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**Datasheet for the decision of 20 July 2022**

**Case Number:** T 2120/19 - 3.3.10

**Application Number:** 10722509.6

**Publication Number:** 2438033

**IPC:** C07C17/25, C07C21/18

**Language of the proceedings:** EN

**Title of invention:**
PROCESS TO MANUFACTURE 2,3,3,3-TETRAFLUOROPROPENE

**Patent Proprietor:**
The Chemours Company FC, LLC

**Opponent:**
ARKEMA France

**Headword:**

**Relevant legal provisions:**
EPC Art. 54, 56, 83, 123(2)

**Keyword:**
Novelty - (yes)
Inventive step - (yes)
Sufficiency of disclosure - (yes)
Amendments - allowable (yes)

**Decisions cited:**

**Catchword:**

Europäisches Patentamt
European Patent Office
Office européen des brevets

**Beschwerdekammern**

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**Case Number: T 2120/19 - 3.3.10**

# D E C I S I O N
# of Technical Board of Appeal 3.3.10
# of 20 July 2022

| | |
|---|---|
| **Appellant:** (Opponent) | ARKEMA France<br>420 Rue d'Estienne d'Orves<br>92700 Colombes (FR) |
| **Representative:** | Arkema Patent<br>Arkema France<br>DRD-DPI<br>420, rue d'Estienne d'Orves<br>92705 Colombes Cedex (FR) |
| **Respondent:** (Patent Proprietor) | The Chemours Company FC, LLC<br>1007 Market Street<br>Wilmington DE 19801 (US) |
| **Representative:** | Morf, Jan Stefan<br>Abitz & Partner<br>Patentanwälte mbB<br>Postfach 86 01 09<br>81628 München (DE) |
| **Decision under appeal:** | **Decision of the Opposition Division of the European Patent Office posted on 22 May 2019 rejecting the opposition filed against European patent No. 2438033 pursuant to Article 101(2) EPC.** |

**Composition of the Board:**

| | |
|---|---|
| **Chairman** | P. Gryczka |
| **Members:** | A. Zellner |
| | T. Bokor |

## Summary of Facts and Submissions

I. The opponent's appeal lies from the decision of the opposition division to reject the opposition against the European patent No. 2 438 033 under Article 101(2) EPC.

II. The patent has been attacked under Articles 100(a) EPC for lack of novelty (Article 54 EPC) and lack of inventive step (Article 56 EPC), as well as under Articles 100(b) and (c) EPC.

III. During the opposition proceedings the following documents have been cited, which are also relevant for the present decision:

A2: EP 1 110 936 A1
A3: WO 2009/137656 A1
A4: WO 96/41679
A5: WO 2008/008350
A6: US 5,036,036

IV. In the contested decision, the opposition division came to the conclusion that the patent as granted fulfilled the requirements of Articles 123(2) and 83 EPC, that the claimed subject-matter was novel over the disclosure of document A2 (Article 54 EPC), and involved an inventive step starting from document A3 as closest state of the art (Article 56 EPC). The opposition was thus rejected.

V. This decision was appealed by the opponent (appellant). In its opinion, the contested decision was erroneous, because the application documents as originally filed did not support amended claim 12 and the contested

patent did therefore not meet the requirements of Article 123(2) EPC. Furthermore, according to the appellant the claimed subject-matter was not sufficiently disclosed to be carried out by the skilled person, was not novel in view of the disclosure of document A2 and not based on an inventive step when considering document A3 as closest state of the art, so that the patent did not meet the requirements of any of Articles 123(2), 83, 54 and 56 EPC.

VI. In reply to the appellant's statement setting out the grounds of appeal, the respondent (patentee) submitted auxiliary requests 1 to 17 and arguments to support their allowability.

VII. The board issued a communication under Article 15(1) RPBA. In that communication, the parties were informed that aspects concerning the ground of opposition under Article 100(c) EPC would be discussed during the oral proceedings. The board further informed the parties about its preliminary opinion that the main request of the respondent (patent as granted) appeared to fulfil the requirements of Article 83 EPC as well as 54 and 56 EPC.

VIII. In reply to the board's communication, the respondent filed further submissions, including auxiliary requests 18 and 19 and further arguments concerning the appellant's objections.

IX. On 20 July 2022 oral proceedings were held in the form of a videoconference.

X. The main request (patent as granted) contains two independent claims, which read as follows:

*"1. A process for the manufacture of 2,3,3,3-tetrafluoropropene comprising: (a) dehydrofluorinating 1,1,1,2,3-pentafluoropropane in the presence of a dehydrofluorination catalyst comprised of chromium (Ill) oxide, and an alkali metal in an amount effective to produce a product mixture comprising 2,3,3,3-tetrafluoropropene and less than 20 parts per hundred an a molar basis of 1,1,1,2,2-pentafluoropropane; and (b) recovering said 2,3,3,3-tetrafluoropropene from the product mixture produced in (a)."*

*"12. Use of a catalyst comprising chromium (Ill) oxide and an alkali metal to dehydrofluorinate CF3CHFCH2F (HFC-245eb) to produce 2,3,3,3-tetrafluoropropene (HFC-1234yf)."*

XI. The appellant's arguments can be summarised as follows:

Claim 12 of the contested patent does not find a basis in the application as filed (Article 123(2) EPC). Neither the process according to claim 1, nor the use according to claim 12 were disclosed in the contested patent in a way sufficiently clear and complete for it to be carried out by the skilled person (Artikel 83 EPC). Furthermore, the claimed subject-matter was not novel in view of the A2 (Article 54 EPC) and not based on an inventive step considering the technical teaching of A3 as closest prior art (Article 56 EPC).

XII. The respondent's arguments can be summarised as follows:

Claim 12 finds a basis in claim 1 as well as the description of the application as filed. The skilled person was in a position to perform the claimed process as well as the claimed use, in particular in view of

the information provided in the description of the contested patent. Novelty was given since the use of a catalyst as referred to in the independent claims was not known before filing the application, and was in particular not disclosed in A2. With respect to inventive step, the respondent argues that the differing feature with respect to the disclosure of A3, i.e. the nature of the catalyst, would lead to a particular technical effect, i.e. a higher selectivity in the product mixture obtained, which can be deducted from the examples provided in the description of the contested patent. Due to this technical effect, the objective technical problem should be seen in the provision of an improved process and use, and the solution provided by claims 1 and 12 was to be considered to be based on ann inventive step in view of the cited prior art.

XIII. The appellant (opponent) requests that the decision be set aside, and that the European patent No. 2 438 033 be revoked.

XIV. The respondent (patent proprietor) requests that the appeal be dismissed, i.e. that the opposition be rejected (main request) or alternatively that the decision under appeal be set aside and the patent be maintained in an amended form on the basis of one of the auxiliary requests 1 to 19.

## Reasons for the Decision

*Main request*

1. Amendments (Article 100(c) EPC)

1.1 According to the decision of the opposition division, claim 12 of the granted patent (main request) finds a basis in the application as filed, in particular in claim 1 and page 2, lines 9 to 15 and 21 to 29 of the description.

1.2 The appellant contested this finding and argued that the application as filed did not provide a basis for claim 12, because:

- no support could be found for a process to dehydrofluorinate HFC-245eb to produce HFC-1234yl, wherein since the amount of alkali metal was unlimited, whereas according to claim 1 and several parts of the original description (page 2, line 29 to page 3, line 12, and page 4, line 25 to page 5, line 3), the amount of the alkali metal had to be sufficient to limit the amount of the by-product 245cb to less than 20 pph

- the only passages cited by the opposition division wherein the amount of an alkali metal was not limited (page 2, lines 12 and 24) did not relate to a catalyst according to claim 12, i.e. a catalyst **comprising** chromium (III) oxide and an alkali metal (thus allowing for further components being present), but to a catalyst **comprised of** (meaning **consisting of**) chromium(III) oxide and an alkali metal (thus not allowing for further components being present)

- the passages on page 2 referred to by the opposition division did not relate to a **catalyst containing an alkali metal**, as required by claim 12, since the use of a comma separating the term *"chromium (III) oxide"* from the term *"alkali metal"*

in the cited passages (page 2, lines 9 to 15 and 21 to 29) indicated that although an alkali metal is present as a component during the dehydrofluorination reaction, it does not form part of the catalyst used therein

Since, however, claim 12 related to the use of a catalyst in a reaction wherein the amount of an alkali metal was not limited, wherein the catalyst could comprise further components, and wherein an alkali metal was part of the catalyst, the claim was not supported by the disclosure of the original application and therefore violated the requirements of Article 123(2) EPC.

1.3 The respondent submitted that the application generally disclosed that the formation of less than 20 pph of the by-product HFC-245cb was the technical effect caused by the use of a catalyst comprising a chromium (III) oxide and an alkali metal. No specific amount of the alkali metal thus had to be mentioned in claim 12. Furthermore, the catalyst as defined in the originally filed application could contain additional components. This was not excluded by the use of the wording *"comprised of"* as evidenced by the examples. The respondent also submitted that the catalyst according to the invention did comprise an alkali metal, because the use of the serial comma separating the terms *"chromium (III) oxide"* and *"an alkali metal"* was writing style and purely optional.

1.4 It was not disputed that the application as filed does not provide a literal basis for the wording of claim 12. The board does, however, consider the description of the application as filed to provide a basis. The

reasons are the following:

1.4.1 Page 4, lines 25 to 27, of the description as filed reads as follows:

*"It is possible to dehydrofluorinate $CF_3CHFCH_2F$ (HFC-245eb) to HFC-1234yf with high selectivity and very little formation of HFC-245cb using a catalyst comprising chromium (III) oxide, and alkali metal."*

The passage discloses the use of a catalyst comprising comprising chromium (III) oxide, and alkali metal to dehydrofluorinate HFC-245eb to produce HFC-1234yf.

1.4.2 The cited passage also includes the wording *"with high selectivity and very little formation of HFC-245cb"*. The board does not consider it necessary that this part of the description be included in claim 12 of the main request. Although the wording refers to an effect which is obtained by the claimed use, it does not relate to features for the definition of the claimed use as such.

1.4.3 The parties argued about the use of the comma, which is present in page 4, line 27, but not in claim 12. The parties disagreed in particular, whether the use of a comma, or not, leads to a different interpretation by the skilled person with respect to the composition of the catalyst.

The board comes to the conclusion that this is not the case.

The description provides a clear basis for catalysts comprising chromium (III) oxide and at least a certain amount of alkali metal (page 5, lines 4 to 18). The description furthermore in detail refers to the

preparation of such catalysts (page 5, line 20 to page 6, line 5 as well as the examples). On the other hand, the application as filed does not provide any indication that the catalyst used according to the invention is only comprised of chromium (III) oxide without the presence of an alkali metal, or that an alkali metal not being part of the catalyst is used in the process.

Therefore, although claim 12 does not contain the comma as disclosed on page 4, line 27 of the description as filed, the board concludes that the skilled person understands both the wording of claim 12 and the wording on page 4 of the description to refer to a catalyst which comprises a chromium (III) oxide as well as an alkali metal in one entity. The absence of a comma in claim 12 compared to page 4, lines 25 to 27 does therefore also not provide the skilled person with new information.

1.5 Since claim 12 of the main request of the respondent does not present skilled person with new technical information which could not have been directly and unambiguously derived from the application as filed, the request complies with Article 123(2) EPC.

2. Sufficiency of disclosure (Article 100(b) EPC)

2.1 The appellant objected to the opposition division's conclusion that the claimed subject-matter was sufficiently disclosed. In support of this objection, the appellant argued that the contested patent did not provide an example showing that a dehydrofluorination reaction was performed in the presence of a chromium (III) oxide catalyst, but rather chromium oxyfluoride, which had been obtained after treatment of chromium

(III) oxide with HF. The skilled person was therefore not in a position to perform the process according to claim 1, in particular not in view of obtaining a product comprising less than 20 pph of HFC-245cb.

2.2 The board is not convinced by the appellant's argumentation. The reasons are as follows:

2.2.1 Claim 1 is directed to a process for the manufacture of 2,3,3,3-tetrafluoropropene (HFC-1234yf) and a maximum amount of 20 pph on a molar basis of 1,1,1,2,2-pentafluoropropane (HFC-245cb) by dehydrofluorination of HFC-245eb. The process is performed in the presence of a dehydrofluorination catalyst comprised of chromium (III) oxide, and an alkali metal.

In order to perform the claimed reaction, the skilled person has to be able to provide a catalyst comprising chromium (III) oxide, and an alkali metal, and to use this catalyst in the dehydrofluorination reaction according to the claim. The dehydrofluorination reaction in the presence of the catalyst has to lead to a product composition wherein the amount of HFC-245cb formed is at most 20 pph.

Although the claim does not require any activation of a catalyst comprising chromium (III) oxide, such a step is not excluded. The claim does also not exclude that the catalyst comprises further components.

In order to be able to perform the claimed process, the skilled person may use all of the information given in the patent itself, and also make use of additional general technical knowledge.

The description of the contested patent describes in

paragraphs [0034], [0037] and [0040] how the catalyst used in the dehydrofluorination process according to the examples is activated, i.e. by HF-activation. The use of an accordingly activated catalyst leads to a product composition wherein the amount of HFC-245cb lies below the threshold of 20 pph (see tables 1, 2 and 3 on pages 5 and 6 of the description). The skilled person also learns from these examples that a certain amount of an alkali metal needs to be used in order to obtain the desired result.

The patent itself therefore already provides sufficient information to perform the claimed process.

2.2.2 The appellant argued that the catalyst actually present during the dehydrofluorination reaction was not comprised of chromium (III) oxide, but of chromium oxyfluoride.

The board is not convinced by this argument.

Although A1 discloses that the activation of chromium (III) oxide with HF leads to a chromium oxyflouride (paragraphs [0021] and [0034]), it has not been shown by way of experimental data or demonstrated in any other convincing manner, that the experiments disclosed in the patent were not performed in the presence of chromium (III) oxide. Even if some of the chromium (III) oxide may be transformed to chromium oxyfluoride during the activation, this may not necessarily lead to a complete transformation. As the respondent pointed out, the activation process according to A1 (paragraphs [0021] and [0034]) appears to be different from the activation according to the examples of the patent (e.g. paragraph [0034]), and may thus lead to different catalysts. This view is also supported by the

disclosure of A2 (page 9, lines 6 to 8) and A4 (page 4, lines 22 to 24), stating that only some or minor amounts of the surface oxides are or may be converted to oxyfluorides.

2.3 The requirements of Article 83 EPC are thus fulfilled.

3. Novelty (Articles 100(a) and 54 EPC)

3.1 The appellant argued that the use according to claim 12 was not novel in view of the disclosure of A2, in particular in view of Fig. 1 and page 7, lines 3 to 4, in combination with the dehydrofluorination catalysts disclosed on page 7, lines 6 to 20 of the document.

3.2 The board is not convinced by the appellant's argument.

A2 discloses the dehyfrofluorination of *"HFC-245eb"* to produce *"HFC-1234yf"* (Fig. 1 and page 7, lines 3 to 4), which is the same reaction as the reaction referred to in claim 12 of the contested patent. Although A2 also discloses that the dehydrofluorination is carried out in the presence of a dehydrofluorination catalyst (page 7, lines 6 to 7), this disclosure refers to *"one embodiment"*. A2 does not disclose the use of a specific catalyst. In the context of a dehydrofluorination catalyst, the document refers to several types of metal compounds, and several types of metals (page 7, lines 7 to 20). The specific combination of *"oxide"* and *"chromium"* is, however, not disclosed since both options have to be selected from a list of a certain length, and combined to form a single specific catalyst. Furthermore, the document does not refer to any chromium**(III)** compound.

3.3 Already for that reason, A2 does not disclose directly and unambiguously a dehydrofluorination reaction in the presence of a catalyst comprising a chromium (III) oxide. The subject-matter of claim 12 of the main request is therefore novel over A2 (Article 54 EPC).

4. Inventive step (Articles 100(a) and 56 EPC)

4.1 Both parties argued inventive step starting from A3 as closest prior art for the subject-matter of claims 1 and 12. They referred in particular to example 1 and Table 1 of A3. The parties also agreed that the differing feature between the process or use claimed in the contested patent and the disclosure of A3 is the nature of the catalyst. The argumentation for claims 1 and 12 were essentially the same.

4.2 The parties disagreed as to the technical effect caused by the different catalyst.

4.2.1 According to the appellant, the patent did not provide evidence for an improvement caused by the use of a different catalyst, since it did not provide an example which showed that a chromium (III) containing catalyst was used. The appellant further argued that there was also no evidence showing that an improvement in terms of the amount of by-product HFC-245cb had been achieved, since A3 did not disclose that any HFC-245cb had formed at all, and that the effect of obtaining less than 20 parts per hundred of that compound had therefore already been achieved by applying the process disclosed in example 1 of A3. As a consequence, the objective technical problem which had effectively been solved could only be seen in the provision of an alternative process or use, respectively. The solution proposed was obvious in the light of A4, which

disclosed the catalyst used according to the patent, and its use in a dehydrofluorination reaction.

4.2.2 The respondent argued that the examples provided in the patent provided evidence that the differing feature, i.e. the different catalyst, did lead to a particular technical effect. According to the respondent, these examples showed that the use of chromium (III) oxide and a certain amount of an alkali metal resulted in reducing the formation of the by-product HFC-245cb thus leading to a higher selectivity of the reaction. The technical problem should thus be seen in the provision of an improved process or use, respectively. Since none of the available documents suggested such a catalyst, in particular not in view of the effects achieved, inventive step had to be acknowledged. Even if the technical problem was only to be seen in the provision of an alternative to the disclosure of A3, inventive step should still be acknowledged, because the skilled person would not apply the catalyst disclosed in A4 for a different reaction. This view was supported by the fact that A4, A5 and A6 even discouraged the skilled person from using an alkali metal in the catalyst used for dehydrofluorinating HFC-245eb.

4.3 The board comes to the following conclusion:

*Closest prior art*

4.3.1 The board agrees with the parties that A3 can be considered to represent the closest prior art for the subject-matter of claims 1 and 12. It relates to a process for the manufacture of 2,3,3,3-tetrafluoropropene (HFC-1234yf) by dehydrofluorination of 1,1,1,2,3-pentafluoropropane (HFC-245eb) in the presence of a dehydrofluorination catalyst (see page 2,

lines 2 to 7), and discloses in example 1 a specific embodiment of that process.

*Differing feature*

4.3.2 The board also agrees with the parties that the process according to claim 1, and the use according to claim 12, of the contested patent differ from example 1 of A3 in the nature of the catalyst used. Claims 1 and 12 require a chromium (III) oxide and an alkali metal, whereas A3 discloses in example 1 a fluorided alumina catalyst (see page 10, line 23).

*Technical problem and its solution*

4.3.3 The board considers the objective technical problem underlying the claimed invention to be at least the provision of an alternative process for the manufacture of 2,3,3,3-tetrafluoropropene by dehydrofluorination of 1,1,1,2,3-pentafluoropropane in the presence of a catalyst (claim 1), and the use of an alternative catalyst (claim 12) for the manufacture of 2,3,3,3-tetrafluoropropene by dehydrofluorination of 1,1,1,2,3-pentafluoropropane. Since the board came to the conclusion that the claimed solution to these problems involves an inventive step, it is not necessary to examine whether a more ambitious technical problem has also been solved.

*Solution to the technical problem*

4.3.4 The board is convinced that the technical problem is solved by the provision of a process according to claim 1, wherein 1,1,1,2,3-pentafluoropropane is process is dehydrofluorinated in the presence of a catalyst comprised of chromium (III) oxide, and an alkali metal

(claim 1), and by the use of the catalyst according to claim 12.

Examples 1 to 3 of the patent show the use of HF-activated chromium (III) oxide and alkali metal in the dehydrofluorination of HFC-245eb to produce HFC-1234yf.

4.3.5 The board does not follow the argument of the appellant that the catalyst used in the claimed process was not comprised of chromium (III) oxide and an alkali metal. Although some of the initially present chromium compound may have been converted to chromium oxifluoride, there is no evidence that the dehydrofluorination reaction is carried out in the absence of any chromium (III) oxide, as suggested by the appellant (see also point 2.2.2 of this decision).

*Inventiveness of the claimed solution*

4.3.6 It remains to be decided whether the proposed solutions to the objective technical problems were obvious to the skilled person in view of the cited prior art.

The appellant referred to A4 and argued that the use of a catalyst according to the claimed process for similar reactions was known, and that the skilled person, who was aware of the teaching of A4 because it related to a similar dehydrofluorination reaction, would have used that catalyst in the process according to the closest prior art, i.e. A3.

4.3.7 The board is not convinced by this argument.

A4 relates to a specific catalytic dehydrofluorination process. In contrast to the contested patent, it concerns the dehydrofluorination of an ethane

derivative (1,1-difluoroethane) to obtain vinyl fluoride, rather than a propane derivative (1,1,1,2,3-pentafluoropropane) to obtain 2,3,3,3-tetrafluoropropene (see page 1, lines 4 to 7 and example 1 of A4). A4 does not refer to other dehydrofluorination processes, in particular not to a process in accordance with the contested patent. In addition, A4 teaches that $Cr_2O_3$ catalysts which may be used for the process may contain alkali metals such as potassium and that the amount of these or other contaminants may preferably be reduced to less than 1000 ppm (page 3, lines 16 to 21; page 2, lines 22 to 30; page 4, lines 31 to 32 and claim 10). The skilled person also learns from A5, which relates to the catalytic production of tetrafluoropropenes, as does the patent, to reduce the amount of alkali metal in the catalyst (page 5, lines 10 to 12 and 21 to 26; example 1: page 9, lines 18 to 19; example 2 (comparative): page 11, lines 22 to 24). A similar teaching is disclosed in A6, which also relates to hydrofluorination reactions and mentions the negative effect of catalysts containing alkali metals as contaminants (column 2, lines 36 to 42; column 1, lines 5 to 8; column 3, lines 52 to 56). In contrast to these disclosures, table 3 of the patent shows a higher yield of 1234yf and a decrease in the amount of the by-product 245cb if the amount of potassium is increased to values of more than 100 ppm, such as 5000 ppm.

A4, in particular in view of the additional information provided in A5 and A6, does therefore not suggest the skilled person to replace the catalyst used in the process of example 1 of A3 with the expectation to obtain a suitable alternative to this process.

4.4 The subject-matter claimed in the patent as granted (main request) therefore meets the requirements of Article 56 EPC.

*Further requests*

5. Since the board decides to allow the main request of the respondent there is no need for a decision on any of the auxiliary requests.

## Order

## For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

C. Rodríguez Rodríguez P. Gryczka

Decision electronically authenticated