1
D3: US 2009/0203863 A1
D5: WO 2005/095465 A1
D6: EP 0 560 035 A1

V. According to the reasons for the appealed decision :

- (a) Claim 1 of the main request lacked novelty over each of D1, D2, and D3. In that respect D1 and D3 were held to describe the polymerization of propylene in a reactor having two or more different flow regimes, whereas the group of antifouling agents used in the polymerization process of D2 was held to comprise activity limiting agents within the meaning of the patent in suit.
- (b) Neither the new First Auxiliary Request submitted during the oral proceedings, nor the former First Auxiliary Request submitted with letter of 30 January 2017 which was withdrawn and resubmitted during the oral proceeding, were admitted into the proceedings.
- (c) The subject-matter of the Second, Third and Fifth Auxiliary Requests was also found to lack novelty over each of D1, D2 and D3, whereas that of the

Fourth and Sixth Auxiliary Requests lacked novelty over D2.

(d) As to the Seventh Auxiliary Request, its subject-matter was found to be novel, but to lack an inventive step starting from D5 as the closest prior art. D5 concerned the polymerisation of polypropylene in a two zone loop reactor operating under fast fluidisation and dense solid bed conditions. The process defined in claim 1 of the Seventh Auxiliary Request differed from that of D5 by the selection of the combination of the specific activity limiting agents (ALA) and selectivity control agents (SCA) as defined therein. The comparative tests of the patent in suit could not show that the alleged technical effect of reducing agglomeration was due to the use of the specific ALA compound employed in these comparative tests. The problem solved over the closest prior art was therefore to provide an alternative process to polymerise polypropylene in a reactor with the flow regimes fast fluidisation and packed moving bed. D3 described the polymerisation of polypropylene using flow regimes which were very similar to those of the patent in suit. It also taught to use a combination of SCA and ALA as defined in the Seventh Auxiliary Request in order to prevent a run-away reaction and/or polymer agglomeration. The skilled person would therefore find a motivation in D3 to use such a combination of SCA and ALA in the process of D5, expecting some effect on agglomeration, even if D3 were considered to concern a different flow regime environment.

(e) The patent in suit was thus revoked.

VI. The patent proprietor (appellant) lodged an appeal against the above decision and filed with the statement of grounds of appeal submitted with letter of 11 September 2017 additional documentary evidence, *inter alia*:

D16: WO 2005/030815 A1 and

D18: P. Cai et al, "Some recent advances in fluidized-bed polymerisation technology", *Particuology*, 2010, 8, 578-581.

VII. To the statement setting out the grounds of appeal were also attached eleven sets of claim requests as Auxiliary Request 1, 1a, 2, 2a, 3, 3a, 4, 4a, 5, 6 and 7. Their claims 1 were defined to comprise the following features in addition to those of claim 1 as granted:

Auxiliary request 1

"wherein the reactor operates under two flow regimes; one is fast fluidization, and the other is packed moving bed" at the end of that claim.

Auxiliary Request 1a

The feature inserted in claim 1 of Auxiliary Request 1 and the additional feature "wherein the activity limiting agent is a composition that decreases catalyst activity as the catalyst temperature rises above a threshold temperature of 85°C" added thereafter.

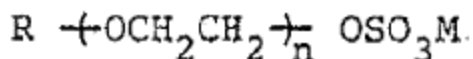
Auxiliary Request 2

"wherein the activity limiting agent is a carboxylic acid ester, a diether, a poly(alkene glycol), a diol

ester, or a combination thereof, provided that the activity limiting agent is not epoxidate soya oil and is not a hydroxyester with at least two free hydroxyl groups, obtained from carboxylic acids with from 8 to 22 carbon atoms and from polyalcohols" at the end of the claim.

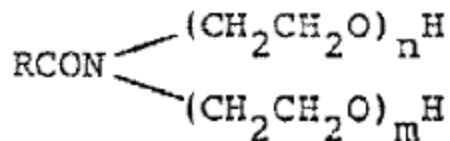
Auxiliary Request 2a

"wherein the activity limiting agent is a carboxylic acid ester, a diether, a poly(alkene glycol), a diol ester, or a combination thereof, provided that the activity limiting agent is not epoxidate soya oil, diisobutyl phthalate, a polyalcohol having from 4 to 8 carbon atoms, a hydroxyester with at least two free hydroxyl groups, obtained from carboxylic acids with from 8 to 22 carbon atoms and from polyalcohols, a compound represented by the general formula



wherein R is a saturated or unsaturated hydrocarbon radical having 1 to 22 carbon atoms, n is a number of from 1 to 10, and M is an alkali or alkaline earth metal,

or a compound represented by the general formula



wherein R is a saturated or unsaturated hydrocarbon radical having from 4 to 22 carbon atoms, and n and m, which are the same or different, are numbers of from 1 to 10" at the end of the claim.

Auxiliary Request 3

"wherein the activity limiting agent is selected from ethyl benzoate, methyl benzoate, ethyl p-methoxybenzoate, methyl p-ethoxybenzoate, ethyl pethoxybenzoate, ethyl p-isopropoxybenzoate, ethyl acrylate, methyl methacrylate, ethyl acetate, ethyl p-chlorobenzoate, hexyl p-aminobenzoate, isopropyl naphthenate, n-amyl toluate, ethyl cyclohexanoate, propyl pivalate, dimethyl phthalate, diethyl phthalate, di-n-propyl phthalate, diisopropyl phthalate, di-nbutyl phthalate, diisobutyl phthalate, di-tert-butyl phthalate, diisoamyl phthalate, di-tert-amyl phthalate, dineopentyl phthalate, di-2-ethylhexyl phthalate, di-2-ethyldecyl phthalate, diethyl terephthalate, dioctyl terephthalate, bis[4-(vinylloxy)butyl]terephthalate, (poly)(alkylene glycol) mono- or diacetates, (poly)(alkylene glycol) mono- or di-myristates, (poly)(alkylene glycol) mono- or di-laurates, (poly)(alkylene glycol) mono- or di-oleates, glyceryl tri(acetate), isopropyl myristate, di-n-butyl sebacate, a diether, a poly(alkene glycol), a diol ester, and combinations thereof" at the end of the claim.

Auxiliary Request 3a

"wherein the activity limiting agent is selected from ethyl benzoate, methyl benzoate, ethyl p-methoxybenzoate, methyl p-ethoxybenzoate, ethyl pethoxybenzoate, ethyl p-isopropoxybenzoate, ethyl acrylate, methyl methacrylate, ethyl acetate, ethyl p-chlorobenzoate, hexyl p-aminobenzoate, isopropyl naphthenate, n-amyl toluate, ethyl cyclohexanoate, propyl pivalate, dimethyl phthalate, diethyl phthalate, di-n-propyl phthalate, diisopropyl phthalate, di-nbutyl phthalate, di-tert-butyl phthalate, diisoamyl

phthalate, di-tert-amyl phthalate, dineopentyl phthalate, di-2-ethylhexyl phthalate, di-2-ethyldecyl phthalate, diethyl terephthalate, dioctyl terephthalate, bis[4-(vinylloxy)butyl]terephthalate, glyceryl tri(acetate), isopropyl myristate, di-n-butyl sebacate, and combinations thereof" at the end of the claim.

Auxiliary Request 4

The feature inserted in claim 1 of Auxiliary Request 1 and the additional feature and the definition thereafter of the activity limiting agent as provided in claim 1 of Auxiliary Request 2.

Auxiliary Request 4a

The feature inserted in claim 1 of Auxiliary Request 1 and the definition thereafter of the activity limiting agent as provided in claim 1 of Auxiliary Request 2a.

Auxiliary Request 5

The feature inserted in claim 1 of Auxiliary Request 1 and the definition thereafter of the activity limiting agent as provided in claim 1 of Auxiliary Request 3.

Auxiliary Request 6

The feature inserted in claim 1 of Auxiliary Request 1 and the definition thereafter of the activity limiting agent as provided in claim 1 of Auxiliary Request 3a.

Auxiliary Request 7

The feature inserted in claim 1 of Auxiliary Request 1 and the additional feature "and wherein the activity limiting agent is isopropyl myristate or di-n-butyl sebacate" added thereafter.

- VIII. The opponent (respondent) replied to the statement of grounds of appeal with letter of 29 January 2018.
- IX. Additional submissions were made by the appellant with letter of 29 June 2018.
- X. In preparation of oral proceedings the Board issued a communication dated 9 March 2020 including a preliminary opinion *inter alia* on inventive step starting from the disclosure of D5 as the closest prior art.
- XI. The appellant and the respondent made additional submissions concerning the substance of the case with letters of 30 March 2020 and 27 April 2021, respectively.
- XII. Oral proceedings, postponed as the consequence of the COVID-19 pandemic, were held with the parties' consent by videoconference on 27 May 2021.
- XIII. The appellant's submissions, insofar as they are pertinent, may be derived from the reasons for the decision below. The appellant essentially submitted that the claimed process according to any of the claims requests was inventive starting from the examples of D5 as the closest prior art, even when taking into account the teaching of D3 and D16.

XIV. The respondent's submissions, insofar as they are pertinent, may be derived from the reasons for the decision below. The respondent essentially submitted that the claimed process according to any of the claims requests did not involve an inventive step over the examples of D5 as the closest prior art when considering the teaching of D3 and D16.

XV. The appellant requested that the decision of the opposition division be set aside and the opposition be rejected (main request), or alternatively that the decision of the opposition division be set aside and the patent be maintained on the basis of one of the auxiliary requests filed with letter of 11 September 2017, in order of preference, Auxiliary Requests 1, 1a, 2, 2a, 3, 3a, 4, 4a, 5, 6 and 7.

XVI. The respondent requested that the appeal be dismissed.

Reasons for the Decision

Main request - Inventive step

Closest prior art

1. According to paragraph [0005] of the patent in suit which has to be read in the light of paragraph [0002], the patent in suit aims at developing an improved polymerization process for the production of polypropylene homo- and copolymers in a multi-regime reactor system. The sought improvement is related to operational problems such as particle agglomeration and formation of polymer "chunks", believed to be mainly

due to inadequately heat removal and/or static adhesion (paragraph [0005]).

1.1 Such operational problems are indicated in paragraph [0005] of the specification to be documented *inter alia* in WO 2005/095465, i.e. document D5 in the appeal proceedings. The examples of D5 (pages 13 to 15) also concern the polymerization in the gas-phase of polypropylene (Example 1) or of a copolymer thereof with ethylene (Example 2) in a reactor operated under two flow regimes, namely fast fluidization and packed moving bed, while preventing the formation of polymer lumps. Those examples are described in D5 by reference to Figure 1 reproduced below.

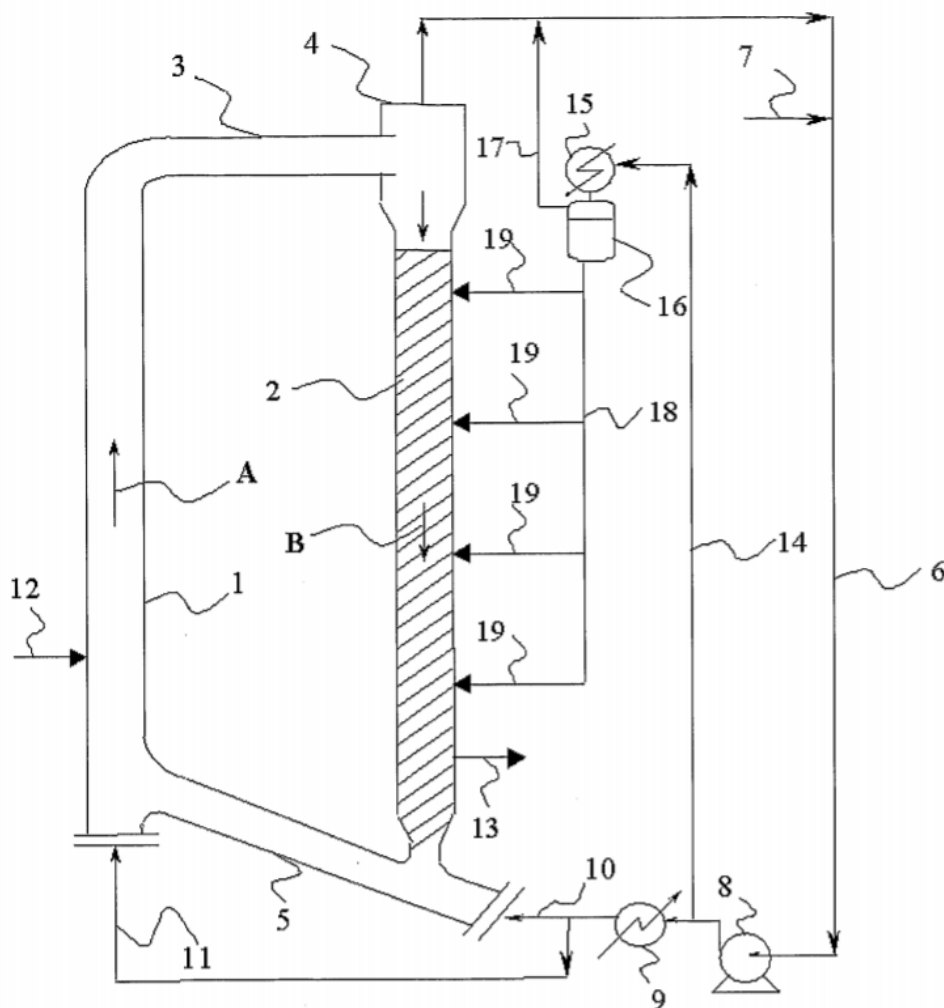


Figure 1 is a diagrammatic representation of the gas-phase polymerisation reactor used in D5 (page 8, lines 17-23 and page 13, lines 2-4). The reactor is a loop reactor which comprises two interconnected vertical polymerization zones having a cylindrical shape (riser 1 and downcomer 2).

The growing polymer particles flow through the first of said polymerization zones (riser 1) under fast fluidization conditions, leave said first polymerization zone and enter the second polymerization zone (downcomer 2), through which they flow in a densified form (packed flow mode) under the action of gravity, leave the second polymerisation zone and are reintroduced into the first polymerisation zone, thus establishing a circulation of polymer between the two polymerisation zones (page 6, last full paragraph, paragraph bridging pages 6 and 7 and first full paragraph of page 7).

The Ziegler-Natta catalyst (page 13, lines 5-9), preferably after a prepolymerization step, is continuously introduced via line 12 into the riser 1. The obtained polymer is continuously discharged from the reactor via line 13 (page 8, lines 24-26).

- 1.2 The method of D5 allows by means of a massive introduction of liquid (monomer and inert diluent) in proximity of the reactor walls of the downcomer through feeding lines 19 to prevent any formation of polymer lumps in the downcomer 2 (passage starting with the four last lines of page 4 and ending with the first seven lines of page 6; Example 1, page 14, third to fifth full paragraphs; Example 2, page 15, last three full paragraphs).

In the absence of liquid introduced in proximity of the reactor walls or in presence of a too low amount thereof, polymer lumps are formed hindering the regular flow of polymer particles into the downcomer 2, which makes it impossible after a certain period of time to discharge the polymer from the reactor via line 13 and causes a complete clogging of the reactor (Comparative Examples A and B, page 15, last line and page 16).

- 1.3 The Board is therefore satisfied, in line with the reasons for the contested decision and the submissions of the parties that the processes described in the examples of D5 (pages 13 to 15) constitute a suitable starting point for the skilled person wishing to solve the problem addressed in the patent in suit.

Distinguishing features

- 1.4 It is also undisputed that the examples of D5 concern a polymerisation reaction in the presence of dicyclopentyl dimethoxysilane as an external donor (page 13, line 9), i.e. a selectivity control agent (SCA) within the meaning of operative claim 1 (see paragraphs [0020] and [0021] of the patent in suit).

Therefore, as found by the opposition division and agreed by the parties the subject-matter of operative claim 1 differs from the process constituting the closest prior art only in that use is made of at least one compound designated in claim 1 of the patent in suit as "activity limiting agent". As in the specification, this terminology is abbreviated hereafter as ALA.

Although operative claim 1 also covers methods in which at least one ALA is added as part of the mixed electron

donor system instead of introducing as in D5 a liquid (monomer and inert diluent) in proximity of the reactor walls, it is sufficient for the present decision to consider only embodiments of operative claim 1 for which at least one ALA is used in addition to all other measures performed in D5, i.e. including the addition a liquid (monomer and inert diluent) in proximity of the reactor walls (which is not excluded in the process of operative claim 1).

Problem successfully solved

2. Having regard to the closest prior art (i.e. the working examples of D5, as opposed to a reactor having two or more flow regimes that does not have liquid monomer introduced in proximity of the walls of the downcomer, such as the reactors described in the introductory portion of D5), the appellant and the respondent take different positions as to which problem can be considered to be successfully solved by the subject-matter of operative claim 1.

Relying on the experimental results described in the patent in suit, the appellant argues that the technical problem solved by the subject-matter of claim 1 is the provision of a process for the polymerization of propylene in a reactor having more than one flow regime in which the amount of clogging (i.e. fouling) within the reactor is reduced (letter of 30 March 2020, page 4, six first full paragraph), whereas the respondent contests the relevance of these comparative tests and argues that the problem solved by the claimed subject-matter is to provide an alternative solution to the technical problem of reducing fouling in a multiple flow regime reactor.

3. An assessment of the problem successfully solved by the process of claim 1, i.e. when using an ALA in the process of D5, necessitates an analysis of the phenomena underlying clogging of the reactor in D5 or prevention thereof and the meaning of the term ALA within the context of the patent in suit.

Phenomena underlying clogging of the reactor in D5 and prevention thereof

- 3.1 D5 describes that the formation of polymer lumps leading to clogging of the reactor has its origin in an excess of heat generated by the exothermic polymerisation reaction which causes softening of the polymer and stickiness of the particles (page 3, lines 3-5 and 10-11 and page 7, lines 22-25). Clogging of the reactor takes place in the downcomer where the density of solid, i.e. of polymer per volume of that part of the reactor, is at least 80% of the "poured bulk density" of the obtained polymer during normal operating conditions (page 7, lines 15-25).

As outlined by the appellant, a first factor at the origin of the excess heating of the particles is a limited amount of gas (essentially monomers and some inert diluent) surrounding the polymer particles in the downcomer. There is therefore only a little amount of gas which acts as a cooling medium in the downcomer for removing the heat of polymerization, meaning that only a relatively low heat transfer coefficient is guaranteed in that part of the reactor (D5, page 7, lines 18-19).

A second fact contributing to the excess heating of the particles is as noted by the appellant that the polymer particles flowing close to the reactor wall are

subjected to a remarkable slowdown due to the friction of the wall (page 3, lines 5-11 and page 7, lines 21-22). For this reason the particles flowing close to the wall take more time to cover the length of the downcomer with respect to the particles flowing in the center of the downcomer (page 3, lines 5-9) and are more prone to an excess of heating. The difference in time for the particles to cover the length of the downcomer is referred in D5 as a velocity gradient along the cross section of the reactor.

3.2 In order to avoid clogging of the reactor due to an excess of heat generated by the exothermic polymerization reaction D5 teaches as already indicated in above point 2.2 to introduce a large amount of liquid in proximity of the reactor walls of the downcomer through feeding lines 19. As explained in the paragraph bridging pages 4 and 5 of D5 this step contributes in different ways to reduce the temperature, namely:

- the fall of the liquid onto the reactor walls does not only provide a liquid layer interposed between the polymer particles and said wall, reducing thereby the friction of the polymer onto the wall of the downcomer and therefore reducing the slowdown of the particles along the wall, but also provides the particles with a downward thrust, also partially counterbalancing the velocity gradient along the cross section of the reactor, and

- the partial evaporation of the liquid added contributes to remove away the heat of polymerization.

Meaning of ALA

3.3 In the absence of any indication that the terminology ALA used for defining an electron donor would have a well recognized meaning in the art, it is necessary for an appropriate interpretation thereof to have recourse to the description. Relevant information in this respect is given in paragraphs [0011], [0018] and [0024] of the specification.

According to paragraph [0018] an ALA is *"a composition that decreases catalyst activity as the catalyst temperature rises above a threshold temperature (e.g. temperature greater than 85°C)"*.

Concerning the meaning of that threshold temperature, paragraph [0024] specifies further that an *"ALA inhibits or otherwise prevents polymerization reactor upset and ensures continuity of the polymerization process. Typically, the activity of Ziegler-Natta catalysts increases as the reactor temperature rises. Ziegler-Natta catalysts also typically maintain high activity near the melting point temperature of the polymer produced. The heat generated by the exothermic polymerization reaction may cause polymer particles to form agglomerates and may ultimately lead to disruption of continuity for the polymer production process. The ALA reduces catalyst activity at elevated temperature, thereby preventing reactor upset, reducing (or preventing) particle agglomeration, and ensuring continuity of the polymerization process"*.

Moreover, paragraph [0011] teaches that the donor mixture (i.e. SCA and ALA (see paragraph [0018])) *"can sufficiently modify the kinetic profile of the polymerization and thus eliminate "hot" spots in the*

reactor associated with agglomeration or chunk formation. In this way, the reactor can avoid the polymer-particle agglomeration and the pluggage of different locations in the production system (e.g., polymerization reactor, product discharge port, gas-recycle pipe, compressor, or heat exchanger)."

Accordingly, an ALA within the meaning of the patent in suit is an electron donor which above a certain temperature (threshold temperature) reduces the activity of the catalyst used for the synthesis of polypropylene or propylene copolymers. It is meant to limit in this way the heat generated by the exothermic polymerisation reaction such as to avoid the presence of "hot" spots, i.e. local points in the reactor at which excessive temperatures locally arise causing softening or melting of the polymer and as a consequence agglomeration of polymer particles.

The appellant submitted with letter of 30 March 2020 (page 4, fourth full paragraph) that it would be clear to a skilled person that the two methods of reducing reactor fouling described in D5 (introducing liquid monomer to the wall of the downcomer) and in the patent in suit (reduction of catalytic activity) would be complementary to one another, and that both methods could co-exist in a single reactor set up. The Board agrees that the use of ALA constitutes an additional means independent from those taught in D5 in order to reduce the heat generated by the exothermic polymerisation and therefore agglomeration of the polymer particles in the downcomer.

Definition of the problem

3.4 D5 does not describe the period of time over which any formation of polymer lumps into the downcomer is prevented in Examples 1 and 2 of that document. Moreover, the patent in suit neither defines the threshold temperature of the ALA, nor the level of reduction of the catalyst activity over said threshold temperature. For the sake of the present reasoning, it is however considered to the benefit of the appellant and in view of the meaning of ALA and of the clogging phenomena potentially arising that said threshold temperature and level of reduction of activity are such that the use of an ALA contributes in the context of the examples of D5 to an additional reduction of the temperature in the reactor and therefore to an additional reduction of agglomeration of the polymer particles, should such agglomeration take place in the process of D5.

Under these circumstances it is not necessary to address the additional submissions made by the parties on the basis of the experimental evidence contained in the patent in suit, D16 and D18 concerning the question whether or not it is credible that the use of an ALA brings about a reduction of agglomeration of the polymer particles.

3.5 Accordingly, the technical problem solved by the process of claim 1 is formulated as the provision of a process for the polymerization of propylene in a reactor having more than one flow regime in which the amount of clogging (i.e. fouling) within the reactor is (further) reduced.

Obviousness of the solution

4. It remains to be decided whether the skilled person desiring to solve the problem identified above would, in view of the disclosure of D5, possibly in combination with other prior art, including common general knowledge, have modified the process of the closest prior art in such a way as to arrive at the process of operative claim 1.
- 4.1 The submission by the respondent that D3 (abstract; paragraph [0002], three last sentences; page 4, paragraph [0056]; page 5, paragraph [0062]; page 7, paragraph [0095]) also concerns the problem of reducing or suppressing agglomeration of polypropylene particles prepared in a gas phase reactor with the same type of Ziegler-Natta heterogeneous catalyst as in D5 (solid catalyst component with an internal donor, aluminum based co-catalyst and external donor), the cause for agglomeration of the particles being the same as in D5, i.e. excessive heat generated by the exothermic polymerisation reaction, was not disputed by the appellant.

D3 teaches for this purpose in paragraph [0062] the use of "activity limiting agent"(s), which expression means according to paragraph [0056] of that document a material that reduces at polymerization conditions catalyst activity at a temperature greater than about 100°C. Such ALA reduce catalyst activity at elevated temperature and consequently the risk of agglomeration of the polymer particles. They can be selected according to paragraph [0062] of D3 from aliphatic esters, isopropyl myristate and/or di-n-butyl sebacate being explicitly mentioned (last sentence of paragraph

[0062] of D3), i.e. ALA which are also recommended in the patent in suit (last sentence of paragraph [0027]).

- 4.2 The fact that D16 confirms the ability of isopropyl myristate and di-n-butyl-sebacate to limit above a threshold temperature the activity of the same type of Ziegler-Natta heterogeneous catalyst as in D5 when polymerizing propylene in a gas phase reactor was also not disputed. Reference is made in D16 to page 1, lines 10-13; page 13, lines 17-22; page 16, lines 21-31; page 17, lines 2-34; pages 20-21, Table 2, Runs 3 to 10. D16 also teaches that the purpose of using SCA/ALA mixtures is to reduce or avoid an uncontrolled acceleration of the reaction, as well as softening or melting of polymer particles that leads to agglomerate formation and sheeting or fouling of the reactor (page 19, lines 8-15 and paragraph bridging pages 1 and 2).
- 4.3 It is not disputed either that the skilled person would have considered the means to achieve a reduction of the heat generated by the exothermic polymerisation reaction taught (i) in D5 (introducing a liquid monomer and diluent to the wall of the reactor) and (ii) in D3 and D16 (reduction of the catalytic activity by addition of an ALA) to be independent from another (see also point 3.3, last paragraph). Accordingly, assuming to the benefit of the appellant that the measures described in D5 were not sufficient to reduce agglomeration of the polymer particles to a satisfactory level (see above point 3.4) which agglomeration is known to the skilled person to be due the amount of heat generated by the exothermic polymerisation reaction, it would have been obvious for the skilled person seeking to reduce the amount of clogging (i.e. fouling) to use an independent and

complementary means to further reduce the amount of heat generated by the polymerisation reaction.

As shown in above points 4.1 and 4.2, such means is for the polymerization reaction using the catalytic system of D5 known from D3 and D16 as the addition of ALA within the meaning of the patent in suit, in particular that of isopropyl myristate and/or di-n-butyl sebacate. By doing so the skilled person would arrived in an obvious manner to a process that falls within the ambit of operative claim 1.

4.4 The appellant, however, disputed that the skilled person would have considered the use of ALA as taught in D3 and D16 to be applicable to the process of D5.

4.4.1 The appellant's argument that the skilled person would not have expected the application of an ALA in a single-regime reactor, as described in D3 or D16, to be transferable to a dual-regime reactor, such as used in D5 cannot convince, as submitted by the respondent. The applicability of using ALA only in specific types of reactor or for specific flow regimes is not addressed in D3 or D16.

Having regard to the functional definition of an ALA (D16, from page 3, line 9 to page 4, lines 17; D3, page 4, paragraph [0056]) and their general applicability in various polymerization processes such as gas phase, slurry, and bulk polymerization processes, operating in one or more than one reactor mentioned in those prior art documents (D16, page 13, lines 17-19; D3, page 6, paragraph [0081]) the skilled person understands that their applicability rather depends on the specific conditions used in a given polymerization process and the threshold temperature above which a specific ALA

reduces the activity of the catalyst and the reduction of activity above that temperature.

- 4.4.2 It is undisputed as argued by the appellant that conduction of heat away from exothermic reaction sites would be far less efficient in a packed moving bed than in a flow regime with an upward flow of fluidizing medium, because the particles in the packed moving bed are more tightly packed together and against the walls of the reactor. On that basis the appellant submitted that the skilled person would not consider that the addition of an ALA as taught in D3 and D16 would enable a sufficient reduction in heat generation within a packed moving bed to prevent clogging arising from polymer particles melting and sticking to one another and/or the walls of the reactor.

The question to be answered, however, is not whether it would have been obvious to the skilled person that the addition of an ALA alone as used in D3 and D16, i.e. instead of the introduction of liquid (monomer and inert diluent) in proximity of the reactor walls, would enable a sufficient reduction in heat generation within a packed moving bed to prevent clogging. The point is rather whether the use of an ALA would be obvious, should the skilled person wish to obtain a further reduction of temperature and a consequential reduction of agglomeration of the polymer particles compared to that achieved with the measures already applied in D5, i.e. in case those were alone not sufficient to reduce agglomeration of the polymer particles to a satisfactory level (see above point 3.4).

In that respect, although the examples of D5 do not provide any indication about the period of time over which any formation of polymer lumps into the downcomer

is prevented, these examples are considered to demonstrate the general applicability of the measured taught in D5. Should the specific conditions used in the Examples 1 and 2 of D5 being insufficient to reduce agglomeration of the polymer particles to a satisfactory level, e.g. over a long period of time, it would be obvious for the skilled person to search for additional measures to further reduce agglomeration of the polymer particles. Having regard to the functioning principle of an ALA as explained in D3 and D16, it would have been obvious for the skilled person that the use of an ALA constituted a promising and complimentary mean to further reduce agglomeration of the polymer particles.

The appellant's argument that the additional use of an ALA within a packed moving bed to prevent clogging arising from polymer particles melting and sticking would not be obvious fails therefore to convince in so far as a process carried out as in D5 is concerned.

- 4.5 The appellant also submitted at the oral proceedings that it could be taken from D2 that anti-fouling agents in general or antistatic agents such as ATMER163[®] (which particular compound as indicated in D6 could be also considered as an agent inhibiting clogging in a fluid bed reactor) would not solve the problem of particles clogging in a packed moving bed, unless particular measures preconised in D2 were adopted. Since the measures preconised in D2 to avoid clogging were not taken in the closest prior art, it was argued by the appellant on this basis that the skilled person would have been taught away from the claimed solution, i.e. using ALA.

As correctly submitted by the appellant in section 5.1.25 on page 12 of the statement of grounds of appeal, D2 was published on 17 March 2011, i.e. after the filing date of the patent in suit (16 December 2010). Already for this reason, the appellant's argument that the skilled person would be taught away from the claimed solution in the light of a document which did form part of the state of the art cannot convince. Under these circumstances, it is not necessary for the Board to explain why this argument as to its technical merits would not be persuasive either.

5. On that basis, even if to the benefit of the appellant it is assumed that the measures described in D5 are not sufficient to reduce agglomeration of the polymer particles to a satisfactory level and the definition of an ALA is limited to compounds exhibiting a threshold temperature and a level of reduction of activity such that the use of an ALA contributes in the context of the reactor of D5 to an additional reduction of agglomeration of the polymer particles (see above point 3.4), the subject-matter of claim 1 of the main request which covers processes obvious to the skilled person does not involve an inventive step and this request cannot be allowed.

6. Under these circumstances, it is not necessary to assess whether the subject-matter of claim 1 over its full breadth, e.g. for embodiments for which a liquid (monomer and inert diluent) is not added in proximity of the reactor walls, would successfully solve the problem formulated by the appellant and would be obvious in the light of the prior art cited.

Auxiliary requests 1, 1a, 2, 2a, 3, 3a, 4, 4a, 5, 6 and 7

7. The amendment introduced in these auxiliary requests are of three types, namely

(i) the definition that the reactor "operates under two flow regimes; one is fast fluidization, and the other is packed moving bed" (auxiliary requests 1, 1a, 4, 4a, 5, 6 and 7),

(ii) a functional definition that the ALA "is a composition that decreases catalyst activity as the catalyst temperature rises above a threshold temperature of 85°C" (auxiliary requests 1a) and

(iii) a restriction of the definition of the ALA on the basis of structural features (auxiliary requests 2, 2a, 3, 3a, 4, 4a, 5, 6 and 7).

7.1 Amendment (i) does not introduce a further distinguishing feature over the closest prior art, as the examples of D5 also concern a process operating under the flow regimes fast fluidization and packed moving bed (see above point 1.1). This amendment is therefore not suitable to overcome the finding that the process according to the main request lacks an inventive step.

7.2 Having regard to the function of the ALA in D3 and D16, i.e. to reduce aggregation of the polymer particle due to softening of the polymer by reducing catalytic activity, it is implicit that the ALA in D3, including isopropyl myristate and/or di-n-butyl sebacate explicitly mentioned in paragraph [0062] of D3, decrease catalyst activity when the catalyst temperature rises above a threshold temperature of

85°C. This is confirmed by paragraph [0056] of D3 in which ALA are explicitly defined to reduce catalytic activity at a temperature greater than about 100°C. Accordingly, amendment (ii) is not suitable to exclude from claim 1 of the main request embodiments which have been found above to be obvious.

7.3 The restricted definition of the ALA in claims 1 of auxiliary requests 2, 2a, 3, 3a, 4, 4a, 5, 6 and 7 do not lead to isopropyl myristate and/or di-n-butyl sebacate to be excluded from the subject-matter of claim 1. This amendment as such is therefore also not suitable to overcome the finding that the process according to the main request lacks an inventive step.

7.4 With respect to auxiliary request 7 the appellant submitted for the first time during the oral proceedings that not every ALA mentioned in D3 would be suitable to reduce agglomeration of the polymer particles in a packed moving bed. It was also submitted that arriving at the process of claim 1 of that auxiliary request would require a multiple selection in D5 (choice of flow regimes) and D3 (choice of ALA) at which the skilled person could only arrive with the benefit of hindsight. These arguments, however, cannot convince.

Firstly, no selection within D5 is necessary, since the process constitutive of the closest prior art already operates under the flow regimes defined in claim 1 of auxiliary request 7.

Secondly, the appellant's argument that isopropyl myristate and di-n-butyl sebacate represent a purposive selection within the teaching of D3 as to their ability to reduce agglomeration in a packed bed is neither

based on the slightest indication in the patent in suit, nor supported by any evidence. Already based on this reason alone the appellant's submissions in respect of auxiliary request 7 cannot convince.

Thirdly, the question what a skilled person would have done in the light of the state of the art depends in large measure on the technical result that person has set out to achieve (see T 0939/92, OJ EPO 1996, 309, reasons Nrs 2.4.2 and 2.5.3). Faced with the problem identified in above point 3.5, i.e. providing a process for the polymerization of propylene in a reactor having more than one flow regime in which the amount of clogging (i.e. fouling) within the reactor is (further) reduced, the skilled person would have considered any measure known in the art which appears to be promising for this purpose, i.e. in the present case the ALA compounds whose use is taught in D3 (see above point 4.4.2), arriving thereby in an obvious manner at the process of claim 1 of auxiliary request 7.

7.5 According, the conclusion with respect to inventive step regarding claim 1 of the main request is equally valid with regard to claim 1 of any of the auxiliary requests. None of the auxiliary requests is therefore allowable.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



A. Voyé

D. Semino

Decision electronically authenticated