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**Datasheet for the decision
of 31 January 2025**

Case Number: T 0280/23 - 3.3.03

Application Number: 17890394.4

Publication Number: 3508508

IPC: C08F236/10, C08K3/04, C08K3/36,
C08L47/00

Language of the proceedings: EN

Title of invention:
MODIFIED CONJUGATED DIENE-BASED POLYMER AND RUBBER COMPOSITION
COMPRISING SAME

Patent Proprietor:
LG Chem, Ltd.

Opponent:
Compagnie Générale des Etablissements Michelin

Relevant legal provisions:
EPC Art. 56
RPBA 2020 Art. 12(3), 12(4), 12(5)

Keyword:

Inventive step (no) - obvious alternative (main request and auxiliary requests 1 to 4)

Evidence submitted with the statement of grounds of appeal - admitted (yes)

Unsubstantiated auxiliary requests - admitted (no) (auxiliary requests 5 to 14)



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Case Number: T 0280/23 - 3.3.03

D E C I S I O N
of Technical Board of Appeal 3.3.03
of 31 January 2025

Appellant: Compagnie Générale des Etablissements Michelin
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Decision under appeal: **Interlocutory decision of the Opposition
Division of the European Patent Office posted on
13 December 2022 concerning maintenance of the
European Patent No. 3508508 in amended form.**

Composition of the Board:

Chairman D. Semino
Members: F. Rousseau
W. Ungler

Summary of Facts and Submissions

- I. The appeal lies from the interlocutory decision of the opposition division according to which European patent No. 3 508 508 as amended on the basis of the claims of the main request submitted with letter of 17 September 2021 and an adapted description met the requirements of the EPC.
- II. The decision was taken having regard *inter alia* to the following documentary evidence:
- D3: WO 2016/001372 A1
D5: WO 2015/065884 A1
D9: Declaration of Mr. Vaultier dated 12 April 2021
D13: EP 3 059 257 A1.
- III. According to the reasons for the contested decision which are pertinent for the appeal proceedings, it was found among others that the subject-matter of claim 1 of the main request was inventive over the disclosure of each of D13 and D3 taken as the closest prior art.
- IV. An appeal against that decision was lodged by the opponent (appellant). With the statement setting out the grounds of appeal, the following document was *inter alia* submitted:
- D25: Reply to the Korean Intellectual Property Office concerning examination of application Nr. 10-2017-0097142.

- V. With its reply to the statement of grounds of appeal, the patent proprietor (respondent) submitted 1st to 14th auxiliary requests.
- VI. In preparation of the oral proceedings, a communication pursuant to Article 15(1) RPBA conveying the Board's provisional opinion was issued.
- VII. Oral proceedings before the Board were held on 31 January 2025.
- VIII. The final requests of the parties were as follows:

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

The respondent requested that the appeal be dismissed (main request), or alternatively that the contested decision be set aside and the patent be maintained on the basis of any of the 1st to 14th auxiliary requests, all filed with the reply to the statement of grounds of appeal.

- IX. The claims relevant to the present decision are as follows:

Main request (main request submitted with letter of 17 September 2021)

"1. A modified conjugated diene-based polymer having:

a unimodal shape of gel permeation chromatography (GPC) molecular weight distribution curve,

a molecular weight distribution (PDI ; MWD) of less than 1.7, and

a Si content of 100 ppm or more based on weight,
and
the modified conjugated diene-based polymer
comprising a repeating unit derived from an
aromatic vinyl monomer in an amount of greater than
0 wt% and less than 15 wt%."

1st to 4th auxiliary requests

Claim 1 of each of these auxiliary requests corresponds
to claim 1 of the main request.

5th to 14th auxiliary requests

Claim 1 of these auxiliary requests correspond to
claim 1 of the main request wherein the modified
conjugated diene-based polymer is in addition defined
to comprise a repeating unit derived from a conjugated
diene based monomer and a functional group derived from
a modifier, wherein the modifier is further specified
by various formulae 1 to 7 or a selection thereof. The
definition of these formulae is not relevant to the
present decision.

- X. The parties' submissions, in so far as they are
pertinent to the present decision, may be derived from
the reasons for the decision below. The contentious
point essentially concerned the question whether the
modified conjugated diene-based polymer in accordance
with claim 1 of the main request involved an inventive
step over D3, in particular when starting from the
disclosure of its polymer B.

Reasons for the Decision

Main request

Inventive step (claim 1)

Closest prior art

1. According to paragraph [0008] of the specification, an object of the present invention was to provide a modified conjugated diene-based polymer having excellent processability due to continuous-type polymerisation, good physical properties such as tensile properties, and excellent viscoelasticity. In this respect, it is not disputed that the tensile strength and the viscoelasticity refer to the properties of the rubber composition comprising the modified conjugated diene-based polymer, whereby the viscoelastic behaviour allows for an assessment of the wet skid resistance and of the rolling resistance (see paragraphs [0145] and [0146] of the specification). In other words, the patent in suit aims at providing a modified conjugated diene-based polymer to be used in a rubber composition for the manufacture of tyres, in particular a tyre tread.

Paragraph [0008] of the specification is to be read in the light of paragraph [0007], in which it is stated that the continuous type polymerisation results in excellent productivity and an improvement of processability, but results in a large molecular weight distribution and inferior physical properties. Accordingly, the modified conjugated diene-based polymer sought to be obtained is one resulting from a

continuous type polymerisation, but which does not have a large molecular weight distribution.

In this context, the breadth of the molecular weight distribution is expressed in claim 1 of the patent in suit by the polydispersity index (PDI corresponding to the ratio M_w/M_n measured by GPC), which in view of the upper limit defined in said claim is considered to be satisfactory if it less than 1.7.

Although initially contested in their written submissions, the respondent acknowledged at the oral proceedings before the Board that polymer B described on pages 24 to 26 of D3, is a realistic and therefore appropriate starting point for assessing inventive step of the subject-matter of operative claim 1.

In accordance with the goals set out in the patent in suit, it concerns the preparation in a continuous type polymerisation process of a modified conjugated diene-based polymer having a narrow molecular weight distribution within the meaning of the patent in suit as shown by a polydispersity index (M_w/M_n) of 1.53 (D3, page 25, lines 33-34 and page 17, lines 28-33).

This modified polymer, which is indicated to have improved processability, is used for the manufacture of tyres, in particular a tyre tread having a reduced rolling resistance measured by $\tan \delta_{\max}$ (at 40°C) (page 2, last paragraph; page 17, 3-8; page 22, lines 17-31; page 31, lines 23-29 and page 32, table 2, 14-15).

Distinguishing feature(s)

2. According to the declaration of one of the inventors of D3 on pages 10 and 11 of D9, the properties of polymer B of D3 are as follows:

- a unimodal molecular weight distribution curve
- a polydispersity value of 1.6 (measured using polystyrene standard)
- a number average molecular weight (Mn) of 281 790 g/mol (measured using polystyrene standard)
- a vinyl content of a butadiene unit of 58 mol%
- a Si content of 114 ppm
- a content of a polymer component having a functional group of 70 wt% and
- a content of repeating units derived from an aromatic vinyl monomer (styrene) of 26 wt%.

2.1 In agreement with the reasons for the contested decision (page 13, section 10.2.2, second paragraph), it is undisputed that the modified conjugated diene-based polymer according to operative claim 1 differs from polymer B of D3 by a lower content of repeating units derived from an aromatic vinyl monomer, i.e. an amount of greater than 0 wt% and less than 15 wt% (rejoinder, page 9, second paragraph of the section "Starting from D3").

2.2 At the oral proceedings, the respondent submitted that a second distinguishing feature over the closest prior art should be taken into account, namely the unimodal character of the molecular distribution curve.

The respondent stressed that the GPC technique used to characterise the modified conjugated diene-based polymer reported in D9 (pages 2 and 3, section

"Chromatographie d'exclusion stérique") would not detect the bimodal molecular weight distribution of the polymer of example B of D3, whereas the GPC technique described in paragraph [0137] of the specification would. The bimodal character of polymer B of D3, allegedly observed using this particular GPC technique, would be due to the fact that this polymer consists of a blend of two diene elastomers, resulting from the preparation of a stellar diene elastomer in the third step of the synthesis by the addition of tin tetrachloride.

Although the alleged existence of a second distinguishing feature with respect to polymer B of D3 was a new submission made for the first time at the oral proceeding and therefore at an extremely late stage of the appeal proceedings, it was taken into account, but not considered convincing. Firstly, the respondent did not provide any evidence that the GPC measuring method defined in paragraph [0137] of the specification would indeed result in a bimodal, but not a unimodal molecular weight distribution. Secondly, operative claim 1 is not limited to the particular GPC measuring method defined in said paragraph [0137], but must be read as allowing any GPC method, including any setting, which can be said to be standard in the art concerned; in other words, any ordinary GPC method within the context of the present claim. In this respect, it is undisputed that this is the case for the GPC method used in D9, which is essentially the same as that described in D3.

2.3 Accordingly, the only distinguishing feature over the closest prior art is the content of repeating units derived from an aromatic vinyl monomer which ranges from greater than 0 wt% to less than 15 wt%.

Problem successfully solved

3. The appellant submits that, in the absence of any evidence to the contrary, in particular of appropriate comparative tests, the problem solved over polymer B of D3 can only reside in the provision of a further modified conjugated diene-based polymer.

The respondent disagrees and considers that the problem solved would be the provision of a modified conjugated diene-based polymer having a better compromise between rolling resistance and wet skid resistance. This would be demonstrated by the experimental data contained in the specification and already mentioned in paragraph [0018] thereof, according to which an excellent balance between rolling resistance and wet skid resistance is achieved (rejoinder, page 10, second and third paragraphs). This formulation of the problem was supplemented during the oral proceedings by adding that the compromise obtained vis-à-vis the closest prior art included an improvement of traction properties, while maintaining wear resistance.

The respondent submitted during the oral proceedings that their formulation of the objective problem was supported by the experimental data contained in Tables 4 to 6 of the specification, which in their view, demonstrate that the modified conjugated diene-based polymers of operative claim 1 exhibit a higher $\tan \delta$ (at 60°C), a similar level of $\tan \delta$ (at 0°C) values and improved tensile properties in terms of tensile strength and 300% modulus values.

- 3.1 As pointed out by the appellant and acknowledged by the respondent at the oral proceedings, all the examples

and comparative examples of the patent in suit, i.e. the only experimental evidence referred to by the respondent, concern modified conjugated diene-based polymers with the same content of 10 wt.% of repeating units derived from an aromatic vinyl monomer (styrene) (pages 18 and 19, Tables 1 and 2, the styrene content being given as a SM value, as indicated in paragraph [0135]).

On that basis, the tests relied upon by the respondent are not suitable to demonstrate that the distinguishing feature identified above is causative for a technical effect over the closest prior art.

- 3.2 Both parties also agreed during the oral proceedings that it is common general knowledge that a reduction of the styrene content in styrene-butadiene copolymers not only result in a lower Tg value, as indicated for example in paragraph [0031] of D5, but also affects wet skid resistance, traction, wear and hysteresis loss, i.e. also rolling resistance.

The appellant's argument, first made in the statement of grounds of appeal (page 13, second full paragraph) and reiterated at the oral proceedings, that it is common general knowledge that a variation of the styrene content in styrene-butadiene copolymers, i.e. of the Tg of the copolymers, results in a different compromise between traction, wear resistance and rolling resistance, was not disputed by the respondent.

- 3.3 While it is credible, on the basis of the above-mentioned common general knowledge, that the variation of the SBR composition undertaken results in a different compromise compared to the closest prior art, it has not been shown that this compromise is

excellent, as the respondent asserts. This is not only because no experimental evidence has been submitted in this respect, as already indicated in point 3.1. above, but also because the nature of compromise in question, e.g. the weighting between these different, in part conflicting, requirements to be taken into account has not been defined by the respondent.

In the absence of any definition of the weighting of the above properties on the basis of which this compromise is to be assessed qualitatively and quantitatively, the Board is not in a position to conclude objectively that an excellent or even better compromise has been achieved by the subject-matter of claim 1 with respect to the closest prior art.

- 3.4 In view of the foregoing, the objective technical problem solved over the closest prior art is to be formulated along the line proposed by the appellant, as the mere provision of a modified conjugated diene-based polymer having a different compromise of rolling resistance, wet skid resistance, traction and wear resistance.

Obviousness of the solution

4. It remains to be decided whether the skilled person desiring to solve the problem defined in section 3.4, would, in view of the disclosure of D3, possibly in combination with other prior art documents or with common general knowledge, have modified polymer B of D3 in such a way as to arrive at the modified conjugated diene-based polymer of operative claim 1. In this respect, the appellant referred to D3 and D5 as relevant prior art.

4.1 The overall teaching of D3, whose polymer B is constitutive of the starting point for assessing inventive step, is not essentially focused on the particular modified diene elastomer used in this embodiment of D3. On the contrary, as the appellant correctly points out, D3 (page 5, lines 13 to 15) teaches that the modified diene elastomer can comprise from 20 wt% to 99 wt% of diene units and from 1 to 80 wt% of vinyl aromatic units.

In addition, the appellant referred to paragraph [0029] of D5, which also concerns SBR-based tread compositions (claims 1 and 2). According to said mentioned paragraph of D5, the microstructure of SBR suitable for use in tyres is typically described in terms of the amount of bound styrene and the form of the butadiene portion of the polymer. While a typical SBR that is often suitable for use in tyres is described in D5 as having about 25 wt% of bound styrene, other amounts described in terms of ranges, for example between 3 wt% and 15 wt% or between 5 wt% and 15 wt%, are also taught (paragraph [0029]).

4.2 It follows from the analysis given in points 3.1 to 3.3 above that the selection of an amount of repeating units derived from an aromatic vinyl monomer, for example of styrene, in particular in the range of greater than 0 wt% and less than 15 wt% (as defined in operative claim 1) from the amounts taught in D3 or D5 is an arbitrary and therefore obvious measure for the skilled person faced with the problem defined in point 3.4 above, in the sense that any variation in the amount of styrene is expected by the skilled person to be suitable for providing a different, but non-specific compromise between rolling resistance, wet skid resistance, traction and wear resistance.

- 4.3 From this the Board deduces that a person skilled in the art, faced with the problem defined in point 3.4 above would find it obvious to repeat the synthesis of polymer B of D3, using a styrene content of greater than 0 wt% and less than 15 wt%, arriving thereby in an obvious manner at a modified conjugated diene-based polymer falling within the ambit of operative claim 1.
- 4.4 At the oral proceedings, the respondent put forward two arguments against the obviousness of the claimed solution in order to merely achieve a different non-specific compromise of rolling resistance, wet skid resistance, traction and wear resistance.
- 4.4.1 With the first argument the respondent contended that the Si content of 114 ppm in polymer B of D3 was fortuitous. For this reason, there would be no reason for the skilled person undertaking a modification of the styrene content of polymer B of D3 to arrive at a polymer with a Si content of at least 100 ppm.

This is not convincing.

As pointed out by the appellant, the purpose of functionalising a conjugated diene-based polymer such as polymer B with silanol groups is to achieve a good interaction between the conjugated diene-based polymer and reinforcing inorganic fillers, such as silica, in order to obtain a decrease of the hysteresis loss (D3; page 1, last paragraph; page 2, first paragraph), meaning for the skilled person a decrease of the rolling resistance, i.e. one of the properties forming part of the compromise sought to be achieved.

Given that the polymer B is also used in D3 for the preparation of a rubber composition comprising a silica reinforcing filler (D3, pages 29 and 30, Table 1), the skilled person aiming at reproducing the teaching of polymer B while reducing the content of repeating units derived from styrene would have a clear incentive to keep at least the same level of functionalising silanol based groups in the diene polymers. By doing so, the skilled person would prepare a modified conjugated diene-based polymer having a lower content of repeating units derived from styrene and a Si content which is still within the range defined in operative claim 1.

- 4.4.2 The respondent also alleged as a second argument that reducing the content of styrene while repeating the synthesis of polymer B of D3 would not result in a unimodal, but in a bimodal molecular weight distribution curve, i.e. the modification operated would not lead to a modified conjugated diene-based polymer in accordance with operative claim 1.

Not only was this argument submitted at a very late stage of the appeal proceedings, i.e. during the oral proceedings, without any evidence to support it, but the respondent did not provide even the slightest technical explanation as to why a reduction in the content of repeating units derived from styrene from 26 wt% for polymer B of D3 to, for example, 15 wt%, corresponding to the upper limit defined in operative claim 1, would be expected by the skilled person to result in a sudden change in the mode of the molecular weight distribution curve. This is not apparent to the Board.

This is also not apparent from the teaching of the patent in suit. Nowhere is the unimodal character of

the molecular weight distribution curve made dependent on the proportion of aromatic vinyl monomer. The sole synthesis described in the patent in suit to lead to a bimodal molecular weight distribution is one which is specified to be by batch (Comparative Example 5, paragraph [0131], Table 2 and paragraph [0141]), contrary to all other synthesis described in the specification, including all inventive examples, which are carried out continuously (paragraphs [0103] to [0130], [0132], [0133] and [0141]; Tables 1 and 2).

This is also confirmed by D25 which was taken into account in order to give the appellant a fair opportunity to answer this second new argument. The respondent did not object to the appellant relying upon D25 as a response thereto. D25 is a reply from the respondent to the Korean Intellectual Property Office regarding examination of application Nr. 10-2017-0097142, which corresponds to the second priority document of the present patent. Claim 1 of this application under examination is indicated on the fifth page of this document. It is substantially the same as claim 1 of the present main request. D25 describes technical reasons provided by the respondent why the modified conjugated diene-based polymer of present claim 1 has a unimodal and not a bimodal molecular weight distribution. It makes it clear that the cause of the bimodal character of the molecular weight distribution curve is to be found in the use of a batch process for the preparation of the modified conjugated diene-based polymer, whereas a continuous process must lead to a unimodal distribution (D25, ninth page, lines 2-12; twelfth page, lines 20-23; thirteenth page, last full paragraph and fourteenth page, first full paragraph). The technical explanations provided in this respect, starting with the last

paragraph of the twelfth page and ending with the first paragraph of the fifteenth page, are credible and have not been put into question by the respondent.

The respondent's argument that a reduction of the proportion of styrene while repeating the synthesis of polymer B of D3 would not result in a unimodal molecular weight distribution curve is therefore not found to be convincing.

- 4.4.3 In view of the foregoing, the Board concludes, contrary to the view taken by the respondent, that a person skilled in the art, putting into practice the obvious modification of polymer B of D3 which consists in the mere reduction of the amount of units derived from styrene to a level of greater than 0 wt% and less than 15 wt%, would arrive at a modified conjugated diene-based polymer falling within the ambit of operative claim 1.

Conclusion

5. Accordingly, the subject-matter of present claim 1 which encompasses obvious embodiments does not meet the requirements of Article 56 EPC, prejudicing maintenance of the patent in the form defined in the present main request.

1st to 4th Auxiliary requests

6. It is undisputed that the 1st to 4th auxiliary requests comprise claim 1 of the main request. On that basis, these auxiliary requests are not allowable for the same reasons as given for the main request.

5th to 14th Auxiliary requests

7. Pursuant to Article 12(3) RPBA, the statement of grounds of appeal and the reply shall contain a party's complete appeal case. Accordingly, they shall set out clearly and concisely the reasons why it is requested that the decision under appeal be reversed, amended or upheld, and should specify expressly all the requests, facts, objections, arguments and evidence relied on.
- 7.1 The 5th auxiliary request corresponds to the main request in which claims 1 and 7 have been amended by restricting the definition of the modifier to those selected from formulae 1 to 7. There is no indication in the reply of the respondent to the statement of grounds as to how that modification is meant to address the issue of inventive step or any other objection raised by the appellant against the main request (rejoinder, pages 19 and 20). Concerning inventive step in particular it is simply referred to the reasons given for requests of higher ranking which do not comprise those limitations.
- 7.2 The same applies to the 6th auxiliary request for which the modifier is now defined to be selected from formulae 1 to 3 and 5 to 7 without any indication as to how this modification would overcome the objections raised against the main request (rejoinder, pages 20 and 21).
- 7.3 The 7th and 8th auxiliary requests correspond to the 5th and 6th auxiliary requests, respectively, in which the independent claim based on claim 7 as granted has been deleted. The lack of substantiation concerning claims 1 of the 5th and 6th auxiliary request equally applies to

claims 1 of the 7th and 8th auxiliary requests (rejoinder, pages 21 to 23).

- 7.4 The 9th auxiliary request corresponds to the 8th auxiliary request in which the dependent claim based on claim 6 as granted has been deleted. The lack of substantiation concerning claim 1 of the 8th request equally applies to claim 1 of the 9th auxiliary request (rejoinder, pages 23 and 24).
- 7.5 The 10th auxiliary request corresponds to the main request in which claims 1 and 7 have been amended by restricting the definition of the modifier to those selected from formulae 2 to 7. Again, there is no indication in the reply of the respondent to the statement of grounds of appeal as to how that modification is meant to address the issue of inventive step or any other objection raised by the appellant against the main request (rejoinder, pages 24 and 25).
- 7.6 The 11th auxiliary request corresponds to the main request in which claims 1 and 7 have been amended by restricting the definition of the modifier to those selected from formulae 2, 3 and 5 to 7. Again, there is no indication as to how that modification is meant to address the issue of inventive step or any other objection raised by the appellant against the main request (rejoinder, pages 25 to 27).
- 7.7 The 12th and 13th auxiliary requests correspond to the 10th and 11th auxiliary requests, respectively, in which the dependent claim based on claim 7 as granted has been deleted. The lack of substantiation concerning claims 1 of the 10th and 11th auxiliary requests equally applies to claims 1 of the 12th and 13th auxiliary request (rejoinder, pages 27-29).

7.8 The 14th auxiliary request corresponds to the 13th auxiliary request in which the dependent claim based on claim 6 as granted has been deleted. The lack of substantiation concerning claim 1 of the 13th request equally applies to claim 1 of the 14th auxiliary request (rejoinder, pages 29 and 30).

7.9 In view of the above, the respondent's submissions concerning the 5th to 14th auxiliary requests do not meet the requirements of Article 12(3) RPBA. This was already communicated with the Board's communication pursuant to Article 15(1) RPBA (see points 19.2 and 19.3). The respondent did not wish to comment at the oral proceedings on the issue of admittance of these auxiliary requests into the proceedings (see minutes, page 2, last paragraph).

On that basis the Board exercised its discretion under Article 12(5) RPBA by not admitting the 5th to 14th auxiliary requests.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The patent is revoked.

The Registrar:

The Chairman:



D. Hampe

D. Semino

Decision electronically authenticated