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**Datasheet for the decision
of 23 March 2017**

Case Number: T 1570/13 - 3.3.03

Application Number: 00944799.6

Publication Number: 1263873

IPC: C08L23/10, C08K5/43, C08F8/34

Language of the proceedings: EN

Title of invention:
POLYOLEFIN COMPOSITION WITH IMPROVED IMPACT PROPERTIES

Patent Proprietor:
Braskem America, Inc.

Opponent:
Borealis Technology OY

Relevant legal provisions:
EPC Art. 56

Keyword:
Inventive step - (no) - all requests- two documents equally
valid as closest state of the art - invention must be non-
obvious over both



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Case Number: T 1570/13 - 3.3.03

D E C I S I O N
of Technical Board of Appeal 3.3.03
of 23 March 2017

Appellant: Braskem America, Inc.
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Decision under appeal: **Decision of the Opposition Division of the
European Patent Office posted on 8 May 2013
revoking European patent No. 1263873 pursuant to
Article 101(3) (b) EPC.**

Composition of the Board:

Chairman D. Semino
Members: M. C. Gordon
C. Brandt

Summary of Facts and Submissions

- I. The appeal lies from the decision of the opposition division posted on 8 May 2013 revoking European patent number 1263873.
- II. The patent was granted with a set of 15 claims, whereby claim 1 read as follows:

"A composition comprising a coupled impact propylene copolymer formed by the reaction of a coupling agent with an impact propylene copolymer comprising an in-reactor blend of a continuous polypropylene phase and a dispersed elastomeric phase."

Claims 2-12 were directed to preferred embodiments of the composition of claim 1. Claims 13 and 14 were directed to various articles comprising the composition of any of claims 6-12 and claim 15 was directed to the use of a coupling agent to improve properties of an impact resistant propylene copolymer composition.

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

Inter alia the following documents were relied on in the opposition proceedings:

D3: US-A-3 336 268

D4: WO-A-99/10424

D7: Moore, E.P. Polypropylene Handbook, Munich 1996, pages 220, 221.

IV. The decision of the opposition division was based on the claims of the patent as granted as the main request and 7 sets of claims forming auxiliary requests. According to the decision, none of the sets of claims met the requirements of one or more of Articles 54, 56 and 123(2) EPC or the request was not admitted to the proceedings (auxiliary request 2).

In particular, auxiliary request 1 consisted of a sole claim which read as follows:

"A coupled impact propylene copolymer formed by the reaction of a coupling agent, which is a poly(sulfonyl azide) with an impact propylene copolymer which is an in-reactor blend of a continuous propylene phase and a dispersed elastomeric phase".

Regarding Article 56 EPC, which was addressed only for auxiliary request 1, the opposition division held that D4, which disclosed a mechanically blended heterophasic polypropylene/elastomer composition was the closest prior art and taught all features except that the polymer was an in-reactor blend. No technical effect had been shown to arise from the distinguishing feature so that the objective technical problem to be solved with respect to D4 was to try to improve the physical and melt properties of the coupled impact propylene copolymers thereof. D7 taught to accomplish this by use of an in-reactor blend as the impact propylene copolymer, leading to the conclusion that no inventive step could be recognised. The fact that an unexpected advantage had been shown to arise by subjecting in-reactor blends to coupling was not relevant since the in-reactor blends did not represent the closest prior art. Accordingly the patent was revoked.

V. The patent proprietor (appellant) lodged an appeal against the decision. Together with the statement of grounds of appeal six sets of claims forming a main request and five auxiliary requests were submitted.

The sole claim of the main request differed from that of auxiliary request 1 considered by the opposition division in that the claim was directed to:

"A composition comprising...[remainder as the above auxiliary request 1]".

The auxiliary requests I and II each consisted also of a single claim.

The additional wording of auxiliary request I read as follows:

"[...and a dispersed elastomeric phase] and wherein the impact propylene copolymer contains at least 5 weight percent and less than 20 weight percent -CH₂CH₂- units, based on the total weight of the impact propylene copolymer."

The additional wording of auxiliary request II, compared to the main request read as follows:

"[...and a dispersed elastomeric phase] and wherein the continuous phase of the impact polypropylene is a homopolymer propylene polymer and the elastomeric phase is comprised of a copolymer containing monomer units derived from ethylene, wherein the impact propylene copolymer contains at least 5 weight percent and less than 20 weight percent -CH₂CH₂- units, based on the total weight of the impact propylene copolymer."

Auxiliary requests III-V corresponded to the main request and auxiliary requests I and II but were directed to a coupled impact propylene copolymer rather than a "composition comprising...".

Additionally a further page (page 218) of the document D7 was submitted and, with a subsequent letter:

D11: declaration of Peter Simon Dias PhD dated 29 August 2014

in which the data already contained in the patent in suit was re-presented and discussed.

VI. The opponent, now respondent replied.
Further documents, *inter alia*

D8: WO-A-98/42760

were submitted.

VII. The Board issued a summons to oral proceedings and a communication setting out its preliminary view of the case.

VIII. Oral proceedings were held before the Board on 23 March 2017.

IX. The arguments of the appellant, insofar as relevant for the present decision, can be summarised as follows:

Inventive step:

Closest prior art was not D4 since this related to mechanical blends whereas the operative claim was directed to "in-reactor" blends. These two classes of

products had, as a result of the respective manufacturing processes, different properties, were each suitable for a different range of end uses and were not interchangeable. The mechanical blending process of D4 gave access to a wider range of products and to different products than did the in-reactor process of D7 in particular in terms of the respective properties of the component polymers involved (different monomer compositions, differing tacticities). Conversely the in-reactor process allowed products with a finer disperse phase (elastomer) even to the extent that the resulting product was no longer heterophasic. D4 contained a reference to D7 indicating that the inventors of D4 had been aware of in-reactor blends but had elected not to use these. As explained in D3, the effect of coupling was - surprisingly - to reduce the particle size of the polymer. Such a reduction in size as resulted from coupling was not required in the case of in-reactor blends, such as known from D7 and could even be disadvantageous, as the heterogeneous structure could in effect be lost if the disperse phase particles became too small. The mechanically blended compositions of D4 were inherently not suitable for the same end uses as polymers prepared by in-reactor processes due to the high elastomer content meaning that D4 was an unrealistic starting point for analysis of inventive step. D4 furthermore covered compositions with no elastomer and compositions with two or more elastomer components, whereby this latter type of composition could not be practically obtained with the in-reactor process which was limited by its nature to binary compositions (two types of polymer only).

The claimed compositions were inventive compared to the correct closest prior art D7. The objective problem was

to provide compositions having improved directionally balanced impact properties in particular as shown by the ductile to brittle transition temperature (DBTT) whilst simultaneously having improved melt strength. This problem was solved compared to the in-reactor blends of D7 by means of the coupling with poly(sulphonyl azides). D7 was however silent on the use of poly(sulphonyl azides) for modification of in-reactor impact polypropylene copolymers. D3 and D4, which did relate to such coupling reactions were silent on improvement of either DBTT or melt strength. Consequently neither D3 or D4 provided any pointer to modification by subjecting to a coupling reaction in-reactor blends as known from closest prior art D7.

The same arguments applied to the auxiliary requests whereby it was acknowledged, for example as confirmed by D8, that the further features of these requests, as compared to the main request, did not provide any additional distinguishing features with respect to the relevant disclosure of D4.

- X. The arguments of the respondent, insofar as relevant for the present decision, can be summarised as follows:

Inventive step:

The closest prior art was D4 which related to heterophasic polypropylene/elastomeric polyolefin blends ("rheology modified polyolefin") formed by the reaction with a poly(sulphonyl azide) and taught *inter alia* that it was advantageous for the disperse phase to attain as small particle size as possible (page 17 lines 33-37). The skilled person would be aware e.g. from D7 to which D4 made reference, that in-reactor blends exhibited very small particle size of the

dispersed phase. Hence starting from D4 it would be obvious to replace the mechanical blends thereof by in-reactor blends to obtain improved heterophasic polypropylene compositions. The route via in-reactor blends also gave access to a wider range of compositions with several different constituents since it was, in contrast to the position taken by the appellant, possible to employ additional reactors to generate further polymer components.

The same arguments applied to the auxiliary requests as no further difference could be acknowledged with respect to D4, as shown in by reference to D8. In particular, the quantity of ethylene in example 13 of D4 was within the range additionally specified in the auxiliary requests.

- XI. The appellant requested that the decision under appeal be set aside and the patent be maintained on the basis of the main request, or alternatively, on the basis of any of the auxiliary requests I-V, all requests filed with the statement setting out the grounds of appeal.
- XII. The respondent requested that the appeal be dismissed.

Reasons for the Decision

- 1. Main request - inventive step
 - 1.1 The patent in suit is directed to the provision of an elastomeric polypropylene composition (heterophasic polypropylene) with improved impact and melt properties. In particular it is desired to obtain compositions which when extruded exhibit directionally balanced properties, i.e. a small difference in impact

properties between notched impact parallel to and perpendicular to the extrusion axis whilst also having improved melt strength. It is also desired to provide compositions with a ductile-to-brittle transition temperature of 0°C or lower (paragraphs [0003] and [0004]).

1.2 Closest prior art

Two documents have been cited as candidates for the closest prior art D4 and D7.

1.2.1 D4 relates to compositions formed by mechanical blending. The aim of D4 is to provide rheology modified polyolefin, either alone or as blends, which products exhibit *inter alia* improved melt strength (page 3, line 19-22). Forming methods envisaged by D4 include injection moulding and extrusion (page 4, lines 29-33). According to the discussion in D4 on page 5, starting at line 3, the process for preparing the compositions involves combining the propylene polymer and, as rheology modifier, poly(sulphonyl azide). An "additional" aspect of the invention, as discussed at page 5, lines 26-29 of D4, is compositions made by reacting an isotactic propylene polymer and at least one elastomeric polymer with poly(sulphonyl azide). According to example 13, 700g of isotactic polypropylene pellets and 300g of ethylene/octene elastomer pellets are blended in a first step and the resulting blend then combined with a bi(sulphonyl azide), subjected to further mixing and then extruded. The employed ethylene/octene copolymer, "Engage 8200", has a monomer constitution of 36.3 wt.% octene, as shown in D8, page 8 lines 18-20. Correspondingly the amount of ethylene is 63.7 wt.%. From this it can be calculated that in the composition of example 13 of D4 there is an ethylene content of 19.1 wt%.

The product is designated a "TPO" (D4, page 26, line 21), which, as explained on page 3 line 12 denotes "thermoplastic polyolefin". As explained on page 16 lines 4-7, "TPO" refers to blends in which polypropylene is the continuous phase (and consequently the elastomeric polyolefin is the disperse phase). The alternative structure - designated "TPE" ("thermoplastic elastomer") has the inverse morphology, i.e. continuous elastomeric polyolefin phase and disperse polypropylene phase. Such a composition is shown in example 14 of D4. The TPO composition of example 13 of D4 was shown to have improved Izod impact properties at 22°C and improved MTS peak impact property at -30°C as compared to a comparative composition without the coupling (sulphonyl azide) treatment. Other physical properties (tensile stress at break, elongation at break and flexural modulus) were also improved in the modified composition compared to the unmodified composition (Table on page 27).

It is correct, as submitted by the appellant, that D4 is not limited to TPOs, since the document in the description and in the examples discloses compositions consisting solely of polypropylene subjected to the coupling reaction (example 1) as well as compositions with a higher proportion of elastomer than polypropylene, thus corresponding to the "TPE" morphology (example 14). Nevertheless, the existence of these compositions, which do not have the morphology as defined in operative claim 1, does not mean that the disclosure of the remainder of the document, in particular example 13, which does relate to a composition having the morphology as specified in operative claim 1, should simply be disregarded or that the document as a whole should be disregarded.

Consequently the argument of the appellant that D4 - as a result of these other disclosures - cannot be seen as forming the closest prior art is incorrect.

It was further argued by the appellant with respect to D4 that, in the light of the teaching of D3 that the coupling reaction resulted in a reduction of the particle size, the skilled person would be aware of and concerned by the risk that heterogeneity could be lost, thus presumably teaching away from subjecting mechanical blends to the coupling reaction and consequently disqualifying D4 as the closest state of the art. There is no unambiguous basis in D3 for this contention. This argument appears to be based on column 1, lines 50-57 of D3 which explains that the bridged polymers contain "a considerably larger number of spherulites of less than one-tenth the size of those found in unbridged polypropylene and exhibits an improved clarity". This passage however indicates that a heterogeneous structure is retained in the bridged polymer, but that the particles are smaller than in the unbridged composition. There is no indication in D3 which would suggest that the reduction in particle size would be such that heterogeneity was lost or that such a loss of heterogeneity was a possibility. Accordingly this argument of the appellant is not based on the teaching - explicit or implicit - of the cited document and does not give any cause to dismiss D4 as the closest state of the art.

In conclusion, D4 relates to the same class of composition as the operative claim, namely modified heterophasic TPO polypropylenes, and in broad terms addresses the same problem as the patent in suit, in particular improvement in moulding properties and impact properties. As a result D4 can be taken as

representing the closest prior art.

With respect to D4, the distinguishing feature of the subject-matter of the operative claim is the nature of the polymer employed, i.e. an in-reactor blend as defined in operative claim 1 rather than a mechanical blend as employed in D4.

- 1.2.2 D7, the document preferred by the appellant as the closest prior art, is a reference handbook relating to polypropylene. The cited section, 5.5.3 on page 220 refers in the third bullet point also to TPO polymers, however formed as an in-reactor blend rather than by mechanical blending. In this section of D7 it is firstly stated that thermoplastic polyolefins are traditionally prepared by mechanical blending, which corresponds to the approach taken by D4. D7 then reports that it is (now) possible to produce "these kinds" of blends (i.e. TPOs) directly in a reactor and lists advantages of these "in-reactor" blends as compared to the mechanical blends such as known from D4, namely:
- decreased variability since the products are prepared directly from the monomers
 - fewer manufacturing steps
 - fine dispersion of elastomer in the olefin matrix, resulting in **improved physical properties and melt uniformity**
 - access to a wider range of elastomeric compositions (Board's emphasis).

The advantages indicated in bold above correspond in essence to the technical problem as set out in the patent and in D4.

According to D7 the problem is solved by adoption of a

particular process to prepare the polymer, i.e. in-reactor blending. D7 is silent on the question of modification with a poly(sulphonyl azide) compound which thus represents the distinguishing feature of the claimed subject-matter over D7.

- 1.2.3 It is apparent that either of D4 or D7 is equally suitable as the closest prior art since both documents address the same problem as the patent in suit and propose different - complementary - approaches to address this. As indicated above the distinguishing feature of the claimed subject-matter compared to each of D4 and D7 corresponds to the teaching of the respective other document.
- 1.2.4 Under these circumstances where two equally relevant documents are present, each forming an alternative closest state of the art, the analysis of inventive step has to be carried for each. If the result of one of these analyses is that the subject-matter claimed does not meet the requirements of Article 56, EPC then the conclusion will be that the request in question is to be refused, irrespective of whether the analysis starting from the alternative closest prior art leads to a different conclusion.
- 1.3 Problem Solved
 - 1.3.1 The evidence provided in the patent in suit (and resubmitted in more structured form by the appellant as D11) relates to D7 as the closest prior art and demonstrates the effect of the coupling reaction on the in-reactor blends. This evidence demonstrates an improvement in the properties identified in the patent in suit as forming the problem to be solved with

respect to D7 as the closest prior art.

1.3.2 However there is no corresponding evidence with respect to the teaching of the alternative closest prior art document, D4. Thus none of the examples demonstrate that a technical effect arises when moving from a coupled mechanical blend as taught by D4 to a coupled in-reactor blend.

1.3.3 Consequently with respect to the teaching of D4 the only technical problem which can be formulated is the minimal one, namely the provision of further modified TPO compositions, this problem being solved by replacing the mechanical blends of D4 by the in-reactor blends of D7.

1.4 Obviousness

1.4.1 D7 itself provides an incentive to make this modification to the teaching of D4, since D7 indicates that among other benefits, the in-reactor blending process is simpler, resulting in cost savings; the finer dispersion of the in-reactor TPOs results in improved physical properties and melt uniformity, which benefits even correspond to the problem as set out in paragraph [0004] of the patent in suit.

1.4.2 Consequently based on the teaching of D4 and seeking to provide either further impact modified TPOs or even products with improved melt and physical properties, it would be obvious that this could be accomplished by replacing the mechanical blends of D4 by the in-reactor blends of D7.

1.4.3 As a result of the foregoing, the subject-matter claimed lacks an inventive step.

2. Auxiliary requests I-V

As explained in section 1.2.1, above and acknowledged by the appellant, none of the auxiliary requests introduce further distinctions compared to the closest prior art, i.e. example 13 of D4, compared to the main request.

Consequently the conclusion reached for the main request applies also to all auxiliary requests.

3. As the subject-matter of claim 1 according to all requests does not meet the requirements of Article 56 EPC due to the absence of an inventive step, the appeal is to be dismissed and there is no need for the Board to decide upon any of the other issues.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



B. ter Heijden

D. Semino

Decision electronically authenticated