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Datasheet for the decision of 22 January 2008

Case Number: T 0870/05 - 3.3.03

Application Number: 97902761.2

Publication Number: 0876406

IPC: C08F 4/78

Language of the proceedings: EN

Title of invention:
Process for producing polyethylenes having a broad molecular weight distribution, and a catalyst system used thereby

Patentee:
Borealis Technology Oy

Opponent:
Basell Polyolefine GmbH

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56, 83, 84

Keyword:
"Main request - novelty - yes"
"Main request - inventive step - yes"
"Main request - disclosure - sufficiency - yes"

Decisions cited:
T 0035/85

Catchword:
-

Case Number: T 0870/05 **-** 3.3.03

DECISION
of the Technical Board of Appeal 3.3.03
of 22 January 2008

(Opponent)	Basell Polyolefine GmbH Patentstelle E 413 Industriepark Höchst D-65926 Frankfurt (DE)
Representative:	-
Respondent: (Patent Proprietor)	Borealis Technology Oy P.O. Box 330 FI-06101 Porvoo (FI)
Representative:	Cockbain, Julian Frank B. Dehn & Co. St Bride's House 10 Salisbury Square London EC4Y 8JD (GB)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office dated 27 April 2005 and posted 13 May 2005 concerning maintenance of European patent No. 0876406 in amended form.**

Composition of the Board:

Chairman:	R. Young
Members:	M. C. Gordon E. Dufrasne

Summary of Facts and Submissions

I. Mention of the grant of European Patent No. 0 876 406 in the name Borealis Technology Oy in respect of European patent application No. 97902761.2 filed on 23 January 1997 as international application No. PCT/NO97/00018, published as WO-A-97/27225 on 31 July 1997 and claiming priority of Norwegian application No. NO 960350 dated 26 January 1996 was announced on 2 January 2002 (Bulletin 2002/01) on the basis of 17 claims. In the following the **emphasis** is that of the patent.

Independent claim 1 read as follows:

"1. A process for the polymerization of ethylene, optionally with α-olefins, to ethylene homopolymers or copolymers having a broad molecular weight distribution, **characterized by** comprising the steps of polymerizing 100 to 80% by weight of ethylene and 0 to 20% by weight of comonomer in the presence of two independent, simultaneously present catalysts A and B, and optionally also a cocatalyst; said catalysts and optional cocatalyst are fed into the reactor concurrently, either separately or in the form of a blend, where said

> catalyst A comprises chromium oxide supported on an inorganic support, and the chromium has an oxidation number of predominantly two; and said
>
> catalyst B comprises a bis-cyclopentadienyl chromium compound reacted with an inorganic support, said bis-cyclopentadienyl chromium compound having the general formula Ar-Cr-Ar', wherein Ar and Ar' are selected from fluorenyl,

> indenyl and cyclopentadienyl, which are optionally substituted with at least one hydrocarbyl group which may contain one or more heteroatom selected from O, N, S, P and B;
> at otherwise well known polymerization conditions."

Claims 2-4 were dependent claims directed to preferred embodiments of the process of claim 1.

Claim 5 was an independent claim directed to a catalyst system for use in the process of claim 1 and characterised by comprising two independent catalysts where catalysts A and B were defined as specified in claim 1. Claims 6-12 were dependent claims directed to preferred embodiments of the catalyst system of claim 5. Claim 13 was an independent claim and read as follows:
"13. A polymer composition consisting of ethylene homopolymers or copolymers having a broad molecular weight distribution, obtained by the process of claim 1, **characterized by** being an intimate blend of two polymer components, where

> (a) 40 to 80% by weight of the total amount of the polymer composition is made up of a polyethylene having $MI_{21}<5$ and $Mw/Mn>15$, and
>
> b) 60-20% by weight of the polymer composition is made up of a polyethylene having $MI_2>300$, said polyethylene contains alkyl side branches, said alkyl being ethyl or higher alkyl, in an amount less than 20% of the number of corresponding side branches in said polymer component a)."

Claims 14-17 were dependent claims directed to preferred embodiments of the polymer composition of claim 13.

II. A notice of opposition to the grant of the patent was filed on 2 October 2002 by Basell Polyolefine GmbH. The grounds pursuant to Art. 100(a) and 100(b) EPC were invoked.

The opponent relied on the following documents:

D1: WO-A-97/08213 (prior art pursuant to Art. 54(3) EPC);

D2: EP-A-339 571;

D3: DE-A-43 23 192.

During the course of the opposition proceedings the following documents were additionally cited by the parties, D4 and D5 being cited by the patentee, D6 and D7 by the opponent, with letters dated 9 July 2004 and 24 February 2005 respectively:

D4: Welch, M.B and McDaniel, M. P., "The Activation of the Phillips Polymerization Catalyst", Journal of Catalysis, vol. 82 (1983), pp. 110-117;

D5: Zecchina, A. *et al,* "On the Chemistry of Silica Supported Chromium Ions. I. Characterization of the Samples", The Journal of Physical Chemistry, Vol. 79 (1975), No. 10 pp. 966-972;

D6: McDaniel, M. P., Advances in Catalysis, vol. 33 (1985), p. 48-59;

D7: WO-A-93/08221.

III. In a decision announced orally on 27 April 2005 and issued in writing on 13 May 2005, the opposition division held that the patent could be maintained in amended form on the basis of claims 1-16 received with letter dated 28 February 2005.

Claim 1 differed from claim 1 as granted in that the phrase
"and where catalyst A constitutes 40 to 90% by weight and catalyst B constitutes 60 to 10% by weight of the catalyst system;"
was inserted before the final phrase "at otherwise well known polymerisation conditions".
The corresponding amendment was also made to independent claim 5 by insertion of the indicated phrase at the end of the claim.
As a consequence of this amendment claim 9 as granted was deleted and the following claims renumbered.

According to the decision the amended claims met the requirements of Art. 84 and 123 EPC.

(a) With respect to Art. 83 EPC:

  (i) It was held that the information provided in paragraphs [0028] and [0056] of the patent with respect to the reduction step required for the preparation of catalyst component (A) indicated one way of carrying out this step and also disclosed how it might be ascertained that the reduction to oxidation state 2 or 3 had occurred. The disclosures of D4-D6 confirmed that the indicated conditions would in fact lead to the required reduction.

  (ii) With regard to an objection concerning the determination of the content of alkyl side branches, specified in claim 12, it was held that this objection relied on an allegation which had not been properly supported by evidence, and which had been contested by the patentee. The opposition division held that the opponent had not discharged its burden of proof in this respect (with reference to T 182/89, OJ EPO 1991, 391).

(iii) Accordingly it was held that the patent in suit met the requirements of Art. 83 EPC.

(b) With respect to the construction of the claims, it was held to be clear that a prereduced catalyst was used in the claimed process.

(c) With respect to novelty, it was held that the subject matter of the claims was not directly and unambiguously derivable from the disclosure of D1, which was prior art pursuant to Art. 54(3) EPC, since multiple selections had to be made:
- chromocene had to be selected as the metallocene;
- the catalyst A had to be prereduced;
- the oxidation state of Cr in catalyst A had to be predominantly II;
- the particular ratio of catalysts A and B had to be selected.

Accordingly the subject matter claimed was held to be novel.

(d) With regard to inventive step, it was held that the disclosure of D2 represented the closest prior art. D2, like the patent in suit, related to a process for preparing ethylene polymers having a broad molecular weight distribution (MWD) by employing a catalyst system comprising (A) a Ti- or Cr- containing inorganic oxide carrier and (B) a metallocene compound. D2 did not mention that component (A) was prereduced or that component (B) was a chromocene.

The objective problem was held to be to provide a high yielding polymerization process for preparing polyethylene having a broad MWD. The solution thereto was to employ a catalyst system as claimed. The examples in the patent demonstrated that using the claimed catalyst system resulted in a five-fold higher yield than was obtained when using a catalyst system in which catalyst A was not prereduced (Patent Table 3, example 6 and comparative example 7).

The combination of D2 with D3 did not yield the claimed subject matter as neither of these disclosed the prereduction of the Cr catalyst to an oxidation state of predominantly II.

Further the combination of D2 with D6 did not render the claimed invention obvious; it was nowhere suggested that the reduced Cr(II) species when used in combination with the chromocene would result in such an increase in polymer yield as demonstrated in the patent.

Accordingly the subject matter of the patent was held to meet the requirements of Art. 56 EPC.

(e) Thus it was held that the patent could be maintained in amended form.

IV. A notice of appeal against this decision was filed by the opponent, now the appellant on 12 July 2005, the requisite fee being paid on the same day.

V. The statement of grounds of appeal was filed on 12 September 2005.

(a) With respect to Art. 83 EPC it was submitted:

(i) With respect to the oxidation state of Cr, that it was not sufficiently disclosed how it could be ensured that the reduction of chromium resulted predominantly in Cr(II). Reference was made in this respect to D6 from which it was apparent that the situation regarding reduction to chromium II was by no means as clear as presented by the patentee. In particular the species obtained was critically affected by the type of reducing agent and the reaction time with the reducing agent.

(ii) The determination of the number of alkyl side chains longer than methyl was not sufficiently disclosed. In particular it was not disclosed how it would be possible to distinguish between methyl side chains and longer side chains.
The determination of the so-called long chain branching was also not disclosed. As evidence that such long chain branches were present reference was made to D7.
Finally, it was argued it was not even clear if long chain branches were encompassed by the definition of alkyl side branches in claim 12.

(iii) It was also stated:
"Im übrigen werden die in der Einspruchsschrift vorgebrachten Einwände bezüglich der mangelnden Ausführbarkeit in vollem Umfang aufrechterhalten." (Further all objections raised in the notice of opposition concerning insufficiency of disclosure are maintained in full).

(b) With respect to the construction of claim 1, it was submitted that the opposition division had erred in its conclusion that catalyst component A had to be reduced prior to introducing this into the reactor (see section III.(b) above). According to the appellant, claim 1 defined a process carried out **in the presence** of a catalyst predominantly in oxidation state II, without any restriction in respect of the oxidation state of the catalyst at the point it was added to the reactor, but only in respect of its oxidation state during the polymerisation.

Concerning the proportions of catalysts employed, it was submitted that this feature defined merely the amount of carriers bearing the catalysts. This feature was irrelevant; only the content of active catalyst components influenced the product properties. The patent allowed the content of chromium in Catalyst A to vary from 0.001 to 10 wt % (patent paragraph [0028]), while the amount of catalyst B on the carrier was not specified at all. Thus this feature merely allowed each catalyst to be present in any possible proportion, i.e. each varying from almost 0 to almost 100 and was therefore unsuitable to distinguish the catalyst composition from the components thereof. It was thus submitted that the subject matter of claim 1 was not operative over its whole scope.

(c) Novelty of the subject matter of claim 1 was denied in the light of the disclosure of examples 2 and 3 of D1.

With regard to the proportions of catalysts, although examples 2 and 3 D1 did not disclose any quantities, the skilled person would implicitly understand that the proportions would be such that a significant amount of the polymer resulting from each catalyst would be present in the final product. Otherwise it would be meaningless to specify a mixture of catalysts. In the case of hybrid catalysts the critical feature was the ratio of the different reactive centres and their activity ratio. The proportions of catalyst inevitably varied significantly from batch to batch since it was impossible to reproduce the reaction conditions precisely. Further the activity of the catalyst varied as a consequence of the storage conditions. The situation was even more complicated with supported catalysts as the carrier influenced the catalyst activity. Further, the catalysts influenced each other. Thus, even if the amounts of catalysts employed was precisely known the product properties were never exactly predictable. The skilled person would have been obliged, when attempting to repeat examples 2 and 3 of D1, to resort e.g. to the proportions of 50:50 as disclosed in examples 4 and 5 of D1 and to vary the proportions until the required product properties had been obtained.

Thus the proportions defined in operative claim 1 overlapped at least with the implicitly disclosed range in D1. Since the defined range was not associated with any technical effect novelty had to be denied.

With respect to the feature that catalyst A was present in oxidation state of II reference was made to the submissions on construction of the claims (see section (b) above).

Even if the claim were to be interpreted as requiring prereduction, this would not confer novelty since D1 disclosed that Phillips catalysts could be employed in a reduced form.

With regard to the definition of chromocene as the second catalyst, it was submitted that this was disclosed in D1 as a preferred embodiment. Thus the subject matter of the operative claim amounted to a combination of two preferred embodiments from the disclosure of D1, which combination could not confer novelty.

(d) With regard to inventive step it was submitted that D2 represented the closest prior art.

The subject matter of claim 1 was distinguished from this disclosure by the features that chromocene was employed as catalyst B and, possibly by the feature that catalyst A contained Cr(II).

There was no evidence of any synergistic effect arising from this combination of features. Hence these features had to be considered in isolation from each other.

(i) The prereduction conferred no advantages on a process carried out in a continuous manner. Examples 2 and 3 of D1 showed that such mixed catalysts could be employed in a continuous process without prereduction and gave yields that were comparable with those reported in the patent in suit. The problem of deactivation, discussed in the patent (paragraph [0029]), appeared to arise only in the case of batch processes.

Thus the technical problem to be solved by the prereduction could only be formulated as to provide an alternative process for the production of polyethylene compositions with broad MWD. The alternative of using a Cr(II) catalyst, i.e. in prereduced form was known from D6.

(ii) With regard to catalyst (B) it was submitted that the examples did not demonstrate any technical effect to arise from the use of chromocene instead of the titanocenes, zirconocenes or hafnocenes disclosed in D2. Accordingly the objective technical problem could be formulated only as the provision of an alternative process for the production of polyethylene compositions with broad MWD. Such an alternative, employing chromocene was rendered obvious by the disclosure of D3. Due to the close similarity between chromocenes and the metallocenes disclosed in D2 the skilled person would have considered chromocene as an alternative.

VI. In its rejoinder, dated 6 January 2006 the patentee, now the respondent maintained the set of claims as upheld by the opposition division as the main request. A further set of claims, forming a first auxiliary request was submitted.

(a) With regard to the objections pursuant to Art. 83 EPC it was submitted:

(i) In respect of the oxidation state of Cr, the patent disclosed in paragraphs [0028] in general and in paragraph [0056] in detail how to perform the reduction. While the patent did not state how much of the Cr was in the oxidation state (II) this was not significant. The claims required that the Cr was "predominantly", i.e. to an extent of at least 50% in the (II) oxidation state, which

was the inevitable result of carrying out a reduction step as taught in the patent in suit. The disclosures of D4-D6 confirmed that the disclosed conditions would lead to reduction of hexavalent chromium to predominantly divalent chromium.
Further the appellant had submitted no evidence to show that the disclosed conditions did not result in the required reduction.

(ii) With respect to the alkyl branches it was first submitted that the appellant had failed to discharge the burden of proving its allegation in this respect.
Operative claim 12 required only that it be possible to distinguish between methyl branches on the one hand and ethyl or higher branches on the other. D7 on page 8 taught that long chain branching was determined using ^{13}C NMR, and that "long chain branches" had more than 6 carbon atoms because these branches could not be distinguished by the disclosed method.
Thus all that it was necessary to do was to determine the presence of branching, and to discount the methyl branches, both of which steps could be accomplished by ^{13}C NMR. The methyl (CH_3) carbons in methyl and ethyl groups were in different electronic environments and hence could be distinguished by ^{13}C NMR. The number of methyl branches and other branches was established by integration and the number per 1000 carbon atoms quantified by the

Randall method described in D7 on page 8. It was further submitted that catalyst B incorporated comonomer poorly, leading to a low number of alkyl branches. Catalyst A incorporated comonomer at a significantly higher level, resulting in high levels of branching.

(b) With respect to the construction of the claims it was submitted that the wording of claim 1 specified that catalyst A was fed into the reactor with catalyst B. The claim defined catalyst A as having chromium in the oxidation state II. Thus the claim required that a prereduced catalyst was added to the reactor. Adding a non-prereduced catalyst hence would not satisfy this requirement of the claim.

(c) With regard to novelty it was submitted that examples 2-5 of D1 did not use chromium which had been pre-reduced and hence did not anticipate the subject matter of the operative claims 1 and 5. With regard to the generic disclosure of D1, it was submitted that a number of selections were necessary to arrive at the subject matter of operative claim 1. D1 taught the use of organic and inorganic supports. Hence it was necessary to select to employ an inorganic support. Secondly it was necessary to select to prereduce the chromium catalyst. The reduction conditions disclosed in D1 - 20-800°C in the presence of carbon monoxide - would not inevitably and necessarily lead to Cr(II). At the lowest temperature disclosed (20°C) hardly any reduction would occur. At the highest temperature disclosed (800°C) the catalyst would become deactivated. Thus it was necessary further to employ conditions intermediate between the limits disclosed in D1, which intermediate conditions were not highlighted in D1. Further the definition of metallocene catalysts in D1 was very generic, whereas the patent required specifically a bis-cyclopentadienyl chromium species on an inorganic support. Whilst it was conceded that this was one of the preferred options for the metallocene in D1, the combination of the two catalysts was not explicitly disclosed. It was also submitted that D1 did not disclose any ratios of the two catalysts.

It was submitted that the submissions of the appellant in the context of Art. 54 EPC with respect to the possibility of prereduction appeared to be one of inventive step. D1 taught prereduction as an optional embodiment and hence did not provide a specific and unambiguous disclosure of reduction to predominantly the (II) oxidation state.

(d) With regard to inventive step the respondent argued essentially as follows:

(i) With respect to the objection that the prereduction conferred no benefit compared to the teaching of D1 (see section V.(d).(i) above), it was first observed that D1 was not prior art pursuant to Art. 54(2) EPC. Further the examples of D1 and those of the patent employed different polymerisation conditions. The attempted comparison was thus invalid and it could not be concluded that D1 suggested that deactivation did not occur. The examples of the patent however clearly showed that employing a non-reduced catalyst led to deactivation.

(ii) The problem to be solved by the invention was to provide a high yielding process for polyethylenes having broad MWD and which could be used to manufacture articles having excellent environmental stress cracking resistance (ESCR), to a catalyst for such a process and to the polymers thus produced.

(iii) The solution was a combination of catalysts which provided such polymers, but which did not hinder each others activities.

(iv) The closest prior art was D2, also directed to the provision of polymers with broad MWD. D2 proposed two alternatives as the first catalyst - either a Ti or a Cr compound. No preference was expressed. This represented a first selection to be made.

It was then necessary to select to reduce the chromium compound to Cr(II). Reduction was not even mentioned in D2.

Example 6 and comparative example 7 of the patent showed that the reduction had clear benefits.

The metallocenes disclosed in D2 had as the metal Ti, Zr or Hf and did not encompass chromocenes. There was no suggestion in D2 to employ chromocenes.

Regarding the combination with D3, it was disputed that the skilled person would learn from D2 or D3 that the catalysts as specified in the operative claims could be used in combination. Further the aim of D3 was to provide polymers with a narrow MWD.

Hence there was no reason to combine the teaching of this document with that of a document concerning the provision of polymers with broad MWD i.e. D2. Further D3 did not teach the possibility of using a chromocene in a mixed catalyst.

(v) Further the teachings of D2 and D3 would not allow the improvements demonstrated in examples and comparative examples numbered 4-7 of the patent in suit to be predicted. In this context it was noted that comparative example 7, employing non-prereduced chromium and resulting in severe productivity losses was actually closer to the subject mater claimed than any of the examples of the prior art.

VII. The Board issued on 6 August 2007 a summons to attend oral proceedings.

VIII. In a letter dated 12 October 2007 the respondent submitted retyped versions of the previously filed main request and first auxiliary request (designated "Auxiliary Request I") in which clerical errors had been addressed.
Four additional sets of claims, designated "Auxiliary Request II" to "Auxiliary Request V" were also submitted.

IX. Oral proceedings took place before the Board on 22 January 2008.

(a) Article 83 EPC:

(i) With respect to the reduction of catalyst A, the appellant submitted that it was not explained in the patent what the term "predominantly" in claim 1 meant, nor how to determine whether this feature was satisfied. Hence it was not possible either to repeat the invention or to know when one was working within the scope of the claim. Although in paragraph [0028] of the patent reference was made to the reduced catalyst having a blue colour, as shown by D6 (page 55) this only appeared after treatment with nitrogen. Further according to the patent the colour would not allow a distinction to be made between Cr(II) and Cr(III). Nor was any other means of distinguishing these possibilities disclosed.

Regarding the actual step of reduction it was submitted that only a single set of conditions was disclosed in the patent (paragraphs [0056] and [0068]), but that all the parameters played a role. No guidance was provided regarding how to adjust these parameters. Further from the teachings of D6 it was incorrect to speak of the chromium having a single valence. On the contrary many different oxidation states were present.

The respondent submitted that the objections of the appellant were predominantly in relation to clarity (Art. 84 EPC). The patent disclosed in paragraph [0056] specific conditions which resulted in reduction to Cr(II). This was confirmed by the disclosures of D4-D6, which also showed that it was possible to confirm that Cr(II) had been obtained, and how to determine the quantity thereof.

(ii) With regard to the content of alkyl branches the appellant relied on its written submissions (see section V.(a).(ii) above).

The respondent submitted that claim 12 required that a ratio be determined, not however the absolute number of branches. No evidence had been advanced that different methods would result in differing conclusions in respect of either the absolute or relative content of alkyl branches.

It was needed to be able to determine whether a branch was present, and if so to distinguish methyl branches from ethyl and higher branches. This could be done by ^{13}C NMR as confirmed by D7.

(iii) The appellant referred to the determination of molecular weight. Following an observation by the Board that this issue had not been raised in the statement of grounds of appeal but only in the notice of opposition, the appellant did not pursue this.

(b) With regard to the construction of the claims, the appellant reiterated the objection that operative claim 1 did not require that catalyst A be reduced prior to introducing it into the reactor (see section V.(b) above).

The respondent essentially reiterated the arguments presented in writing (see section VI.(b) above).

(c) With respect to Art. 54 EPC the appellant emphasised the objections based on D1 (see section V.(c) above).

D1 explicitly disclosed that prereduction could be employed. Regarding the ratio of catalysts A and B it was submitted that the absence of any disclosure of this in D1 would serve as an incentive to employ in a first step equal proportions (50/50). It was emphasised that it was necessary to consider the disclosure of D1 as a whole and not merely specific examples. All the requisite features of the operative claim 1 were disclosed as preferred features in D1. No selections from lists were needed.

The respondent essentially reiterated the arguments presented in writing regarding the need to make multiple selections from the disclosure of D1 (see section VI.(c) above). It was submitted that the ratio was a technically meaningful feature. In particular it was necessary that the content of metallocene was controlled, since a too high content thereof would lead to problems with the catalyst and/or impurities.

(d) With regard to Art. 56 EPC and D2 as the closest state of the art, the appellant submitted that the effect of the pre-reduction to Cr(II) was to increase the yield, while the presence of two catalysts resulted in broadened MWD.

D1 provided evidence that the prereduction was not necessary in order to obtain a good yield.

The patent merely related to an alternative embodiment. Similarly the selection of chromocene, which was a known metallocene as shown by D3, conferred no advantage. It was conceded that D2 contained no examples in which both catalysts were based on Cr.

The respondent submitted that the technical problem was to provide polymer compositions with broad MWD and good ESCR in a one step process. The solution was to use a mixed catalyst with the precondition that the catalysts did not interfere with each other (cf paragraph [0013] of the patent in suit). The inventor had identified that a problem occurred in employing catalyst A in the non-reduced state and that this problem could be solved by reduction prior to introducing the catalyst to the reactor. This deactivation was shown by example 6 and comparative example 7 of the patent in suit. The beneficial effects occurred in both batch and continuous processes, reference being made to comparative example 23.

There was no teaching in D2 either to the existence of this problem, or to the claimed solution thereof. Hence D2 could not provide an incentive to employ the step of prereduction. The metallocene as specified in the operative claims was not one of those disclosed in D2 although it was encompassed by the generic disclosure thereof.

Regarding D3, all this taught was that chromocene existed. However D3 indicated that a broad MWD was undesired. Hence there was no incentive to combine the teaching of D3 with that of a document seeking to provide polymers with a broad MWD, e.g. D2.

The examples of D1 could not demonstrate a lack of inventive step. These could not be repeated since no proportions were disclosed and the appellant had advanced no evidence in support of its contention in this respect.

The appellant submitted that there was no evidence that deactivation did in fact occur. D1 could be taken into account as evidence that prereduction was not necessary. From D4-D6 it was known that prereduction of the catalyst conferred advantages. There was no reason to assume that this advantage would not also appear when using a mixed catalyst in order to obtain a broad MWD polymer, which use of mixed catalysts was conventional.

X. The appellant (opponent) requested that the decision under appeal be set aside and that the European patent No. 876 406 be revoked.

The Respondent (patent proprietor) requested that the decision under appeal be set aside and that the patent be maintained on the basis of the main request, or in the alternative one of the auxiliary requests I to V, all filed with letter dated 12 October 2007.

Reasons for the Decision

1. The appeal is admissible.

Main request

2. *Art. 84, 123(2) and (3) EPC*

The appellant (opponent) raised no objections pursuant to Art. 84, 123(2) or (3) EPC.
Nor has the Board any objections of its own.

Accordingly the claims of the main request are held to meet the requirements of Art. 84, 123(2) and 123(3) EPC.

3. *Art. 83 EPC*

3.1 *Oxidation state of Cr in catalyst A.*

The appellant has raised a number of objections in this respect:

- the patent in suit was lacking details on how the reduction was to be carried out (see section V.(a).(i) above);
- only a single set of conditions was disclosed and no guidance was provided how to adjust the various parameters (section IX.(a).(i) above);
- There was no way of distinguishing between Cr(II) and Cr(III) (section IX.(a).(i) above);
- the patent did not explain what "predominantly" meant or how to determine when this feature was satisfied (sections V.(a).(i) and IX.(a).(i) above);
- It was incorrect to speak of chromium having a single valence (section IX.(a).(i) above).

3.1.1 Regarding the reaction conditions, in paragraph [0028] of the patent it is disclosed that the reduction is performed by exposing the calcined, impregnated catalyst to carbon monoxide or a mixture of carbon monoxide and e.g. nitrogen or argon. It is further taught that the reduction is normally performed at a temperature within the range from 300 to 500°C for a period of time from 5 minutes to 48 hours, preferably 1 to 10 hours.
It is further taught that the reduced catalyst has a blue colour, indicating an oxidation state of 2 or 3 whereby up to 50% of the catalyst may be in an

oxidation state higher than 2.
A more precise teaching is provided in paragraphs [0056] and [0068] according to which reduction is carried out for 4 or 5 hours at a temperature of 380°C under nitrogen containing 5% by volume of CO.
Accordingly the patent in suit does disclose conditions under which the reduction is to be carried out and indicates how it may be confirmed that such reduction has in fact occurred.

That these conditions do result in reduction of Chromium to Cr(II) is confirmed by D4-D6.
According to D4, page 111 in the section entitled "Results and Discussion" it is disclosed that the reduction can be carried out with carbon monoxide at 300-400°C, under which conditions "most or even all of the Cr is cleanly reduced to a highly coordinatively unsaturated Cr(II) species". According to the introductory summary of D5 reduction with CO leads to Cr(II) at the surface being "mainly obtained", the most active catalysts being obtained at a reduction temperature of 350°. On page 969, in section B of D5 a study is reported of the influence of the reaction temperature on the reduction of activated chromium compounds with CO. The conclusion is that the activity towards CO, measured by the quantity absorbed, reaches a maximum at 350°C and then decreases as the temperature increases. Thus the conclusion is that 350°C is the most efficient reduction temperature. The data (figure 4) shows that at a temperature of 100°C or less there is hardly any activity towards CO, whereas above 700° a significant decrease in activity takes place. Further D5 discloses on page 970 a method by which the mean oxidation number can be determined,

according to which it was concluded that the disclosed reduction method results in predominantly an oxidation state of Cr(II) with the content of Cr(III) ranging from 5 to 15%.
Finally, a similar teaching is provided by D6, section II.C on page 54 where it is taught that hexavalent chromium can be quantitatively reduced to Cr(II) by CO at 350°C. This catalyst is light green, turning blue on exposure to nitrogen.

Accordingly the evidence of D4-D6 is not only that the reaction conditions disclosed in the patent in suit lead to the required product, but that the conditions defined in the patent are those which lead to the highest degree of reduction. D4-D6 further confirm that it is possible to ascertain quantitatively that such a product has in fact been obtained.
Accordingly the disclosure of the reaction conditions for accomplishing the reduction is sufficient (Art. 83 EPC).

3.1.2 Regarding the objection of the appellant that only a single set of conditions was disclosed in the patent in suit (see second indent in section 3.1 above) the Board notes that according to the established case law of the Boards of Appeal, a single example is, in principle, sufficient to meet the requirements of Art. 83 EPC (see the publication "Case Law of the Boards of Appeal of the European Patent Office", 5th Edition (2006) section II.A.3).

The critical question in this respect is whether the information is sufficient to allow the skilled person to carry out the invention over the whole range claimed

rather than allowing only certain classes to be obtained (with reference to the 4th paragraph in the above referenced section of "Case Law").
In the present case the claim is directed to a process in which a reduced chromium species is employed but is not directed to a method for carrying out the reduction itself. Accordingly the disclosure of only a single set of conditions for preparing the catalyst is no obstacle to carrying out the claimed polymerisation process over the whole scope of the claims.

Accordingly the preparation of the catalyst is sufficiently disclosed pursuant to Art. 83 EPC.

3.1.3 An objection was raised pursuant to Art. 83 EPC relating to the precise nature of the reduced chromium species, specifically whether it is possible to distinguish between Cr(II) and Cr(III) (section IX.(a).(i) above).

(a) The issue to be decided is thus the feasibility of determining whether this feature of the catalyst has been obtained, i.e. whether the skilled person is faced with an undue burden in ascertaining whether he is reproducing the invention.

(b) In order to make this assessment for the subject matter of operative claim 1 it is necessary to be able reliably to identify the presence of Cr(II). According to D4, page 111 under "results and discussions" the reduction to Cr(II) can be confirmed by pulsed titration. D5 on page 966 also discloses (in the passage bridging the columns) work according to which it was confirmed that the oxidation state of chromium after reduction was (II).

From D4 and D5, it is thus apparent that methods are known by which the required analysis can be carried out to distinguish Cr(II) from Cr(III).

(c) The appellant has advanced no arguments or evidence that the methods disclosed in D4 and D5 would not in fact permit the required assessments to be made.

(d) Accordingly the Board concludes that this objection is not supported by the facts.

3.1.4 Regarding the meaning of "predominantly" (section 3.1, 4th indent) it is apparent from the submission made at the oral proceedings (see section IX.(a).(i) above) that this objection is one relating to the clarity of the claim, i.e. a matter governed by Art. 84 EPC. The feature in question was however present in the claims as granted. Accordingly an objection pursuant to Art. 84 EPC is not admissible in respect of this feature.

3.1.5 Regarding the submission that the reduced chromium did not have a single valency (see last indent, section 3.1 above), it is noted that no evidence has been advanced to support this objection. Further, according to the specific disclosure of D5 and D6, discussed in section 3.1.1 above, the conditions set out in the patent in suit result in products of defined oxidation states: either predominantly Cr(II) (D5) or even quantitative reduction to Cr(II) (D6). Accordingly the allegation of the appellant that no single oxidation state was obtained but that many different oxidation states were present (section IX.(a).(i) above) is not supported by the facts.

3.1.6 Accordingly, the Board is satisfied that the disclosure of the patent in respect to the oxidation state of Cr(II) is sufficient (Art. 83 EPC).

3.2 *The content of alkyl branches*

3.2.1 Operative claim 12 defines the polymer composition *inter alia* by the relative content of alkyl side branches, defined as being ethyl or higher, of the two polymers.

As in the case of the distinction of Cr(II) and Cr(III) the question raised by the appellant here is one of whether the skilled person is faced with an undue burden in assessing whether he is reproducing the invention (see section 3.1.3.(a) above).

3.2.2 In order to make the required assessment for the subject matter of operative claim 12, it is necessary to be able to identify alkyl branches of C_2 or higher and to distinguish these from methyl branches. Further it is necessary to be able quantitatively to determine the relative amounts of these two groups of branches.

3.2.3 D7 relates to elastic, substantially linear olefin polymers. According to page 8, line 9 of D7, long chain branches in such polymers can be determined and quantified using ^{13}C-NMR spectroscopy. Reference in this respect is made to "the method of Randall", for which a literature reference is given. It is further taught that above a chain length of 6 carbons the length cannot be distinguished. As submitted by the respondent (see section VI.(a).(ii) above), and not disputed by the appellant, it would be possible by this method to distinguish between methyl branches on the one hand and ethyl and higher branches on the other.

3.2.4 Accordingly, as shown by D7, ^{13}C NMR provides a method which allows the distinction between C_1 branches and C_2 and higher branches to be made, and further allows this to be done quantitatively, thus making it possible to determine the relative contents of said branches in the polymer.

3.2.5 Thus the Board is satisfied that this aspect of the invention of the patent in suit is sufficiently disclosed (Art. 83 EPC).

3.3 The appellant also sought at the oral proceedings, for the first time in the appeal procedure, to make submissions with respect to the determination of molecular weight (see section IX.(a).(iii) above). This matter was however not elaborated further and the Board saw no reason to pursue this *ex officio*. Hence no objection arises.

3.4 The patent in suit thus satisfies the requirements of Art. 83 EPC.

4. *The construction of the claims*

As is apparent from the written and oral exchanges reported above, a matter of dispute between the parties was the construction of the claims. Accordingly it will be necessary to address this matter before consideration of the issues of Art. 54 and 56 EPC.

4.1 With respect to operative claim 1 it was disputed whether it is required that catalyst A be reduced prior to addition thereof to the reactor, or whether it is permissible that the reduction be carried out *in situ*, i.e. in the reaction (see sections V.(b), VI.(b) and IX.(b) above).

Claim 1 specifies that the reaction is carried out in the presence of catalysts A and B. This wording thus defines the state of the catalysts when in the reactor but imposes no restrictions concerning the form in which they are added to the reactor.

However the claim further specifies "[…]**said** catalysts[…]are fed into the reactor concurrently, either separately or in the form of a blend, where **said** catalyst A comprises chromium oxide […] and the chromium has an oxidation number of predominantly two[…]" (emphasis by the Board).

The antecedent for the second occurrence of "said" is the "said catalysts" which are fed into the reactor. Accordingly this wording makes unambiguously clear that the species which is added to the reactor as catalyst A is a species wherein the chromium is in the oxidation state of predominantly two, i.e. that the catalyst is reduced prior to adding it to the reactor.

The construction favoured by the appellant according to which catalyst A is added with the chromium in a higher oxidation state and is reduced to the II state only in the reactor is inconsistent and incompatible with the express wording of the claim.

Accordingly claim 1 requires that a Cr(II) species is added to the reactor.

4.2 It was also submitted that the specified proportions of the - supported - catalysts was of no meaning (submission of the appellant in section V.(b), and of the respondent at the oral proceedings (section IX.(c) above).

4.2.1 Firstly, the Appellant has failed to specify under which provision of the EPC this objection was being raised and has made ambiguous submissions in this respect. According to one submission made in the statement of grounds of appeal (see section V.(b) above), it was objected that this feature was irrelevant since it was the amount of active catalyst which was of significance. This would suggest that the objection was in fact one of lack of conciseness. This is however a requirement specified in Art. 84 EPC, which is not one of the grounds of opposition specified in Art. 100 EPC. As this feature was present in claim 9 as granted an objection pursuant to Art. 84 EPC in respect thereof is not admissible.
The further submission of the appellant in the statement of grounds of appeal according to which the specification of the proportions of the supported catalyst did not make it possible to distinguish this from the components thereof (see section V.(b) above), appears to be an objection concerning the clarity of the claims, which is also a matter governed by Art. 84 EPC, which as noted above is not admissible in respect of this feature.
Accordingly, insofar as the objections of the appellant in respect of the ratio of the catalysts can be understood, these appear to relate to matters governed by Art. 84 EPC, which is however not admissible since the feature in question was present in the claims as granted.

4.2.2 The foregoing notwithstanding it has not been argued that the feature is unclear in its own terms. Accordingly the Board considers that the terms of this feature are clear and that there is thus no reason for concluding that this feature has no limiting effect on the claim.

5. *Novelty*

5.1 *Claim 1*

5.1.1 Novelty was challenged on the basis of the disclosure of D1 which is prior art pursuant to Art. 54(3) EPC. D1 relates according to claim 1 thereof to a polymerisate of ethylene and optionally other comonomers obtainable by polymerisation in the presence of (I) a Phillips catalyst and (II) a metallocene *inter alia* wherein the metal is a group IV-VIII transition metal or a lanthanide.

According to page 4, line 35 to page 5, line 1 of D1 the preparation of catalyst I involves exposing the supported Cr species to oxidising conditions. It is possible to follow this by a reduction, for example with carbon monoxide at a temperature from 20 to 800°C. According to the examples catalyst (I) is prepared by reaction of chromium trinitrate nonahydrate with diammoniumhexafluorosilicate in a suspension of silica gel. After removal of the water the solid is treated for 2 hours in air at 550°C. No reduction step is carried out. Thus catalyst (I) of D1 is a Cr(VI) species. Catalyst (IIa) is chromocene supported on silica, which according to the examples can be prepared in one of three different ways.

For the polymerisation examples 2 and 3 the catalysts I and IIa are added to the reactor from two different ports. It is not stated whether the addition is concurrent. The proportions of the two catalysts employed is not stated. The polymerisation was carried out continuously.

5.1.2 The subject matter of operative claim 1 is thus distinguished from the disclosure of examples 2 and 3 of D1 by the features:

- the chromium oxide catalyst which is added to the reaction system (Catalyst A) has Cr in an oxidation state of predominantly II;
- the supported catalysts are present in specified ratios;
- D1 does not disclose that the catalysts are fed into the reactor concurrently.

5.1.3 Regarding the oxidation state of catalyst A, as was established in section 4 above, operative claim 1 mandatorily requires that the catalyst A be reduced prior to addition to the reactor. Accordingly the formulation of claim 1 excludes any process in which a non-reduced catalyst is employed as component (A). Although, as submitted by the appellant, D1 does disclose that reduction can be carried out, (sections V.(c) and IX.(c) above), it is a matter of fact, and not disputed, that no such step was carried out in examples 2 and 3 of D1. The question of whether the process of examples 2 and 3 of D1 *would* or *could* have been modified by the optional reduction step is a question which belongs in the domain of inventive step, and not of novelty.

5.1.4 Regarding the proportions of the catalysts as noted above examples 2 and 3 of D1 do not disclose this feature. The submissions of the appellant (sections V.(c) and IX.(c) above) relate to considerations of how the skilled person would address the lack of information in this respect of D1. However these considerations belong to a consideration of inventive step, not of novelty.

5.1.5 Regarding the submissions of the appellant with respect to the broader disclosure of D1 (see section IX.(c) above), it is apparent that a number of selections have to be made in order to arrive at the subject matter of operative claim 1.

(a) Firstly, it is necessary to select to employ the optional reduction of catalyst (I) of D1.

(b) Having made this selection, it is then necessary to select the target oxidation state, for which there is no basis in D1. It would then be necessary to select appropriate conditions to achieve this. In this respect it is observed that the conditions disclosed for this step in D1 cover a temperature range of 20 to 800°C (see above). As may be derived from D5 (see 3.1.1 above) the extent of reduction is critically affected by the temperature. There is no indication, even implicitly, in D1 of the reaction conditions required in order to yield a chromium catalyst being predominantly in oxidation state II. Accordingly in order to arrive at a chromium catalyst in oxidation state II, a number of selections are required from the disclosure of D1, of which two are not even generally indicated.

(c) Regarding catalyst (II) of D1, it is noted that the broadest definition specifies the metal only to the extent of groups of the periodic table. Claim 2 of D1 restricts this to chromium and zirconium. While examples 2 and 3 of D1 employ a chromocene catalyst (see section 5.1.1 above) , examples 4 and 5 of D1 employ a zirconicene species. Thus it is necessary to make a further selection regarding the metal in the second catalyst component of D1.

(d) Having made these selections, it is then necessary to select proportions of the supported catalyst to employ.
The submissions of the opponent (see section IX.(c) above) regarding the "incentive" of selecting proportions of 50/50 and then modifying to achieve the required product properties, the Board notes that these considerations are those properly pertaining to the question of inventive step, not novelty.

(e) A final selection is required in respect of the mode of adding the catalysts to the reactor. D1 at page 9 lines 29-33 discloses that the catalysts can either be pre-mixed and added together or that they can be added separately, e.g. at several parts of the reactor. It is not explicitly stated that the catalysts are to be added concurrently. Thus a further selection is necessary in respect of this feature.

(f) Accordingly also the broader disclosure of D1 does not make available unambiguously, even implicitly, a process having the features specified in operative claim 1.

5.1.6 Accordingly the subject matter of claim 1 of the main request is novel with respect to D1.

5.2 *Claim 5*

As is derivable from the discussion of claim 1 above, D1 does not disclose a catalyst system in particular having catalyst component A of operative claim 5. Accordingly the subject matter of this claim is novel with respect to the disclosure of D1.

5.3 *Claim 12*

No evidence has been advanced that the polymers resulting from the process of D1 would exhibit the features specified in operative claim 12. Nor has any evidence been advanced that polymers having the defined properties are disclosed in any other document. Accordingly the subject matter of claim 12 is novel.

5.4 Accordingly the subject matter claimed according to the main request is novel.

6. *The patent in suit, the technical problem, its solution*

6.1 According to paragraph [0001] of the patent in suit the technical problem is to provide a process for the polymerization of ethylene to obtain polyethylenes having a broad molecular weight distribution, and a catalyst system for use in said process.

6.1.1 In the prior art it is known to achieve this by using two reactors in series (paragraph [0002] of the patent).

6.1.2 It is known to employ a two-component catalyst system wherein the first catalyst is a chromium species which is subjected to oxidation and then reduced with CO; the second catalyst being a Cr or V arene. The catalysts are preferably fed into the reactor separately (paragraph [0004]).

6.1.3 It would be desirable, according to the patent in suit, instead of using two reactors in series and operating at different conditions, to use a single reactor and two different types of catalysts to obtain a composition consisting of two different ethylene polymers. Simultaneous use of the catalysts requires that neither of them reduces the activity of the other. A suitable choice of catalysts and reaction conditions can yield polymers with broad molecular weight distributions which are useful in extrusion processes, and yield blow moulded articles having especially good environmental stress cracking resistance (paragraph [0013]).

6.1.4 Prior art polymerisation processes exist in which chromium oxide introduced into the reactor has Cr in its highest oxidation state, and the Cr is reduced with ethylene inside the reactor. It has however been observed that if the unreduced chromium oxide compound comes into contact with a chromocene catalyst, both catalysts become deactivated (paragraph [0029] of the patent in suit).

6.2 The problem to be solved by the patent in suit is thus to identify a catalyst system or combination of catalysts which can be used simultaneously in a single reactor without any inhibition of the activities and which composition yields polymers with a broad molecular weight distribution, and the necessary reaction conditions (paragraph [0013]).

6.3 This problem is solved, according to paragraph [0029], cited above, by prereduction of the chromium oxide catalyst. If this step is carried out then neither catalyst will be inactivated upon combining them and they can function together with good activity.

6.4 This is confirmed by the examples of the patent in suit:

6.4.1 Comparative examples 1 and 2 and example 3 demonstrate, respectively polymerisations employing reduced chromium oxide (Catalyst A) on its own, chromocene (Catalyst B) on its own and a combination of both catalysts. The yield of the process employing the combined catalyst is intermediate between that of catalysts A and B alone. The properties of the resulting polymers, in particular the molecular weights and molecular weight distribution show that in the mixed polymerisation the catalysts are acting with minimal interaction or interference.

6.4.2 Comparative examples 4, 5, and 7 and example 6 further demonstrate that while the prereduction step has little effect on the outcome when catalyst A is used alone (comparative examples 4 - reduced and 5 - unreduced), in the case of a combination with catalyst B the result of using non reduced catalyst A (comparative example 7) is to reduce the yield by ca 80% compared to using a prereduced catalyst A (example 6).

6.5 The examples thus show that the above formulated problem is solved (cf paragraph [0029] of the patent in suit). In particular comparative examples 4, 5 and 7 and example 6 show the criticality of reducing catalyst A prior to adding this to the reactor.

6.6 The evidence of examples 13-21 and comparative example 23 also confirm that the observed effect is obtained in a continuous process.

7. *The closest state of the art*

There is consensus among the parties that D2, and in particular examples 16-19 thereof represents the closest state of the art.

7.1 The aim of D2 according to section 1 of the description ("Field of the Invention") is to provide a polymer having a broad molecular weight distribution, i.e. a problem aligned with that of the patent in suit.

7.2 D2 relates according to claim 1 thereof to a process for the preparation of ethylene polymers whereby the catalyst is a combination of a titanium or chromium compound on a porous inorganic oxide carrier, a transition metal compound containing a group having a conjugated π-electron as a ligand and an alumoxane. According to claim 9, the metal in the transition metal compound is Zr, Hf or Ti.

7.3 According to example 16 silica and chromium trioxide are combined. The final stage of the preparation is to expose the catalyst to air at 600°C for 8 hours. Thus the chromium will be in the oxidised state, i.e. Cr(VI). For the polymerisation, this supported catalyst is combined with a methylalumoxane/toluene solution and a

solution of biscyclopentadienyldichloro-zirconium in toluene. Ethylene is then introduced and polymerisation carried out.
Examples 17-19 employ variations on the process of example 16, whereby the concentration of chromium trioxide is modified.

7.4 The subject matter of operative claim 1 is thus distinguished from the process of examples 16-19 of D2 by the following features:

- The chromium oxide catalyst is prereduced to an oxidation state of predominantly (II);
- The second component is a chromocene rather a zirconocene;
- The second component is on a support rather than in solution, and consequently by the specified proportions of supported catalysts.

8. *The objective technical problem*

8.1 It has been alleged by the appellant (see section V.(d).(i) above) that, compared to D2 the objective technical problem could be formulated as to provide a further process for the production of broad molecular weight distribution polyolefins based on ethylene.

8.2 However it is clear from the analysis given in sections 6.4-6.6 above that a comparison differing only in one feature, namely the prereduction of the chromium oxide catalyst A is given in the patent in suit, this comparison thus lying closer to the claimed subject matter than the disclosure of D2. This comparison demonstrates that when catalyst A is employed in prereduced form, i.e. is added to the reactor in the Cr

(II) oxidation state the resulting yield is significantly higher - of the order of 80% - than when the non-reduced form is employed (see section 6.4.2 above).

8.3 According to Art. 56 EPC, as applied in T 35/85 (16 December 1986, not published in the OJ EPO) an applicant or patentee can discharge the onus of proof by voluntarily submitting comparative tests with newly prepared variants of the closest state of the art making identical the features common with the invention in order to have a variant lying closer to the invention so that the advantageous effect attributable to the distinguishing features of the invention is thereby more clearly demonstrated (T 35/85 Reasons 4).

8.4 The comparative examples of the patent in suit correspond to the construction considered in T 35/85 in that the sole point of difference lies in that distinguishing feature with respect to D2 which is identified in the patent in suit as being the core of the invention, namely the oxidation state of the chromium catalyst (see sections 6.1.4 and 6.3 above). Accordingly the examples and comparative examples of the patent in suit enable a precise evaluation of the effect of this feature.

8.5 In the light of the examples and comparative examples of the patent in suit as discussed in sections 6.4-6.6 above and the foregoing considerations with respect to T 35/85, it is apparent that the objective technical problem is in fact a different, more ambitious one than that proposed by the appellant. Specifically on the strength of the data in the patent in suit, it must be concluded that the objective technical problem to be solved in comparison to D2 is to provide a more efficient process with a higher yield for the production of broad molecular weight polyolefins.

8.6 The solution to this problem, according to claim 1 of the patent in suit, was to employ a catalyst system including as the first catalyst a supported chromium oxide in an oxidation state of predominantly II and as the second catalyst a chromocene on a support rather than in solution whereby the supported catalysts were employed in defined proportions.

8.7 As explained above, the examples and comparative examples of the patent in suit confirm that this problem has been effectively solved by the claimed measures.

9. *Obviousness*

9.1 D2 contains no suggestion to subject the chromium oxide catalyst to reduction to an oxidation state of predominantly II prior to adding it to the reactor. Nor is there any teaching in D2 which would guide the skilled person to replace the zirconocene catalyst employed in solution by a supported chromocene, let alone to avoid loss of yield through mutual interaction of the catalysts.

In this connection, D2 contains no discussion or consideration of any interaction between the catalysts, let alone an inhibitory interaction as evidenced in the examples of the patent in suit (See section 6 above). In particular there is no discussion relating to the mutual deactivation demonstrated in examples and comparative examples 4-7 of the patent in suit (see section 6.4.2 above).

9.2 Nor can D3 contribute anything to overcoming this absence of recognition.

9.2.1 D3 relates according to the introduction and claim 1 thereof to a process for polymerising 1-alkenes, especially ethylene employing as a catalyst chromocene on an inorganic oxide support.
According to page 2 line 23-25 of D3 a problem with prior art processes is that they yield polymers with a broad molecular weight distribution. Thus by implication the aim of D3 is to provide a process which yields polymers with a narrow molecular weight distribution.
This problem is diametrically opposed to the problem common to the patent in suit and D2 (see sections 6.1 and 7.1 above).
Thus there would be no *prima facie* reason for the skilled person seeking to provide a solution to the objective technical problem even to consult D3.

9.2.2 Even if, nevertheless, the teaching of D3 were to be considered, this would provide only one part of the claimed solution, namely the use of a supported chromocene as one component of the catalyst.
D3 does not teach to use a chromium oxide catalyst of any kind, let alone one in a defined oxidation state when added to the reactor.

9.2.3 Accordingly even if the skilled person were to consider D2 and D3 in combination this would merely teach to employ a supported chromocene together with unreduced chromium oxide. There is no discussion in D2 or D3 relating to the interaction between chromium oxide and supported chromocene catalysts in general, and in particular there is no discussion or recognition of the mutual deactivation identified and demonstrated in the patent in suit.

9.2.4 Thus it is concluded that the combination of the teachings of D2 and D3 does not render the subject matter of the operative claim 1 obvious.

9.3 Regarding the argument of the appellant (section IX.(d) above) that prereduction was known from D4-D6 to confer advantages, the Board notes that these documents merely teach that reduction of the catalyst occurs in a preliminary step of the polymerisation by interaction with ethylene (for example D4, page 111), and that it is the reduced species which initiates polymerisation. This is however explicitly recognised in the patent in suit (paragraph [0029]).
Arguably this teaching might lead the skilled person to expect that the initiation phase of the polymerisation could be shortened by prereduction. This indeed appears to be the case, as demonstrated by the increase in yield observed between comparative examples 4 and 5 of the patent in suit. However the teaching of D4-D6 provides no information in relation to the effect demonstrated by the examples of the patent in suit to arise from prereduction in the case of mixed catalyst systems.

9.4 Accordingly the subject matter of claim 1 is not rendered obvious by the cited prior art and therefore meets the requirements of Art. 56 EPC.

9.5 As the recognition of inventive step for the subject matter of claim 1 relies on the nature of the catalyst system it follows that the same conclusions apply to the subject matter of claim 5.

9.6 With respect to claim 12, directed to the polymer, the appellant advanced no arguments pursuant to Art. 56 EPC with regard to the subject matter of this claim. Accordingly the Board sees no reason to diverge from the conclusion of the opposition division that this subject matter is likewise founded on an inventive step.

10. Since the claims according to the main request are found to meet the requirements of the EPC there is no need to consider the 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 maintain the patent on the basis of claims 1 to 16 of the main request filed with letter dated 12 October 2007 and after any necessary consequential amendment of the description and drawings.

The Registrar: The Chairman:

E. Görgmaier R. Young