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**Datasheet for the decision
of 20 September 2006**

Case Number: T 0480/04 - 3.3.03

Application Number: 98925286.1

Publication Number: 0986586

IPC: C08F 10/00

Language of the proceedings: EN

Title of invention:

Polymeric supported catalysts for olefin polymerization

Applicant:

ExxonMobil Chemical Patents, Inc.

Opponent:

-

Headword:

-

Relevant legal provisions:

EPC Art. 84, 123(2), 54, 56

Keyword:

"Inventive step (yes)"

Decisions cited:

-

Catchword:

-



Case Number: T 0480/04 - 3.3.03

D E C I S I O N
of the Technical Board of Appeal 3.3.03
of 20 September 2006

Appellant: ExxonMobil Chemical Patents, Inc.
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Baytown, TX 77520-5200 (US)

Representative: Denness, James Edward
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 3 November 2003
refusing European application No. 98925286.1
pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: R. Young
Members: C. Idez
E. Dufrasne

Summary of Facts and Submissions

- I. European patent application No. 98 925 286.1, based on International application No. PCT/US98/11696, was filed on 5 June 1998, claiming the priority of the earlier US-patent applications No. 60/048965 filed on 5 June 1997 and No. 60/079569 filed on 27 March 1998, and published under No. WO-A-98/55518 on 10 December 1998, was refused by a decision according to the state of the file of the Examining Division issued on 3 November 2003.
- II. The decision of the Examining Division was based on Claims 1 to 18 submitted as main request with the letter dated 10 October 2002, on a first auxiliary request and a second auxiliary request as proposed by the Applicant at the oral proceedings of 28 November 2002. As can be deduced from the minutes of the oral proceedings, the main request did not meet the requirements of Article 84 EPC in view of an inconsistency between the claims and the second formula set out on lines 7 to 8 of page 5 of the description, the first auxiliary request contravened Article 123(2) EPC, and the subject-matter of the second auxiliary request could only be considered as involving an inventive step over the teaching of documents D1 (EP-A-0 727 443) and D2 (EP-A-0 633 272), read in the light of document D3 (Comprehensive Polymer Science, Vol. 6 (1989) Pergamon Press, pages 82-85) provided the Applicant would have submitted comparative examples as mentioned in paragraph IV.1 of the minutes of the oral proceedings demonstrating a surprising effect, which, however, was not done.

- III. Notice of Appeal was filed on 5 January 2004 by the Appellant (Applicant) with simultaneous payment of the prescribed fee. With the Statements of Grounds of Appeal filed on 11 March 2004, the Appellant submitted a new main request.
- IV. A communication was issued on 30 September 2005 by the Board, in which the Board gave its preliminary view concerning issues under Articles 123(2), 84, and 56 EPC and Rule 88 EPC. All these points were addressed by the Appellant in its response dated 8 February 2006. This letter was accompanied by three sets of Claims representing a new main request and two auxiliary requests, by an amended page 5 of the description, and document D4 (S. Roscoe et al. "Polyolefin Spheres from Metallocenes Supported on Noninteracting Polystyrene"; Science, Vol. 280, 10 April 1998; pages 270-273).
- V. In a communication issued on 7 June 2006 accompanying a summons to oral proceedings, the salient issues were identified by the Board as being the allowability of the main request, the first auxiliary request and the second auxiliary request under Article 123(2) EPC, the question as to whether the surface area of the polymer support might be considered as a characterizing feature of the claimed catalyst composition, and the validity of the comparison made by the Appellant between Example 5 of document D1 and the Examples A, E and D of document D4.
- VI. With its letter dated 18 August 2006, the Appellant submitted a new main request and five auxiliary requests, as well as the following document:

D5: Statement by Mr John Walzer dated 18 August 2006.

Claims 1 to 15 of the main request read as follows:

"1. An olefin polymerization catalyst composition comprising the reaction product of a) a polymeric support i) having a surface area as measured by single point nitrogen B.E.T. of from 1 to less than or equal to $10\text{m}^2/\text{g}$ and ii) comprising a covalently bound protonated ammonium salt of a noncoordinating anion, and b) an organometallic transition metal compound having ancillary ligands, and at least one labile ligand capable of abstraction by protonation by said ammonium salt and at least one labile ligand into which an olefinic monomer can insert for polymerization, in which the active catalyst sites are essentially uniformly distributed within the polymeric support.

2. The catalyst composition of claim 1 wherein said organometallic transition metal compound is a monocyclopentadienyl ligand-containing Group 4 metal compound.

3. The catalyst composition of claim 1 wherein said organometallic transition metal compound is a biscyclopentadienyl ligand-containing Group 4 metal compound.

4. The catalyst composition of claim 1 wherein said organometallic transition metal compound is a Group 4-10 metal compound other than a monocyclopentadienyl or biscyclopentadienyl ligand-containing Group 4 metal compound.

5. The catalyst composition of any of claims 2-4 wherein said noncoordinating anion is one derived from an organoboron or organoaluminium compound.
6. A polymeric supported activator for use in the preparation of the catalyst composition of claim 1 comprising a polymeric support having a surface area of from 1 to 10 m²/g as measured by single point nitrogen B.E.T. and functionalized with a protonated ammonium salt of a noncoordinating anion, said protonated ammonium salt being covalently bound to the polymeric support.
7. An olefin polymerisation process comprising contacting one or more ethylenically unsaturated olefin under suitable polymerization conditions with the catalyst composition according to claim 1.
8. The process according to claim 7 conducted under gas phase polymerization conditions.
9. The process according to claim 7 conducted under slurry polymerization conditions.
10. The process according to claim 8 or 9 wherein olefin is selected from ethylene and C₃-C₈ α-olefins, and combinations thereof.
11. The process according to claim 8 wherein said olefin is selected from ethylene, propylene, 1-butene, 1-hexene and 1-octene, and combinations thereof.

12. The process according to claim 9 wherein said olefin is propylene, optionally with ethylene.

13. The process according to claim 9 wherein said olefin is selected from ethylene, cyclic olefins, and styrenic olefins, and combinations thereof.

14. A process for the preparation of the polymeric supported activator of claim 6 comprising 1) protonating a) a neutral amine of the formula $\text{Polymer}-(R^1)(R^2)(R^3)N$ where Polymer is an essentially hydrocarbon polymer bead having a surface area at or below $10 \text{ m}^2/\text{g}$ as measured by single point nitrogen B.E.T., at least one of R^1 , R^2 and R^3 links the amine functionality to the polymeric support wherein R^1 , R^2 and R^3 are the same or different and are selected from the groups consisting of hydrogen, hydrocarbyl, and substituted hydrocarbyl and two or three R groups may be joined together to each other so as to form an alicyclic or aromatic ring having a ring nitrogen atom, with b) at least 0.1 molar equivalent of an acid, relative to the molar concentration of the amine; and 2) conducting an ion exchange reaction with a salt of a compatible noncoordinating anion.

15. A process for the preparation of the polymeric supported activator of claim 6 comprising reacting a) a neutral amine of the formula $\text{Polymer}-(R^1)(R^2)(R^3)N$

where Polymer is an essentially hydrocarbon polymer bead having a surface area at or below $10 \text{ m}^2/\text{g}$ as measured by single point nitrogen B.E.T., at least one

of R¹, R² and R³ links the amine functionality to the polymeric support wherein R¹, R² and R³ are the same or different and are selected from the groups consisting of hydrogen, hydrocarbyl, and substituted hydrocarbyl and two or three R groups may be joined together to each other so as to form an alicyclic or aromatic ring having a ring nitrogen atom, with b) at least 0.1 molar equivalent of an ammonium salt of a compatible noncoordinating anion, R⁴R⁵R⁶NH⁺NCA⁻ relative to the molar concentration of the amine, in which R⁴, R⁵ and R⁶ may be the same or different and are selected from the group consisting of hydrogen, hydrocarbyl, and substituted hydrocarbyl and are chosen so as to yield an ammonium salt with a lower pKa value than that of a product Polymer-R¹R²R³NH⁺[NCA⁻]."

The Appellant also argued essentially as follows:

(i) Concerning the main request:

(i.1) The invention related to olefin polymerization catalysts derived from a polymeric support comprising a protonated ammonium salt functionality covalently bound to the polymeric support and a non-coordinating cation.

(i.2) The ammonium salt functionality was randomly incorporated on the polymer chain and was therefore evenly spread/uniformly distributed/homogenously dispersed throughout the polymeric support.

(i.3) The skilled person would understand that to be a key distinction from the catalysts of the prior art, in which the active sites are located solely on the surface of the support.

(i.4) It was not a speculative assertion by the Appellant that the pores collapsed after removal of the solvent. This was supported by document D3. Any increase in size of the beads due to incorporation of the catalyst components would furthermore give only a slight increase of the surface area of the support. Reference was made to document D5 in that respect.

(i.5) The relatively low surface area of the support was related to the technical effects of limiting the monomer access to the catalyst active sites (as stated in the application at page 7, lines 6 and 7) and ensuring that the polymerization reaction occurred within the polymer matrix rather than on the surface.

(i.6) In document D2 the B.E.T surface areas of the polymer supports were stated to be generally higher than 30 m²/g, preferably higher than 50 m²/g, more preferably higher than 100 m²/g and could reach 500 m²/g and over (D2, page 2, lines 49 to 51).

(i.7) It was agreed that the experimental results of the present application were not directly comparable to Example 5 of D1.

(i.8) Nevertheless, a reduction in temperature from 80°C (Example 5 of D1) to 40°C (present Example 8) and changing from no comonomer (Example 5 of D1) to including hexene as comonomer (present Example 8) were both factors which would be expected to very significantly reduce the yield of polymer. The Examples of the application in suit emphasized the excellent low

temperature activity and the long life of the claimed catalysts.

(i.9) The meaning of the words "better morphology" would be well understood by the skilled person, i.e. closer to the ideal morphology of regular, spherical particles, and high bulk density.

(i.10) The products of Examples 8 and 9 of the present application were discrete free flowing spherical beads of high bulk density (greater than 0.4g/cc). In Example 5 of D1 the bulk density was very low.

(ii) Concerning the auxiliary requests:

The same arguments as those presented in respect of the main request concerning the surface area of the polymer support and the comparison between Example 5 of D1 and the Examples of the present application would equally apply.

VII. Oral proceedings took place before the Board on 20 September 2006.

At the beginning of the oral proceedings the Appellant submitted a new main request and five new auxiliary requests which differed from the requests submitted with its letter dated 18 August 2006, in that the range of surface area had been amended to less or equal to $10 \text{ m}^2/\text{g}$ instead of from 1 to less than or equal to $10 \text{ m}^2/\text{g}$ in the claims where this feature occurred.

Following preliminary observations from the Board concerning the clarity of the Claims 1, 6, and 14 and

15 of the main request and the allowability of the modified page 5 submitted with letter dated 8 February 2006 under Article 123(2) EPC, the Appellant submitted a new page 5 which differed from original page 5 in that the second formula on lines 7 to 8 thereof, i.e. the formula:



had been deleted, and a new set of Claims 1 to 13 as new main request.

Claims 1 to 13 of the main request read as follows:

"1. An olefin polymerization catalyst composition comprising the reaction product of a) a polymeric support i) having a surface area as measured by single point nitrogen B.E.T. of less than or equal to $10\text{m}^2/\text{g}$ and ii) comprising a covalently bound protonated ammonium salt of a noncoordinating anion, and b) an organometallic transition metal compound having ancillary ligands, and at least one labile ligand capable of abstraction by protonation by said ammonium salt and at least one labile ligand into which an olefinic monomer can insert for polymerization, in which the active catalyst sites are essentially uniformly distributed within the polymeric support by virtue of the randomly incorporated functional groups on the polymeric chains making up the support.

2. The catalyst composition of claim 1 wherein said organometallic transition metal compound is a monocyclopentadienyl ligand-containing Group 4 metal compound.

3. The catalyst composition of claim 1 wherein said organometallic transition metal compound is a biscyclopentadienyl ligand-containing Group 4 metal compound.

4. The catalyst composition of claim 1 wherein said organometallic transition metal compound is a Group 4-10 metal compound other than a monocyclopentadienyl or biscyclopentadienyl ligand-containing Group 4 metal compound.

5. The catalyst composition of any of claims 2-4 wherein said noncoordinating anion is one derived from an organoboron or organoaluminium compound.

6. A polymeric supported activator for use in the preparation of the catalyst composition of claim 1 comprising a polymeric support having a surface area of less than or equal to $10 \text{ m}^2/\text{g}$ as measured by single point nitrogen B.E.T. and functionalized with a protonated ammonium salt of a noncoordinating anion, said protonated ammonium salt being covalently bound to the polymeric support, and being uniformly distributed within the polymeric support by virtue of the randomly incorporated functional groups on the polymeric chains making up the support.

7. An olefin polymerisation process comprising contacting one or more ethylenically unsaturated olefin under suitable polymerization conditions with the catalyst composition according to claim 1.

8. The process according to claim 7 conducted under gas phase polymerization conditions.

9. The process according to claim 7 conducted under slurry polymerization conditions.

10. The process according to claim 8 or 9 wherein olefin is selected from ethylene and C₃-C₈ α-olefins, and combinations thereof.

11. The process according to claim 8 wherein said olefin is selected from ethylene, propylene, 1-butene, 1-hexene and 1-octene, and combinations thereof.

12. The process according to claim 9 wherein said olefin is propylene, optionally with ethylene.

13. The process according to claim 9 wherein said olefin is selected from ethylene, cyclic olefins, and styrenic olefins, and combinations thereof."

The arguments presented by the Appellant concerning novelty and inventive step of the subject-matter of the main request may be summarized as follows:

(i) In Example 5 of D1, the active catalyst sites remained on the surface of the polymeric support. Furthermore, the surface area of the polymeric support was not disclosed.

(ii) In document D2, the polymeric support had a high surface area (cf. Examples 1, 24, 27 and 33). Furthermore, D2 utilized alumoxane as activator, while in the present application the activator i.e. the non coordinating anion was bound to the support.

(iii) Document D1 would represent the closest state of the art. Starting from D1, the technical problem was to be seen in the provision of an efficient olefin polymerisation catalyst which was resistant to premature fracture, and hence reduced fouling of the reactor and which allowed the production of polymer particles with high bulk density and good morphology.

(iv) Since D1 taught that the active catalyst sites should be on the surface and since D2 taught to use high surface area polymeric support, the subject-matter of the present application was not *prima facie* obvious and there was no need to provide comparative examples as requested by the Examining Division.

(v) Even if the examples of document D4, in which a catalyst according to the present application had been used, were not directly comparable with Example 5 of D1, the differences in terms of reactivity and bulk density were so important, that they could be used to show that the technical problem was effectively solved. Furthermore Fig. 1 of D4 illustrated the good morphology i.e. spherical form and size distribution of the polymer particles obtained.

VIII. The Appellant requested that the decision of the Examining Division be set aside, and a patent be granted on the basis of Claims 1 to 13 of the main request filed at the oral proceedings and a description consisting of pages 1, 2, 6, 8 to 15, 17 to 24 of the application as filed; pages 3, 16 and 16a filed with letter dated 20 November 2000 and pages 3a, 4, 5 and 7 filed at the oral proceedings, or in the alternative,

on the basis of one of the 1st to the 5th auxiliary requests filed at the oral proceedings.

Reasons for the Decision

1. The appeal is admissible.

Main request

2. *Wording of the claims and of amended page 5*
 - 2.1 Claim 1 differs from Claim 1 as originally filed in that it has been indicated (i) that the surface area of the polymeric support is less than or equal to 10 m²/g, (ii) that the surface area is determined by single point nitrogen B.E.T, (iii) that the protonated ammonium salt of the non coordinating anion is covalently bound to the support, and (iv) the indication that the active catalyst sites are essentially uniformly distributed within the polymeric support by virtue of the randomly incorporated functional groups on the polymeric chains making up the support.
 - 2.2 Amendment (i) finds its support on page 4, line 2, as well on page 7 lines 5 to 6, and 9 to 10 of the application as originally filed.
 - 2.3 Amendment (ii) is supported by the page 7, lines 10 to 11 of the application as originally filed, while support is to be found in the passage from page 3, line 30 to page 4, line 1 for amendment (iii), and on page 7, lines 5 to 9 for amendment (iv).

- 2.4 Consequently, the Board is satisfied that Claim 1 meets the requirements of Article 123(2) EPC. The same conclusion applies, in the Board's view, to Claim 6 which is directed to a polymer supported activator for use in the preparation of the catalyst composition of Claim 1.
- 2.5 Since Claims 2 to 5 and 7 to 13 correspond to Claims 2 to 5 and 8 to 14 of the application as originally filed, respectively, they also meet the requirements of Article 123(2) EPC.
- 2.6 The Board is also satisfied that the requirements of Article 84 EPC are met by all the claims, since the distribution of the active catalyst sites is now related to the random incorporation of the functional groups on the polymeric chains making up the support.
- 2.7 The deletion on page 5 lines 7 to 9 of the description of the formula:



overcomes the inconsistency between this formula and the definition given for the radicals R^1 , R^2 , and R^3 at page 4, lines 17 to 25 which led to the refusal of the main request by the Examining Division, and does not result in an extension of the content of the application beyond the content of the application as filed.

3. *Prior art*

3.1 D1 to D3 have been relied on by the Examining Division in the course of the examining procedure.

3.2 D1 relates to a catalyst for olefin polymerization obtainable by contacting:

(a) a transition metal compound containing a transition metal of the Group 4 of the Periodic Table,

(b) an organometallic compound, and

(c) a solid catalyst component comprising a carrier and an ionized ionic compound capable of forming a stable anion on reaction with said transition metal compound, wherein said ionized ionic compound comprises a cationic component and an anionic component wherein the cationic component is fixed on the surface of the carrier through a chemical bond (claims 1 and 2).

Inorganic compounds such as silica, alumina, clays or organic polymeric compounds can be used as carriers (cf. page 10, lines 49-52).

In its Example 5, D1 discloses the preparation of a polymeric support for a catalyst composition comprising a transition metal obtained by reacting particles of poly(vinylpyridine hydrochloride) with lithium tetrakis(pentafluorophenyl) borate. Due to this reaction a polymeric support comprising a covalently bound protonated ammonium salt of a non coordinating anion is obtained. This polymeric support is further contacted with a transition metal catalyst. Example 5

of D1 does not, however, disclose the surface area of the polymeric support.

According to D1, these catalysts are used in the production of olefin polymers in a satisfactory shape with excellent properties, at good productivity without causing contamination of the polymerization vessel (cf. page 2, lines 49 to 51; page 17, lines 36 to 42).

3.3 Document D2 refers to a supported catalyst for the polymerization of olefins comprising:

(A) a porous organic support functionalised with groups having active hydrogen atoms;

(B) at least one organo-metallic compound of aluminium containing at least one heteroatom selected from oxygen, nitrogen and sulphur; and

(C) at least one compound of a transition metal selected from those of groups IVb, Vb or VIb of the Periodic Table of the Elements, containing at least one ligand of the cyclopentadienyl type (Claim 1).

The organic support has preferably a surface area greater than 30 m²/g (Claim 2).

Supports which can be used in the catalysts are polymers, which show functional groups having active hydrogen atoms. Examples of suitable functional groups are hydroxyl groups, primary and secondary amino groups, sulphonic groups, carboxylic groups, amido groups, N-monosubstituted amido groups, sulphonamido groups, N-monosubstituted sulphonamido groups, sulphydril groups, imido groups and hydrazido groups. A class of supports which are particularly suitable are partially cross-linked porous styrenic polymers. These

supports can be prepared by copolymerization of styrenic monomers, such as styrene, ethylvinylbenzene, vinyltoluene, methylstyrene and mixtures thereof, with comonomers able to be crosslinked such as divinylbenzene or divinyltoluene (page 3, lines 1 to 11).

In particular, D2 discloses in its Examples 2, 6, 10, 15, 17, 19, 21, 25, 28, 31 and 34 the preparation of catalyst compositions obtained by contacting in toluene a functionalized crosslinked polystyrenic support with an alumoxane compound and a metallocene compound. In all these examples the polystyrenic support exhibits a surface area according to B.E.T of greater than 300 m²/g.

These catalysts are able to produce polymers which duplicate the shape of the catalyst and therefore are endowed with controlled morphology and high bulk density (page 2, lines 35 to 38).

- 3.4 Document D3 relates to method for functionalizing polymeric supports (e.g. polystyrene resins) by swelling microporous or macroporous polymer beads in a solvent and treating them with a functionalizing agent. It also refers to the use of these functionalized polystyrene as catalysts (Paragraphs 3.2.1 and 3.2.2; Table 1).

4. *Novelty*

- 4.1 Claim 1 of the main request requires in particular

(i) that the polymeric support used in the manufacture of the catalyst composition has a surface area of less than or equal to 10 m²/g;

(ii) that a protonated ammonium salt of a non coordinating anion be covalently bound to the polymeric support,

(iii) that the catalyst composition comprises an organometallic transition metal compound and

(iv) that the catalyst active sites be essentially uniformly distributed **within** the polymeric support by virtue of the randomly incorporated functional groups on the polymeric chains making up the support.

4.2 Although it could *prima facie* be questionable whether the surface area of the polymeric support used in the manufacture of the catalyst composition would amount to a feature of the final catalyst composition, since, as submitted by the Appellant in its letter dated 10 October 2002 (page 5, third paragraph), the low surface area polymer support needs to be swollen in a solvent in order to get the ammonium functionality dispersed throughout the support, it is credible to the Board, in view of the declaration of Mr Walzer (cf. D5, page 1, second paragraph), that the surface area of the starting polymer support is in fact not substantially modified at the end of the process for the preparation of the supported catalyst composition. Consequently, the low surface area of the polymer support must be considered as a characterizing feature of the claimed catalyst composition.

4.3 Since document D1 does not mention the surface area of the polymeric support used in Example 5, and since it is clear from the general teaching of D1 (cf. page 2,

lines 53 to 57) that the active catalyst sites would be on the surface of the polymeric support instead of being dispersed within, it is thus evident that D1 cannot destroy the novelty of the subject-matter of Claim 1.

4.4 Nor can D2 destroy the novelty of the subject-matter of Claim 1, since as indicated above it relates to supported catalyst compositions in which the polymeric support has a high surface area (more than 30 m²/g) and since it does not disclose the use of a polymeric support having a protonated ammonium salt of a non coordinating anion covalently bound to the support for the manufacture of the catalyst composition.

4.5 While document D3 mentions the use of functionalized polymeric support (e.g. polystyrene) in catalysts, it discloses neither a catalyst composition comprising an organometallic transition metal compound nor a polymeric support functionalized with a protonated ammonium salt of a non coordinating anion covalently bound to the polymeric support and dispersed within the polymeric support. It cannot therefore destroy the novelty of the subject-matter of Claim 1.

4.6 Consequently, the subject-matter of Claim 1 must be regarded as novel over D1, D2 and D3 (Art. 54 EPC).

4.7 The same conclusion applies for the subject-matter of dependent Claims 2 to 5, to the subject-matter of Claim 6 which refers to the polymeric supported activator for use in the manufacture of the claimed catalyst composition according to Claim 1, and to the subject-matter of Claims 7 to 13 which are directed to

an olefin polymerization process in presence of the catalyst composition according to Claim 1.

5. *Closest state of the art, the technical problem*

5.1 The application in suit relates to an olefin catalyst composition comprising a polymeric support.

5.2 Such a catalyst composition is known from document D1. This document has been considered by both the Examining Division and the Appellant as representing the closest state of the art. The Board sees no reason to depart from that view.

5.3 As can be deduced from the application in suit, the aim of the invention is to provide an olefin polymerization catalyst composition which is resistant to premature fracture, which leads hence to a low fouling of the reactor, and which allows the production of polymer particles with good bulk density and good shape with good control of the polymerization reaction (cf, page 3, lines 8 to 15; lines 23 to 30).

5.4 As indicated above, document D1 is concerned with the problem of producing olefin polymer in a satisfactory shape and at a good productivity without causing fouling of the polymerization vessel. In the only example of D1 (Example 5) using a polymer supported catalyst, the polymeric supported catalyst composition was used in the slurry polymerization of ethylene and led to a polymer having a bulk density of 0.21 g/cm³ and, according to that example, fouling of the reactor was not observed.

5.5 In this connection, it has been submitted by the Appellant, that the catalyst composition according to the application in suit would allow to obtain olefin polymers having a higher bulk density than the catalyst composition of Example 5 of D1. While it is true that the bulk density of the olefin polymers obtained in Examples 8 and 9 of the patent in suit is much higher (i.e. greater than 0.4 g/cm^3) than the bulk density obtained in Example 5 of D1, it is, however, questionable whether Examples 8 and 9 of the application in suit could be directly compared with Example 5 of D1 in that respect, since in Example 5 of D1 an ethylene **homopolymer** is produced using slurry polymerization in **toluene at 80°C** while Runs A, B and C of Example 8 of the application in suit deal with the slurry **copolymerization** of ethylene with hexene in **hexane at 40°C**, and Runs D and E of Example 9 refer to the slurry **copolymerization** of ethylene with hexene in **isobutane at 60°C**.

5.6 Under these circumstances, the Board deems it hence appropriate to consider a less ambitious formulation of the technical problem starting from D1, according to which the technical problem might be seen in the provision of a further polymer supported catalyst composition which allows the obtaining of olefin polymers in a satisfactory shape with a good bulk density, while retaining a good productivity and avoiding fouling of the reactor.

5.7 The solution to the technical problem defined above proposed by the application in suit consists in a catalyst composition according to Claim 1 in which the polymer support has a low surface area i.e. of $10 \text{ m}^2/\text{g}$

or less and in which the active catalyst sites are essentially uniformly distributed within the polymeric support.

5.8 In view of the Examples 8 and 9 of the application in suit which show that olefin polymers are obtained in form of spherical beads with a good bulk density with essentially no catalyst fracture and hence no fouling of the reactor, while retaining a good productivity, the Board is satisfied that the claimed measures provide an effective solution to the technical problem.

6. *Inventive step*

6.1 It remains to be decided whether the claimed subject-matter was obvious to a person skilled in the art having regard to the relevant prior art, i.e. documents D1 to D3.

6.2 As indicated above in paragraph 3.2, D1 unambiguously teaches to use a solid catalyst component comprising a carrier and an ionized ionic compound capable of forming a stable anion on reaction with said transition metal compound, wherein said ionized ionic compound comprises a cationic component and an anionic component wherein the cationic component is fixed **on the surface** of the carrier through a chemical bond. Since furthermore, Example 5, which is the only Example of D1 dealing with the use of polymeric carrier, is totally silent on the surface area of the polymeric carrier, it is evident that D1 itself cannot provide a hint to the solution of the technical problem.

- 6.3 Although document D2 relates to supported catalyst for the polymerization of olefins comprising a porous organic support functionalized with groups having active hydrogen groups and although, in view of D3 (page 82, lines 32 to 34), it might be assumed that the functionalizing agent could be distributed on the internal surface of the pores and within the polymeric support, it is clear that D2 not only teaches, in contrast to the application in suit, that the polymeric support should have a high surface area, i.e. higher than 30 m²/g, and preferably higher than 100 m²/g, but that it would moreover lead the skilled person away from the solution proposed in the application in suit, since Example 40 thereof (comparative) in which a catalyst composition on a polymeric support with a very low surface area is used (cf. Example 38 (comparative); surface area "not detectable" according to B.E.T) shows that in such case fouling of the reactor and a low productivity are observed (cf. Table 1).
- 6.4 Consequently, the subject-matter of Claim 1 must be considered as involving an inventive step over the relevant prior art.
- 6.5 The same conclusion applies to the subject-matter of Claim 6 which refers to the polymeric supported activator for use in the manufacture of the claimed catalyst composition according to Claim 1, and to the subject-matter of Claims 7 to 13 which are directed to an olefin polymerization process in presence of the catalyst composition according to Claim 1.
- 6.6 Although this conclusion has been reached by the Board in view of the less demanding formulation of the

technical problem over D1, it is evidently clear that the same conclusion would have also been drawn by the Board, if it would have been considered in view of the comparison between the Examples 8 and 9 of the application in suit and Example 5 of D1 that an increase of the bulk density of the ethylene polymers would have been obtained by the claimed measures.

6.7 It thus follows that the main request of the Appellant is allowable, and that the decision under appeal must be set aside.

6.8 Since the main request of the Appellant is allowable, there is no need for the Board to consider its auxiliary requests.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to grant a patent on the basis of Claims 1 to 13 of the main request filed at the oral proceedings and after any necessary consequential amendment of the description consisting of pages 1, 2, 6, 8 to 15, 17 to 24 of the application as filed; pages 3, 16 and 16a filed with letter dated 20 November 2000 and pages 3a, 4, 5 and 7 filed at the oral proceedings.

The Registrar:

The Chairman:

E. Görgmaier

R. Young