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Datasheet for the decision of 12 May 2016

Case Number: T 1255/12 - 3.3.03

Application Number: 06813466.7

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Language of the proceedings: EN

Title of invention:
SOLID STATE PROCESS TO MODIFY THE MELT CHARACTERISTICS OF POLYETHYLENE RESINS AND PRODUCTS

Patent Proprietor:
Equistar Chemicals, LP

Opponent:
Akzo Nobel Chemicals International B.V.

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

Keyword:
Sufficiency of disclosure - main request (yes)
Novelty - main request (yes)
Inventive step - main request (yes)

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Case Number: T 1255/12 - 3.3.03

DECISION
of Technical Board of Appeal 3.3.03
of 12 May 2016

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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office posted on 4 April 2012 concerning maintenance of the European Patent No. 1969018 in amended form.**

Composition of the Board:

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

Summary of Facts and Submissions

I. The appeal by the opponent lies from the decision of the opposition division of the European Patent Office posted on 4 April 2012 maintaining the European patent No. 1969018 in amended form.

II. A notice of opposition against the patent was filed in which the revocation of the patent was requested on the grounds according to Article 100(a) (lack of novelty and lack of inventive step), 100(b) and 100(c) EPC.

III. The opposition division maintained the patent on the basis of the second auxiliary request submitted during the oral proceedings. Said request contained 12 claims, of which independent claim 1 read as follows:

"1. A process for modifying the melt characteristics of polyethylene resins comprising contacting an ethylene copolymer resin powder with 0.5 to 450 ppm of organic free radical initiator at a temperature above the initiation temperature of the organic free radical initiator and below the melting point of the ethylene copolymer resin to increase the rheological polydispersity of the modified resin by at least 10 percent, the rheological polydispersity being measured as ER according to the method of R. Shroff and H. Mavridis, "New Measures of Polydispersity from Rheological Data on Polymer Melts”, J. Applied Polymer Science 57 (1995) 1605, and to paragraphs [0033] to [0036] of the description."

Claims 2 to 11 were directed to preferred embodiments of claim 1. Claim 12, which was related to a film obtained using a modified linear low density polyethylene resin produced by the process of claim 9, is not relevant for the present decision.

IV. The following documents were *inter alia* cited in opposition:
D1: US 3 153 025
D2: US 5 064 908
D4: R. Shroff and H. Mavridis, J. Appl. Polymer Science, Vol. 57 (1995), 1605-1626

The opposition division held that the second auxiliary request satisfied the requirements of Article 84 and 83 EPC, was novel over D1 and was inventive starting from either D1 or D4 as closest prior art.

V. The opponent (appellant) lodged an appeal against the opposition division's decision. The statement setting out the grounds of the appeal. The appellant requested that the opposition division's decision be set aside and that the patent be revoked.

VI. The reply to the statement of grounds of the appeal was received on 19 November 2012, in which the respondent (patent proprietor) requested the dismissal of the appeal.

VII. On 14 August 2015, the parties were summoned to oral proceedings to be held on 12 Mai 2016. A communication pursuant to Article 15(1) RPBA was sent by the Board on 23 March 2016.

VIII. On 11 April 2016, the respondent confirmed its requests of dismissal of the appeal and submitted two new auxiliary requests.

IX. At the end of the oral proceedings, which were held on 12 May 2016, the Board announced its decision.

X. The appellant's arguments, as far as relevant for the present decision, may be summarised as follows:

Main request - Sufficiency of disclosure

The process step of contacting the starting materials in claim 1 was defined by a result to be achieved, namely the increase in rheological polydispersity ER. The patent did not indicate what one had to do to achieve this result, other than contacting the indicated resin with the indicated amount of initiator at the indicated temperature. There was no information in the patent in suit on what determined whether or not the increase of 10% was achieved or not. If novelty over D1 was to be acknowledged, essential technical features were missing in the claims. The patent in suit lacked sufficiency of disclosure.

Main request - Novelty

D1 disclosed at column 2, lines 34-49 a process to modify the melt characteristics of polyethylene resins comprising contacting an ethylene copolymer resin powder with a free radical initiator at a temperature above the initiation temperature of the organic free radical initiator and below the melting point of the ethylene copolymer resin. The amount of organic free radical initiator disclosed in D1 was 100-50,000 ppm, which overlapped with the 0.5-450 ppm range of claim 1 of the main request. D1 disclosed therefore the use of 100 ppm organic peroxide explicitly. The process of D1 led to a change in rheology of the (co)polymer, as reflected in column 2, lines 34-49. Although an explicit disclosure of an increase in rheological polydispersity ER was missing from D1, D1 applied all the process steps listed in claim 1 of the patent in suit, meaning that the result - i.e. the change in rheological polydispersity ER – had to be inherently the same. Also, the contradictory results reported for example 1 and comparative example 6 of the patent in suit showed that no correlation could be established between the variation of molecular weight and that of the rheological polydispersity ER of an ethylene copolymer treated with an organic free radical. The decrease in molecular weight of the treated resin in D1 did therefore not suggest that its rheological polydispersity (ER) had also decreased. Claim 1 lacked novelty over D1.

Main request - Inventive step

D1 was the closest prior art because it related to a process for changing the melt characteristics of a polyethylene powder, as did the patent in suit. The difference between the process of D1 and that of claim 1 of the patent in suit was the lower amount of initiator compared to the examples of D1. No evidence for any effect linked to that difference was provided. The only process using more than 450 ppm of initiator in the patent in suit was comparative example 6, which used 2,000 ppm of peroxide to modify a specific type of HDPE powder. An example using less initiator, e.g. 450 ppm, in combination with the same HDPE powder was not provided, so it was unknown what a smaller amount of initiator would have done to this particular polyethylene. Also, ethylene copolymers treated with 450 ppm of organic radical initiator according to the process of the patent in suit might also be oxidized as disclosed in D1. That was confirmed in D2, in particular in comparison example B. Therefore, the patent in suit did not make plausible that the claimed process would prevent oxidation over the whole scope of the claims. Further, the examples of the patent in suit did not convincingly show that the alleged advantage (increase of the rheological polydispersity ER, as measured by the parameter ER) had its origin in the distinguishing feature (amount in peroxide). The problem therefore had to be formulated as the provision of a further, alternative process for modifying the melt characteristics of polyethylene resins. The solution was the use of less, i.e. 10-450 ppm, initiator. In the search for an alternative process, the skilled person would have turned to column 2, line 40 of D1, which disclosed a range of 0.01-5.0 wt% of peroxide which included the value of 100 ppm. So, D1 itself suggested the use of 100 ppm of peroxide. Also in D2, initiator amounts of 200 and 250 ppm were disclosed for such a process (column 2, lines 44-45; Examples B and 1). An increase of the rheological polydispersity ER of the resins treated according to D1 was suggested in Table III of D4. Therefore, the solution was obvious and the claims lacked inventive step.

XI. The respondent’s arguments, as far as relevant for the present decision, may be summarised as follows:

Main request - Sufficiency of disclosure

The patent in suit contained sufficient guidance about how to measure the ER and the examples gave a guide in order to fulfil this parameter. The skilled person was always in the position to see if he was working in the forbidden area of the claims. He could also always tune the amount of initiator for putting the invention into practice starting from the examples without using inventive skills.

Main request - Novelty

D1 was completely silent about the limitation that the increase in ER had to be higher than 10% as mentioned in operative claim 1. It could not be considered that this feature was mandatorily met in D1 as shown in comparative example 6 of the opposed patent. In this example it was shown that ER did not increase by increasing the initiator, but on the contrary working outside the range claimed in the opposed patent ER decreased considerably. Thus D1 did not disclose unambiguously this feature. Comparative example 6 of the patent in suit showed that the variation of the molecular weight of the treated resin was correlated to its rheological polydispersity ER. The process of D1 requested a decrease of the molecular weight of the oxidized resins and therefore implied a decrease of their rheological polydispersity ER. The claims of the main request were therefore novel over D1.

Main request - Inventive step

D1 was the closest prior art. The main difference with respect to the patent in suit was that the rheological polydispersity ER had to be increased by at least 10%. That difference gave rise to the technical effect that the melt characteristics of the polymer was improved, as was shown in table 1 of the opposed patent, without significant oxidation of the polymer as was shown in example 3 and without significantly altering the molecular weight distribution. The problem solved was to improve the melt characteristics of the polymer without significant oxidation of the resin and without significantly altering the molecular weight distribution of the resin. D1 pertained to the oxidation of polyolefins and thus did not solve the above problem. The claims of the patent in suit involved an inventive step.

XII. The appellant (opponent) requested that the decision under appeal be set aside and that the patent be revoked.

XIII. The respondent (patent proprietor) requested that the appeal be dismissed or, alternatively, that the patent be maintained on the basis of the first or second auxiliary request filed on 11 April 2016.

Reasons for the Decision

Main request

1. Each of the objections pursuant to Article 83, 54 and 56 EPC raised by the appellant either in writing or during the oral proceedings before the Board were directed to the process claims of the operative main request. In particular, no objection was raised against the product claim 12.

2. Sufficiency of disclosure

2.1 In order to fulfil the requirements of Article 83 EPC, the patent in suit must disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art. The appellant argued that the patent in suit did not indicate what the skilled person had to do to achieve the increase in rheological polydispersity ER as measured by the parameter ER of at least 10% as required in claim 1 of the operative main request.

2.2 Operative claim 1 pertains to a process for modifying the melt characteristics of polyethylene resins comprising contacting an ethylene copolymer resin powder with 0.5 to 450 ppm of organic free radical initiator at a temperature above the initiation temperature of the organic free radical initiator and below the melting point of the ethylene copolymer resin to increase the rheological polydispersity ER as measured by the parameter ER by at least 10%.

2.3 The polyethylene resin copolymer powders that can be used in the process of claim 1 of the patent in suit are disclosed in paragraphs 12 and 18. These are said to be produced by known polymerization procedures described in paragraph 18. Free radical initiators employed for the process of claim 1 include organic peroxides, organic hydroperoxides and azo compounds which decompose at temperatures below the melting point of the polyethylene resin. Examples of suitable organic free radical initiators are disclosed in paragraphs 16 and 17. The rheological polydispersity ER as represented by the parameter ER in claim 1 of the patent in suit is defined in paragraph 26 and a reference to a scientific publication corresponding to D4 is provided for further details on that parameter. The conditions under which the determination of ER is to be performed in the patent in suit are provided in paragraphs 33 to 36. It is therein disclosed how ER is to be determined from the measurement of the storage modulus G′ at a loss modulus G′′ of 500 Pa. The method of determination of the parameter ER is therefore described in the patent in suit. That was not in dispute between the parties. The general process of claim 1 is further exemplified in examples 1 to 4 of the patent in suit.

2.4 According to paragraph 11 of the patent in suit, the process entails the solid state modification of PE resin powder by incorporating a free radical initiator into the resin powder followed by controlled heating of the mixture below the melting point of the resin to effect changes in one or more melt characteristics of the resin. The free radical initiator is said to be combined with the polyethylene resin powder and uniformly distributed therein and adsorbed on the powder particles by any suitable mixing means, whereby the free radical initiator is distributed throughout the entire powder volume and uniformly adsorbed on the powder particles. Such methods may include stirring, rolling, tumbling, fluidization (paragraph 13). Also, the modalities of addition of the free radical initiator to the resin are described in paragraphs 14, 15, 22 and 23.

2.5 According to paragraph 19 of the patent in suit, the modification of the polyethylene resin powder is brought about by maintaining the resin powder having the free radical adsorbed thereon at a temperature below the melting point of the resin and for a period of time sufficient to effect the desired change in melt characteristics. The temperature and time of the modification are said to vary depending on the resin being modified, the amount and type of free radical initiator used, powder particle size and other factors. Temperatures within the range 40°C to 115°C are indicated. The modification time is addressed in paragraph 20. For most operations, and particularly large scale operations, the modification time is said to represent several times the initiator's half-life.

2.6 It can be concluded from the above that the description of the patent in suit describes the process of claim 1 in general terms and provides guidance as to the choice of the chemicals that can be used in that process. The patent also identifies variables of the process that are said to be crucial when operating the modification of the resin. Finally, the process of claim 1 is performed in such a way that the rheological polydispersity ER of the resin measured as ER is increased by at least 10%. The patent in suit also provides a method to determine the rheological polydispersity ER of the resin. The person skilled in the art is therefore in a position to figure out the details and the end of the process by finding out whether the minimum increase of the rheological polydispersity ER has been achieved or not.

2.7 The appellant argued that a skilled person would not find sufficient information in the patent to carry out the claimed process and that the examples would not provide a disclosure sufficient to practice the invention over the whole scope of the claims. The appellant's arguments however do not identify the information missing from the patent in suit without which a skilled person would be prevented to reproduce the invention without any inventive effort and undue burden. The appellant did not establish what information needed to perform the claimed process was missing from the patent in suit, let alone why the person skilled in the art wouldn’t have been able to supplement that information by its common general knowledge. In particular, no evidence was provided showing that it was not possible to achieve the increase of ER by at least 10 % mentioned in operative claim 1 by following the teaching provided by the patent in suit (see sections 2.4 to 2.6 above).

2.8 According to EPO case law, sufficiency of disclosure has to be assessed on the basis of the patent as a whole and not of the claims alone (Case Law of the Boards of Appeal of the EPO, 7th Ed., 2013, II.C.3.2). Under such circumstances, the question to be answered is whether or not the patent in suit **as a whole** provides sufficient information in order to achieve the increase in ER of at least 10% defined in operative claim 1. That requirement is fulfilled in the present case as was shown above. Under such circumstances, it was not shown that the appellant's objections related to the formulation of claim 1 as a result-to-be-achieved and/or to the lack of essential features amount to a lack of sufficiency in the sense of Article 83 EPC.

2.9 It cannot be concluded that the claimed process infringes the requirements of Article 83 EPC. For those reasons, the appellant's objection according to which the process according to claim 1 infringes the requirements of Article 83 EPC is rejected. The same is valid for the dependent claims 2-11.

3. Novelty

3.1 The only objection raised by the appellant was in respect of the passage at column 2, lines 34-51 of D1.

3.2 D1 discloses a process for oxidising polyethylene including copolymers of ethylene having an initial melt index of less than 0.01 which comprises admixing the polyethylene in solid or particulate form with 0.01 to 5% (100 to 50 000 ppm) of an organic peroxide capable of generating free radicals at an effective rate at a temperature in the range of 80 to 140°C, and thereafter in the presence of free oxygen heating said admixture while maintaining the polymer in solid form at a temperature ranging from 80°C up to but not including the melting point of said polyethylene until the carbonyl content of said oxidised resin is at least about 0.05% and the melt index is between 0.1 and 500 or higher (claim 1; column 2, lines 34 to 51). It was not disputed by the parties that D1 did not disclose the rheological polydispersity ER of the polyethylene resins as defined by the parameter ER in operative claim 1.

3.3 The argument submitted by the appellant was that the process of D1 had to inherently result in an increase of the rheological polydispersity ER of at least 10% when the polyethylene copolymer resin was treated with 100 ppm (0.01%) of organic peroxide as disclosed in column 2 lines 34 to 51 since the process of D1 shared the same steps with that of the patent in suit. The process of claim 1 of the patent in suit pertains to the modification of polyethylene resins comprising contacting the resin with an organic free radical initiator at a given temperature such that the rheological polydispersity ER of the resin is increased by more than 10%. Rheological polydispersity as characterized by the parameter ER in claim 1 is influenced by the type and amount of branching, chain extension and other inter- and intramolecular interactions as described in paragraph 26 of the patent in suit. The rheological polydispersity ER is also defined in D4 (first full paragraph of column 1 on page 1617 and column 1 of page 1618) as a way to quantify high molecular weight polydispersity essentially dependent on the long chain branching and the molecular weight distribution of the polymer. That parameter is therefore related to the distribution of molecular mass in a given polymer sample and is thus a parameter linked to the structure of the polyethylene. The process of claim 1 resulting in an increase of the rheological polydispersity ER is thus not only defined by contacting a resin with a given amount of an organic free radical initiator at a specific temperature, it also entails purposive choices and an implementation of these combined features, including the duration of the process, to obtain an increase of the rheological polydispersity ER of the resin by more than 10%. The question to be answered is therefore whether the process of D1 would implicitly result in a modification of the molecular weight distribution and long chain branching of the polyethylene in a way that its rheological polydispersity ER is increased by at least 10%. There is however in D1 no information on the long chain branching of the polyethylene resins so that it cannot be deduced from that document how that property is affected by the oxidation process taught in D1. There is also no mention of the molecular weight distribution of the resins after oxidation in D1. The lack of information concerning the long chain branching and the molecular weight distribution of the resins before and after oxidation does not allow any conclusion as to how the rheological polydispersity ER of the resins could have changed as a result of the oxidation process.

3.4 The aim of D1 is to provide a process for oxidizing polyethylene homo or copolymers. To that extent, the resins are heat treated in the presence of free oxygen and an organic peroxide. The advancement of that oxidation is monitored by measuring the carbonyl content of the resin until that content is at least about 0.05% and the melt index of the resin has raised from less than 0.01 to a melt index comprised between 0.1 and 500 or higher (column 2, lines 45 to 51). The teaching of D1 is to stop the oxidation before the polymer degrades to such an extent that it no longer has a useful molecular weight as represented by the melt index. The oxidation process of D1 is thus carried out with a different purpose in mind than the process of the patent in suit since the process of the patent in suit aims to avoid "significant oxidation" of the resin (paragraphs 11, 29 and 47). For this reason alone, it cannot be concluded that the process of D1 is so similar to that of the patent in suit that it will inherently result in similar resins, i.e. lead to an increase of the rheological polydispersity ER of the resin by more than 10%. Finally, it is disclosed in D1 that the oxidation process is carried out such that the molecular weight of the resins is reduced, as shown by the increase in melt index after oxidation. That is in contrast with the process of the patent in suit which does not lead to a significant change of the molecular weight of the resins. As result, it is not possible to draw a parallel between the process steps performed in D1 and in the patent in suit and deduce that these steps are analogous in any way. On that basis either, it cannot be concluded that the process of D1 would inherently result in a rheological polydispersity ER as claimed in the patent in suit.

3.5 D4 is a publication about measures of polydispersity from rheological data on polymer melts. It defines new polydispersity measures that can be extracted from frequency response data in the linear viscoelastic region as a way to reliably characterize polydispersity in polymer melts (abstract). Among these new measures, rheological polydispersity ER is introduced and its dependency on molecular weight distribution and long chain branching is discussed (pages 1614 to 1617 and 1622). In the case of HDPE, it is showed that increasing long chain branching results in increasing rheological polydispersity ER with two examples in which a first a HDPE was put through successive extrusion passes, and a second HDPE to which with increasing levels of peroxide were added (page 1622, column 2). Thus, rheological polydispersity ER as defined by the parameter ER also referred to in the patent in suit is reported in Table III, page 1615, for HDPE resins containing 75, 125 and 175 ppm of added peroxide. Although the values reported in Table III show an increase in ER of more than 10% for all the resins containing peroxide as compared to the same virgin resin, it remains doubtful whether any conclusion can be drawn from these experiments that could also be applied to the process of D1. First, D4 does not disclose if the HDPE resin used for the experiments was a copolymer as in the patent in suit and D1 or if it was a homopolymer. As a result, it remains uncertain whether the effect shown in D4 with one resin would also be observed with another resin. Second, D4 does not disclose if the resins to which peroxide was added have been heat treated according to the process of D1, namely in the presence of free oxygen at a temperature ranging from 80°C and up to but not including the melting point of the resin or if the resins have been melted through extrusion, as is the case for the first set of examples of Table III. Third, D4 does not specify if the process used led to an increase in melt index as disclosed at column 2 lines 37 and 48-49 of D1. As a result, it cannot be concluded from the experiments of Table III alone that an amount in peroxide of between 75 and 175 ppm is sufficient to increase the rheological polydispersity ER of resins by more than 10% independently of any other process parameters. D4 does therefore not provide a demonstration that the process of D1 as disclosed in column 2, lines 34 to 51 will inherently result in resins having a rheological polydispersity ER increased by more than 10%.

3.6 It is concluded from the above that the process of claim 1 of the main request is novel over D1. For those reasons, the appellant's objection according to which the process according to claim 1 lacks novelty is rejected. The same is valid for the dependent claims 2-11.

4. Inventive step

4.1 The patent in suit provides a process for the modification of polyethylene resins to improve their melt characteristics (paragraph 8). D1 discloses a process for oxidizing polyethylene resins by which the melt index of the resin is modified (column 2, lines 34 to 51). D1 was seen as the document representing the closest prior art by both parties. The Board sees no reason to depart from that view. In particular, example 4 of D1, which specifically deals with a process for modifying an ethylene copolymer resin powder, represents a promising starting point.

4.2 Example 4 of D1 pertains to an oxidation process of a copolymer of ethylene and butene-1 in particulate form having a density of 0.939, a melting point of 130°C, a melt index of 0.00 and a reduced specific viscosity of 4.5, which was slurried at room temperature in a benzene solution containing 0.5% (5000 ppm) benzoyl peroxide (an organic free radical initiator) based on the weight of the polymer. The benzene was evaporated and the resulting mixture was placed in a circulating air oven maintained at a temperature of 128°C. After 6 hours the carbonyl content as measured by infrared

analysis was in excess of 0.45% and the melt index was 1.0. The change in the rheological polydispersity ER of the oxidized ethylene copolymer is not disclosed in that example (see also point 3.4 above).
The process of claim 1 of the patent in suit differs from that disclosed in example 4 of D1 in that the modification of the resin is performed such that the rheological polydispersity ER of the resulting resin is increased by more than 10% and in that 0.5 to 450 ppm of initiator are used instead of 5000 ppm in example 4.

4.3 Both in writing and during the oral proceedings before the Board, the respondent considered that the problem to be solved over D1 resided in the improvement of the melt characteristics of polyethylene resins without substantially altering its molecular weight and without causing significant oxidation.

4.4 The patent in suit contains four examples representing the process claimed in which different polyethylene resin powders of various densities but of a melting point of 125°C (examples 1, 3 and 4) were treated at 100°C in the presence of 10 ppm of 2,5-dimethyl-2,5-di(t-butylperoxy) hexane (an organic free radical initiator) for up to 20 hours. On the basis of the data provided in the patent in suit, the increase of rheological polydispersity ER of these resins was calculated and reported to be between 26% and 600% (see Annex to the minutes of the oral proceedings before the opposition division). The patent in suit contains also two comparative examples that show a process wherein the resin was melted during heat treatment (comparative example 5) and one example wherein the process was carried out in the presence of 2000 ppm of organic radical initiator (comparative example 6). The patent in suit does not exemplify a process according to D1, in particular not according to example 4 of D1, wherein a copolymer of ethylene and butene-1 is oxidized in a circulating air oven and under such conditions that the carbonyl content of the resulting resin is at least 0.05% (claims 1 and 8 of D1). Thus, the patent in suit does not contain examples that represent an oxidation process according to D1. As a result, the data on file cannot demonstrate an improvement in the properties of the resins as compared to that of the closest prior art.

4.5 The patent in suit summarizes in Table 1 the properties of three resins before and after modification according to the claimed process. The rheological polydispersity ER and the molecular weights M_n and M_w of three resins (Example 1: commercial medium density PE resin powder; example 2: commercial high density PE powder and example 3: commercial LLDPE powder) unmodified and modified by the process of examples 1 to 3 are reported below:

	ER	M_n	M_w
Ex 1 (modified)	2.09	23213	82583
Ex 1 (unmodified)	0.80	25814	97958
Ex 2 (modified)	4.98	12902	132269
Ex 2 (unmodified)	3.94	13718	131407
Ex 3 (modified)	8.10	25052	113872
Ex 3 (unmodified)	1.07	28062	119142

The data show that the process according to claim 1, while leading to an increase of rheological polydispersity ER of more than 10%, does not result in a significant change of the molecular weight of the ethylene copolymer resins as compared to the unmodified resin. On that basis, it was made plausible that the claimed process does not result in a significant change of the molecular weight of the resin.

4.6 The patent in suit also discloses that the claimed process does not lead to a significant oxidation of the modified resins (paragraphs 11, 29 and 47). In support of that effect, only one example, example 3, is provided in the patent in suit. In that example, an LLDPE copolymer of ethylene and hexene-1 was treated for 20 hours in the presence of 10 ppm of 2,5-dimethyl-2,5-di(t-butylperoxy) hexane as organic peroxide at a temperature of 100°C. In D1 however, the copolymer resin of example 4 was treated for 6 hours with 5000 ppm of benzoyl peroxide at a temperature of 128°C. The process of example 3 of the patent in suit and that of example 4 of D1 were therefore performed under different conditions of peroxide, duration, amount of peroxide and temperature. Since it has not been demonstrated nor argued that these process conditions resulted from the choice of peroxide used, it can be assumed that each process condition may for itself influence the treatment of the resin. Thus, the influence of the duration of the treatment on the oxidation rate of the resin is taught in D1. In examples 13 to 17, several identical resin samples were treated at 128°C in the presence of varying amounts of benzoyl peroxide and for an increasing amount of time. The carbonyl content of the resins for each sample was measured after treatment and is reported in Table III. The results show that for a given amount of peroxide (0.1%, 0.5% or 1.0%), the carbonyl content of the resin, which is indicative of its oxidation rate, increases with the duration of the treatment (0, ½, 1, 2, 4 ¼ hours). The results of Table III also show that for a given peroxide (benzoyl peroxide) and duration of the treatment, an increasing amount of peroxide results in a higher carbonyl content on the resin. These results show that duration and peroxide content influence the oxidation rate of polyethylene resins significantly.

The temperature is also taught in D1 to have a direct influence on the rate of oxidation (column 3, lines 44 and 45). That is demonstrated in the examples 23 to 26 of Table V of D1 wherein several identical polyethylene samples were treated at temperatures varying between 131.5°C and 110°C in the presence of the same amount of benzoyl peroxide (5000 ppm). The carbonyl content measured on the resin after treatment is reported in Table V. That table teaches that under otherwise identical conditions, a process conducted at a lower temperature (131.5°C to 110°C) leads to a resin with a lower carbonyl content (0.134 to 0.050). These results show that the process temperature is paramount to the oxidation rate of the resin.

It is concluded from the teachings of D1 that for a given peroxide, duration, amount of peroxide and temperature of the treatment influence the oxidation rate of the resin. The process of example 3 of the patent in suit was performed under conditions that significantly differ from those of example 4 of D1 and an example representative of D1 is not provided in the patent in suit. It is therefore not possible to determine whether the absence of oxidation of the resin put forward in the patent in suit can be ascribed to the distinguishing features of the claimed process or if it is the result of a choice of a combination of processing conditions which are not part of the claimed subject matter, i.e. type of peroxide, temperature and duration of the process. It has therefore not been made plausible that the claimed process results in less oxidation than the process of the closest prior art.

4.7 Under such circumstances, the technical problem that was effectively solved over the closest prior art D1 can be formulated as the provision of a process for modifying the melt characteristics of polyethylene resins without significant change of their molecular weights.

4.8 The question that remains to be answered is whether it was obvious, starting from example 4 of D1, to perform an oxidation process such that the rheological polydispersity ER of the ethylene copolymer resin increases by 10% in order to oxidize an ethylene copolymer resin without significantly changing its molecular weight.

4.9 Neither the rheological polydispersity ER, nor the long chain branching (which is known from D4 to be related to the rheological polydispersity ER as discussed above in point 3.3) of the oxidized resins are mentioned in the closest prior art D1. There is also no evidence on file showing that the oxidation process according to D1 could be performed such that the rheological polydispersity ER of the modified resin is increased by at least 10% while at the same time ensuring that the carbonyl content is at least 0.05% after oxidation (claims 1 and 8). Also, since the oxidation process of D1 aims at a decrease of the molecular weight of the resin, D1 cannot provide a motivation to increase the rheological polydispersity ER of the resin in order to solve the technical problem of modifying that resin without significantly changing its molecular weight. D1 can therefore not provide a hint towards the solution of the technical problem posed.

4.10 D4 provides a description of the rheological polydispersity ER of resins to which peroxide was added in an amount of 75 to 175 ppm (Table III). There is however no mention of an oxidation process in that document and the effect of an increase of the rheological polydispersity ER on the oxidation of the resin and its melt index is not derivable from D4. As a result, it cannot be assumed that by performing the process of D1 with an amount of peroxide comprised between 100 and 450 ppm such that the resulting resin has a carbonyl content of more than 0.05% (claims 1 and 8 of D1), the rheological polydispersity ER of the resin could be increased by 10%. Starting from D1 as the closest prior art, the skilled person had no motivation to modify the process of example 4 and use between 75 and 175 ppm of peroxide as in the experiments of Table III of D4 to oxidize the ethylene copolymer and expect not to change of its molecular weight significantly.

4.11 It is concluded from the above that claim 1 of the patent in suit is inventive in view of D1 as closest prior art. That conclusion also applies to the dependent claims 2 to 11 of the main request. Therefore, the appellant's objection according to which the process claims of the main request do not satisfy the requirements of Article 56 EPC is rejected.

4.12 Under the present circumstances of the case there is no need to consider the auxiliary requests submitted by the respondent.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

Beschwerdekammern des Europäischen Patentamts
Boards of Appeal of the European Patent Office
Chambres de recours de l'Office européen des brevets

M. Schalow O. Dury

Decision electronically authenticated