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**Datasheet for the decision
of 1 March 2024**

Case Number: T 0626/22 - 3.3.09

Application Number: 15755722.4

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Language of the proceedings: EN

Title of invention:
CROSS-LINKED PRODUCT AND PRODUCTION METHOD AND USE THEREFOR,
AND ETHYLENE COPOLYMER

Patent Proprietor:
Mitsui Chemicals, Inc.

Opponent:
Borealis AG

Headword:
CROSS-LINKED PRODUCT/MITSUI CHEMICALS

Relevant legal provisions:
EPC Art. 56, 100(a)
RPBA 2020 Art. 13(1)

Keyword:

Inventive step - (yes)

Amendment to appeal case - not admitted

Decisions cited:

T 0606/89, T 0870/96, T 0066/97, T 2114/16



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Case Number: T 0626/22 - 3.3.09

D E C I S I O N
of Technical Board of Appeal 3.3.09
of 1 March 2024

Appellant: Borealis AG
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Decision under appeal: **Decision of the Opposition Division of the
European Patent Office posted on 17 December
2021 rejecting the opposition filed against
European patent No. 3112398 pursuant to Article
101(2) EPC.**

Composition of the Board:

Chairman A. Haderlein
Members: C. Meiners
N. Obrovski

Summary of Facts and Submissions

- I. The present decision concerns the appeal filed by the opponent (appellant) against the decision of the opposition division to reject its opposition to the patent in suit ("the patent").
- II. In its decision, the opposition division decided *inter alia* that the subject-matter of the independent claims as granted involved an inventive step in view of document D1 as the closest prior art.
- III. In its notice of opposition, the opponent had requested revocation of the patent based *inter alia* on Article 100(a) EPC for lack of inventive step.
- IV. The following documents are relevant to this decision.
- D1 US 2009/0249645 A1
- D10 V. Busico et al., "¹H NMR Analysis of Chain Unsaturation in Ethene/1-Octene Copolymers prepared with Metallocene Catalysts at High Temperature", *Macromolecules*, 2005, 38, 6988-6996.
- V. *Wording of the relevant claims*

Independent claim 1 as granted reads as follows.

"A method for producing a crosslinked product, comprising the steps of: melt molding an ethylene copolymer (A) or a resin composition containing the ethylene copolymer (A); and carrying out crosslinking;

wherein the ethylene copolymer (A) contains a constitutional unit derived from ethylene and a constitutional unit derived from an α -olefin having from 3 to 20 carbon atoms, and satisfies all of the following requirements (1), (2), (3) and (4):

- (1) a vinyl group content per 1,000 carbon atoms as measured by $^1\text{H-NMR}$ is 0.06 or more and one or less;
- (2) a ratio $\text{MFR}_{10}/\text{MFR}_{2.16}$ is 8.6 or more and 50 or less;
- (3) a density d is 850 kg/m^3 or more and 920 kg/m^3 or less; and
- (4) $\text{MFR}_{2.16}$ is within the range of from 2.0 to 200 g/10 min (wherein, MFR_{10} represents a melt flow rate (g/10 min) as measured in accordance with ASTM D1238 at a load of 10 kg and at a temperature of 190°C ; and $\text{MFR}_{2.16}$ represents a melt flow rate (g/10 min) as measured in accordance with ASTM D1238 at a load of 2.16 kg and at a temperature of 190°C).

Independent claim 5 as granted reads as follows.

"A crosslinked product obtained by the method for producing a crosslinked product according to any one of claims 1 to 4."

Independent claim 9 as granted reads as follows.

"An ethylene copolymer (A) which contains a constitutional unit derived from ethylene and a constitutional unit derived from an α -olefin having from 3 to 20 carbon atoms, and which satisfies all of the following requirements (1), (2), (3) and (4):

- (1) a vinyl group content per 1,000 carbon atoms as measured by $^1\text{H-NMR}$ is 0.06 or more and one or less;

- (2) a ratio $MFR_{10}/MFR_{2.16}$ is 8.6 or more and 50 or less;
- (3) a density d is 850 kg/m^3 or more and 920 kg/m^3 or less; and
- (4) $MFR_{2.16}$ is within the range of from 2.0 to 200 g/10 min (wherein, MFR_{10} represents a melt flow rate (g/10 min) as measured in accordance with ASTM D1238 at a load of 10 kg and at a temperature of 190°C ; and $MFR_{2.16}$ represents a melt flow rate (g/10 min) as measured in accordance with ASTM D1238 at a load of 2.16 kg and at a temperature of 190°C).

VI. The appellant's arguments, where relevant to the present decision, can be summarised as follows.

- (a) Document D10 had been filed in response to the patent proprietor's (respondent's) arguments in its reply to the appeal, regarding the relevance of terminal unsaturations. The filing of D10 was an allowable response to these arguments of the respondent and was thus admissible.
- (b) A skilled person would have considered Example 5 and Comparative Example 3 of D1 suitable starting points for the assessment of inventive step. In particular, the copolymer featured in the latter example was a *starting* material. The final product was crosslinked, however. Hence, the MFR (melt flow rate) "disappeared" in the final product obtained. Thus, no technical effect associated with MFRs could be acknowledged.

As to the alleged improvement of the moulding stability associated with the claimed subject-matter, it was not credible that this property was

determined merely by the features of claim 1 (and by analogy claim 9). By contrast, the amount of vinylene groups in a terminal position and the total content of unsaturation of the copolymers was not indicated in the claims. As a considerable amount of the unsaturated bonds was terminal, their content in the polymers could also influence the moulding stability. Hence, decisive features such as the amount of terminal unsaturations in the copolymers were not indicated in claim 1. This was also apparent from the graph of the standard deviation values for the size of moulded articles ("moulding stability") over the concentration of total unsaturations in the copolymers obtained in the patent. Thus, it could not be inferred that the difference(s) established between the claimed subject-matter and D1 had a causal association with the decisive technical effect, i.e. moulding stability.

Thus, it was reasonable to start from Examples 5/10 or Comparative Examples 3/11 of D1 for assessing inventive step. These examples also addressed the second aspect, "excellent physical properties", aimed at in the patent.

Moreover, it had not been shown that the objective technical problem identified by the opposition division had indeed been solved across the whole scope claimed. In this context, the moulding conditions had not been changed and the (foamed) compositions contained substantial amounts of other polymers and other agents.

In view of this, and in view of either Example 5 or Comparative Example 3 of D1, the *objective*

technical problem was merely to provide an *alternative*.

The solution to this problem was *obvious* to a skilled person in view of D1. They would have used a higher MFR_2 because this had higher fluidity. The ratio MFR_{10}/MFR_2 did not constitute a hurdle in that respect. Paragraphs [0100] to [0106] of D1 provided information on the measures for adapting this ratio in the same way as the patent, including means for influencing long-chain branching.

VII. The respondent's arguments, where relevant to the present decision, can be summarised as follows.

- (a) Document D10 was filed late, and should not be admitted into the proceedings.
- (b) The subject-matter of the granted claims still involved an inventive step in view of document D1. Example 1 in D1, rather than Example 5, constituted the most promising starting point for assessing inventive step. The difference between the claimed subject-matter and that example resided in an $MFR_{10}/MFR_{2.16}$ ratio of from 8.6 to 50. The data in the patent made it credible that this ratio and the copolymers' $MFR_{2.16}$ as claimed were responsible for the observed effect of improved moulding stability. The *objective technical problem* was to provide ethylene copolymers that gave a foamed product having *improved moulding stability whilst maintaining excellent mechanical properties*. D1 taught that the $MFR_{10}/MFR_{2.16}$ ratio should be below 8.5. Starting from Example 1 of D1, the claimed subject-matter was not obvious to a skilled person. The same applied when starting from Example 5 of

D1, whereas Comparative Example 3 was not a suitable starting point for assessing inventive step.

VIII. Final requests

The appellant requested that the decision under appeal be set aside and that the patent be revoked.

The respondent requested that the appeal be dismissed.

Reasons for the Decision

1. Admittance of document D10

1.1 The respondent requested that document D10 not be admitted into the appeal proceedings.

1.2 The appellant submitted document D10 after filing its statement of grounds of appeal. Consequently, the provisions of Article 13(1) RPBA apply.

1.3 Document D10 deals with the analysis of chain unsaturations in ethene/1-octene copolymers prepared at high temperature. The appellant argued that document D10 had been filed in response to the respondent's reply to the statement of grounds of appeal, referring to the influence of the unsaturated double bonds of the ethylene copolymers on moulding stability.

1.4 However, this issue had already been discussed in the opposition proceedings and addressed in the decision under appeal. The opposition division concluded that

the burden of proof was on the opponent to show that the further differences (other than those related to melt flow properties) between Example 3 and Comparative Example 3 of the patent had a significant impact on the properties measured (see section 3.3.2 of that decision). Consequently, in wishing to challenge that conclusion, the appellant should have adduced pertinent evidence at the latest with its statement of grounds of appeal. Document D10 should thus have been filed earlier.

- 1.5 What is more, it is *common ground* between the parties that the amount of unsaturated bonds of the polyethylene polymer influences its crosslinking properties. In this context, the appellant mentioned that this statement by the respondent was also supported by D10.

Moreover, the mere fact that ethylene copolymers which fall within the scope of the claims as granted can also comprise terminal vinylene groups does not undermine the opposition division's assessment that the cause of the improved moulding stability effect is to be ascribed to the $MFR_{10}/MFR_{2.16}$ ratio stipulated in the granted claims (see for example the fourth paragraph on page 21 of the decision under appeal).

Therefore, D10 was not *prima facie* relevant to the decision to be taken.

- 1.6 Consequently, the board did not admit document D10 into the appeal proceedings (Article 13(1) RPBA).

2. *Inventive step*

2.1 The patent

The patent relates to a method for producing a crosslinked product, a crosslinked product, the use thereof, an ethylene copolymer, and an ethylene copolymer composition (see paragraph [0001] of the patent).

2.2 Closest prior art

2.2.1 In the decision under appeal, it was held that document D1, and in particular Example 1 thereof rather than Example 5 or Comparative Example 3, was the most promising starting point for the assessment of inventive step of the granted claims. The board sees no reason to deviate from this assessment, for the following reasons.

2.2.2 It is uncontested that document D1 is directed towards the same purpose as the patent or a similar one, namely to provide ethylene- α -olefin copolymers that can be crosslinked, crosslinkable compositions comprising them and foamed moulded products obtained therefrom (see paragraph [0015] of D1; paragraphs [0001] and [0006] to [0009] of the patent).

2.2.3 However, it is disputed whether Examples 5/10 or Comparative Examples 3/11 represent promising alternative starting points for the assessment of inventive step.

2.2.4 Examples 5/10 are a less promising starting point than Example 1, because the claimed subject-matter differs from Example 1 only by the $MFR_{10}/MFR_{2.16}$ ratio, whereas

it is further distinguished from Examples 5/10 by the $MFR_{2.16}$ value.

- 2.2.5 At the oral proceedings before the board, the discussion focused on whether Comparative Examples 3/11 could be considered a suitable starting point for the assessment of inventive step.

As regards Comparative Example 3, the board endorses the opposition division's assessment that an embodiment that requires improvement in the light of D1 alone, an example that is labelled as "comparative", would not normally represent a suitable springboard for arriving at the claimed subject-matter. This finding is in line with decision T 2114/16 (Reasons 5.3.4), for example, to which the respondent referred. In addition, Comparative Example 3 has an $MFR_{10}/MFR_{2.16}$ ratio which D1 clearly teaches away from (see paragraph [0046]).

Moreover, keeping the MFR_{10} value in Comparative Examples 3/11 constant and increasing the $MFR_{2.16}$ value to a value of, for example, 2.0 g/10 min to arrive at the subject-matter of claims 1 and 9 of the patent, as proposed by the appellant at the oral proceedings, would mean approximately *doubling* $MFR_{2.16}$ from 1.1 to 2.0 g/10 min. However, this would result in an $MFR_{10}/MFR_{2.16}$ ratio of about 5, falling outside claim 1 and claim 9. Such an increase would thus not have led to the subject-matter of claims 1 and 9 of the patent.

This shortcoming is not overcome by the fact that paragraphs [0100] to [0106] of D1 provide information on means for adjusting the long-chain branching content in the ethylene copolymers and thus the $MFR_{10}/MFR_{2.16}$ ratio. As argued by the respondent, the skilled person - having decided to raise the $MFR_{2.16}$ value to values

falling within claim 1 - would have to change the copolymer used in Comparative Example 11 and adjust (raise) the $MFR_{10}/MFR_{2.16}$ ratio to a value falling within claims 1 and 9 of the patent, which would be against the teaching of D1. Whether the MFRs "disappear" in the final, crosslinked material, as argued by the appellant, has no bearing on this conclusion.

It is for these reasons that Comparative Examples 3/11 of D1 do not represent a suitable and realistic starting point for the assessment of inventive step.

- 2.2.6 In line with the decision under appeal, Example 1 of D1 is considered to be the most promising starting point, for the following reasons.

Having established (i) that the entire document D1 is directed towards the same (or a similar) purpose/use as the patent and (ii) that *none* of the embodiments described in D1 addresses the aspect of the moulding stability/dimensional stability of foamed moulded products, the most promising starting point for the notional skilled person is established from the *structural similarity* between the claimed subject-matter and the specific embodiments of D1. Example 1 is such an embodiment of D1, since the claimed subject-matter differs from the patent only in the $MFR_{10}/MFR_{2.16}$ ratio. A starting point established in such a manner is realistic and would require a minimum of structural and functional modifications to arrive at the claimed invention (see Case Law of the Boards of Appeal, tenth edition, 2022, I.D.3.2, second paragraph; T 606/89, Reasons 2). This finding is also in line with decision T 870/96 (Reasons 4.1, also referring to T 66/97) cited by the appellant, in particular since

the purpose/use addressed by Examples 1 and 5 of D1 is already similar, and the claimed subject-matter differs from Example 5 by an additional feature (see point 2.2.4 above).

In view of these considerations, Example 1 qualifies as the most promising starting point for the assessment of inventive step.

2.3 Distinguishing features

As correctly held in the decision under appeal (see page 14), the ratio of $MFR_{10}/MFR_{2.16}$ in independent claims 1 and 9 represents the only distinguishing feature over Example 1 of D1 (the copolymer of Example 1 is used in Example 7 to prepare a crosslinked foamed product).

2.4 Technical effect and objective technical problem

2.4.1 The appellant argued that no technical effect had been substantiated of which the cause could be ascribed to the distinguishing feature. Consequently, the objective technical problem underlying the granted claims was to provide *alternative* compositions suitable for foam applications.

2.4.2 The board does not agree. There is no information at hand to indicate that the results described in the patent, and in particular in Table 1, could not be generalised. In this context, the appellant failed to present convincing arguments why an indication in the claims of the total content of unsaturated bonds, vinylidene groups and/or terminal vinylene moieties would be required in order to render the distinguishing feature non-arbitrary. The indication in claims 1 and 9

of the concentration of vinyl groups per 1000 carbon atoms ensures good mechanical strength and homogeneous crosslinking of the resulting moulded article (see paragraphs [0025],[0163] and [0165] of the patent). In view of this, whether or not other unsaturated groups would also contribute to mechanical strength and homogeneous crosslinking (to some extent) does not seem relevant. Similarly, the board holds that in view of the explanations provided in paragraph [0163], to which the respondent referred in this context, it is also convincing that the distinguishing feature brings about improved mouldability, in respect of the dimensional stability of moulded articles. The experimental results described in Table 1 of the patent reflect and support these conclusions. The appellant, challenging the corresponding conclusions in the decision under appeal, has not adduced any evidence that would prove the contrary.

- 2.4.3 The mere possibility that a considerable amount of the olefinic double bonds present in the copolymers can be situated at the ends/terminal position of the ethylene copolymers cannot *per se* undermine a link between the effect (dimensional stability of moulded foamed articles) and the distinguishing feature. In the appellant's submission dated 18 January 2023, the graphical representation of a linear regression displayed in point 16 does not indicate any R value (correlation coefficient) or therefore its significance. It does not demonstrate the causal nature of the alleged correlation between (dimensional) moulding stability and total unsaturation either. In this context, the respondent convincingly argued that paragraphs [0083] and [0084] of the patent set out that increasing the polymerisation temperature led to an increased $MFR_{10}/MFR_{2.16}$ ratio and an increased vinyl

group content. The connection between vinyl group content and the distinguishing feature thus seems to be the influence of *temperature* on long-chain branching (associated with said MFR ratio) and vinyl group content/formation of unsaturated bonds. Hence, the technical effect of which the cause is ascribable to the distinguishing feature is indeed an improved moulding/dimensional stability.

- 2.4.4 It is not apparent that this benefit would not be obtainable across the full scope of the granted claims.

In this context, the appellant has not argued credibly that varying, for example, the content of the additional polymer such as ethylene vinyl acetate copolymer, silicone rubber and/or crosslinking agents in foamable compositions could undo the observed effect, even though it could be expected that this effect would be achieved to a lesser extent in compositions comprising smaller amounts of the ethylene copolymers than the examples of the patent.

- 2.4.5 The objective technical problem underlying the subject-matter of claim 9 in view of Examples 1/7 of D1 (the polymer of Example 1 is used in Example 7 of D1) is thus to provide ethylene copolymers that give a (foamed) product having improved moulding stability (dimensional stability).

2.5 Obviousness

- 2.5.1 Confronted with this objective technical problem, the skilled person would not be in a position to arrive at the subject-matter of claim 9 in an obvious way. D1 does not contain any teaching as to the missing link. The appellant's allegations that the skilled person

would have used a higher melt flow rate (MFR_{2.16}), in an obvious way in view of the higher resin fluidity in moulding applications, and that the MFR₁₀/MFR_{2.16} ratio did not constitute a hurdle to arriving at the claimed subject-matter have not been substantiated. They are also irrelevant, considering that obviousness is judged on the basis of the problem to be solved as set out above. Put differently, it is not apparent why the skilled person would have arrived at the claimed subject-matter when trying to solve the problem posed. Consequently, this line of argument does not convince the board.

- 2.5.2 The conclusions arrived at in respect of inventive step would not be different even if Examples 5/10 of D1 were taken as the starting point. The board agrees with the opposition division that a comparison between Example 1 and Comparative Example 4 of the patent is pertinent. This comparison supports the above conclusions regarding the presence of the aforementioned technical effect and the non-obviousness of the solution provided by the subject-matter of claim 9. Whilst the MFR₁₀/MFR_{2.16} ratio, vinyl group content and density values differ slightly between the ethylene copolymers obtained in Example 5 of D1 and Comparative Example 4 of the patent, the results obtained make credible the assertion that the moulding stability of the foamed specimens is markedly improved when moulding crosslinkable compositions comprising polymers as claimed in claim 9. This can be inferred from the doubled standard deviation value for the size of the moulded articles reported for Comparative Example 4, as compared to Example 1 of the patent.

2.5.3 The subject-matter of independent claim 9 is thus not obvious to a skilled person and therefore meets the requirement of Article 56 EPC.

2.5.4 Independent claims 1, 5, 6 and 11 as granted involve the copolymers of independent claim 9 as a technical feature. They too meet the requirement of Article 56 EPC for the aforementioned reasons, applied *mutatis mutandis*.

Consequently, the main request meets the requirement of Article 56 EPC. The corresponding ground for opposition under Article 100(a) EPC, lack of inventive step, does not prejudice the maintenance of the patent.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



K. Götz-Wein

A. Haderlein

Decision electronically authenticated