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Datasheet for the decision of 10 February 2026

Case Number: T 0517/24 - 3.3.02

Application Number: 05738906.6

Publication Number: 1735400

IPC: C09K5/04, C08J9/00, C09K3/30

Language of the proceedings: EN

Title of invention:
AZEOTROPE-LIKE COMPOSITIONS OF TETRAFLUOROPROPENE AND PENTAFLUOROPROPENE

Patent Proprietor:
Solstice Advanced Materials US, Inc.

Opponent:
ARKEMA France

Relevant legal provisions:
EPC Art. 56

Keyword:
Inventive step - (no)

Decisions cited:
T 0596/21

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Case Number: T 0517/24 - 3.3.02

D E C I S I O N
of Technical Board of Appeal 3.3.02
of 10 February 2026

Appellant: (Opponent)	ARKEMA France 420 Rue d'Estienne d'Orves 92700 Colombes (FR)
Representative:	Bandpay & Greuter 11 rue Christophe Colomb 75008 Paris (FR)
Respondent: (Patent Proprietor)	Solstice Advanced Materials US, Inc. 251 Little Falls Drive Wilmington, DE 19808 (US)
Representative:	Crooks, Elizabeth Caroline Kilburn & Strode LLP Lacon London 84 Theobalds Road London WC1X 8NL (GB)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted/ electronically transmitted on 21 February 2024 concerning maintenance of the European Patent No. 1735400 in amended fo rm.**

Composition of the Board:

Chairman	M. O. Müller
Members:	P. O'Sullivan
	B. Burm-Herregodts

Summary of Facts and Submissions

I. The appeal of the opponent (hereinafter "appellant") lies from the decision of the opposition division, according to which the patent as amended in the form of the main request met the requirements of the EPC.

II. European patent No. 1 735 400 was opposed under Article 100(a) EPC (lack of novelty and inventive step) and Article 100(b) EPC.

III. The following documents were *inter alia* submitted during opposition proceedings:

D1 : JP H4-110388
D1a: English translation of D1
D27: Knunyants *et al.*, Journal of the USSR Academy of Sciences, Chemistry Department, no. 8, p. 1412 to 1418

IV. In a first oral proceedings, which took place on 9 March 2021 (hereinafter: "first oral proceedings"), the opposition division decided that the requirements of Article 83 EPC were not met and revoked the patent.

V. The patent proprietor filed an appeal, which was assigned case number T 596/21. Documents D37 to D40 were filed during those appeal proceedings. The board in that case decided that the set of claims of the main request filed by letter dated 31 October 2022 met the requirements of Article 83 EPC. The decision under appeal was set aside, and the case was remitted to the opposition division for further prosecution.

VI. After remittal and a second oral proceedings, the opposition division decided that the main request, which was identical to the main request underlying the decision in T 596/21, met the requirements of the EPC. In particular, the subject-matter of the claims of the main request was found to be novel and to involve an inventive step.

VII. The present appeal of the opponent (hereinafter "appellant") lies from this decision.

VIII. In a communication pursuant to Article 15(1) RPBA, the board provided its preliminary considerations.

IX. Oral proceedings by videoconference took place as scheduled on 10 February 2026 in the presence of both parties.

X. Requests relevant to the present decision

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

The respondent requested that the appeal be dismissed and that the patent be maintained on the basis of the main request submitted with the letter dated 9 October 2025.

The main request submitted with the letter dated 9 October 2025 is identical to the first auxiliary request submitted with the reply to the appellant's statement of grounds of appeal, and was first filed as third auxiliary request during the first oral proceedings before the opposition division. Claims 1-3 of this request are identical to claims 1 to 3 of the

main request submitted with the respondent's reply to the statement of grounds of appeal.

XI. For the relevant party submissions, reference is made to the reasons for the decision set out below.

Reasons for the Decision

Main request (sole request on appeal) - Inventive step - Article 56 EPC

1. Claim 1 of the main request reads as follows:

"*An azeotrope-like composition which consists essentially of effective amounts of HFO-1234yf and HFO-1225yeZ, wherein the azeotrope-like composition consists essentially of from 93 to less than 100 weight percent HFO-1234yf and from greater than zero to 7 weight percent of HFO-1225yeZ*."

HFO-1234yf denotes 2,3,3,3-tetrafluoropropene, and HFO-1225yeZ denotes the Z-isomer of 1,2,3,3,3-pentafluoropropene.

2. Closest prior art

2.1 The appellant argued that the subject-matter of claim 1 lacked inventive step starting *inter alia* from D1a, an English language translation of Japanese patent document D1.

2.2 It was common ground that example 5 of D1a represented the closest prior art.

3. Distinguishing features

3.1 It is undisputed that example 5 of D1a discloses HFO-1234yf and its use as a heat exchange fluid (D1a: "heat medium"). It was also undisputed that D1a does not explicitly disclose HFO-1225yeZ, either in example 5, or elsewhere.

3.2 The appellant submitted that any method used to prepare HFO-1234yf, including that used to prepare HFO-1234yf disclosed in D1a, would inevitably result in the formation of a host of closely related halogenated secondary products. Among these products, HFO-1225yeZ was inevitably present at least in trace amounts, even after purification. Hence, example 5 implicitly disclosed a composition comprising HFO-1234yf and greater than 0 wt.% HFO-1225yeZ as required by claim 1.

3.3 In the following, to the respondent's advantage, it is assumed that example 5 of D1a does not implicitly disclose HFO-1225yeZ.

3.4 It is also accepted by the board that HFO-1234yf disclosed in example 5 of D1a is not "azeotrope-like" as required by claim 1, since it is a single compound, rather than a composition of two or more components, as required for a mixture to be azeotropic or azeotrope-like (see paragraph [0011] of the patent).

3.5 The distinguishing features of claim 1 over example 5 of D1a are thus:

- the presence of HFO-1225yeZ
- in an amount *of* from greater than zero to 7 weight percent
- that the composition is "azeotrope-like".

4. Objective technical problem

4.1 The respondent formulated the objective technical problem at oral proceeding as the provision of an alternative azeotrope-like composition.

4.2 To assess whether this problem is solved by the claimed subject-matter, the meaning of "azeotrope-like" needs to be determined.

4.3 According to paragraph [0011] of the patent, the term "azeotrope-like" is

"*intended in its broad sense to include both compositions that are strictly azeotropic and compositions that behave like azeotropic mixtures*".

4.4 Referring to the patent, in particular paragraph [0067] and table 1 of example 1, the respondent submitted that "azeotrope-like" defined a mixture:

- whose boiling point is depressed compared to the boiling point of either component of the mixture (hereinafter "first aspect"), and
- whose components are constant-boiling or near-constant boiling (hereinafter "second aspect").

4.5 The board does not accept the first aspect of the respondent's definition, i.e. that "azeotrope-like" necessarily implies boiling point depression. The respondent referred to example 1 and paragraph [0067] of the patent. Example 1 describes testing in an ebulliometer in which HFO-1225yeZ is added, in measured increments, to a charge of HFO-1234yf. The boiling point of the mixture is then determined. It is stated

that "[t]*emperature depression is observed when HFO-1225yeZ is added to HFO-1234yf, indicating a binary minimum boiling azeotrope is formed*".

4.6 The respondent submitted that this temperature depression effect was evident from the results shown in table 1 of example 1. Specifically, compared to 100 wt. % HFO-1234yf (table 1, first entry), the addition of 3.43 wt.% HFO-1225yeZ (table 1, second entry) led to boiling point depression for the mixture (i.e. a lowering of the boiling point from -28.863°C to -29.108°C), despite HFO-1225yeZ having a higher boiling point than HFO-1234yf (ca. -20°C).

4.7 The board does not agree. As noted by the board at oral proceedings, the third entry of table 1 in which 6.42 wt.% of HFO-1225yeZ was employed did not lead to boiling point depression: the boiling point of this mixture is reported as -28.765°C, which is higher than the boiling point of 100 wt.% HFO-1234yf (-28.863°C).

4.8 Furthermore, and more crucially in the view of the board, as noted by the appellant, the first aspect of the respondent's definition is contradicted by claim 7 of the patent, which stipulates that the azeotrope-like composition of claim 1 has a boiling point of from -26°C to -30°C. This range includes boiling points higher than that of pure HFO-1234yf (-28.863°C according to table 1), thereby indicating that "azeotrope-like" compositions according to the patent are not limited to those compositions displaying boiling point depression.

4.9 The board accepts the second aspect of the respondent's definition of "azeotrope-like" as a composition whose components are constant-boiling or near-constant boiling.

4.10 During oral proceedings, the respondent agreed that the property of having a "near-constant boiling point" corresponds to a composition having a low temperature glide, i.e. the mixture will boil over a narrow temperature range. For a true azeotrope, there will be zero temperature glide.

4.11 The board therefore reformulates the respondent's objective technical problem (see point 4.1, above) underlying claim 1 as the provision of an alternative composition with low temperature glide.

4.12 Solely in written proceedings, the respondent submitted that the objective technical problem should be formulated as the provision of an improved composition comprising HFO-1234yf, on the basis that the technical effect of the composition of claim 1 was that it was "azeotrope-like".

4.13 The technical effect of the feature "azeotrope-like" is, however, already reflected in the formulation of the objective technical problem set out above, since the feature "azeotrope-like" is encompassed therein by the reference to a low temperature glide, which, as explained above, defines the term "azeotrope-like".

5. Obviousness

5.1 The appellant submitted that the claimed composition would have been obvious to the skilled person starting from example 5 of D1a in view of the general teaching

of D1a in combination with common general knowledge, as evidenced *inter alia* by D27, which confirmed that HFO-1225ye, including its cis (Z) isomer HFO-1225yeZ, was a known compound available to the skilled person.

5.2 D1a discloses generally heat transfer fluids which comprise an organic compound of molecular formula $C_3H_mF_n$ where m = from 1 to 5, n = from 1 to 5 and m + n = 6 having one double bond in the molecular structure (D1a, page 3, lines 2-6). The use of the term "comprise" indicates that the presence of more than one compound defined by the above formula is not excluded. This is further confirmed later in D1a, which explicitly refers to mixtures comprising "at least" one compound of this formula, i.e. not limited to a single compound of said formula, together with at least one further compound selected from a list (page 6, lines 1 to 6). While HFO-1225yeZ is not explicitly mentioned in D1a, it falls within its general formula $C_3H_mF_n$ addressed above and possesses one double bond, as required by D1a. D1a thus discloses HFO-1234yf, as illustrated in example 5, within a general teaching that encompasses compositions containing further fluorinated compounds, including HFO-1225yeZ.

5.3 Journal article D27 concerns the catalytic hydrogenation of perfluoroolefins, and was relied on by the appellant as evidence that HFO-1225yeZ was known to the skilled person. Although the respondent disputed that D27 discloses the Z isomer of HFO-1225ye, it did not dispute that HFO-1225yeZ was a known compound available to the skilled person at the effective date of the patent. It is therefore not necessary for the board to decide whether D27 explicitly discloses this isomer.

5.4 As stated by the appellant, in order to solve the above-mentioned objective technical problem, the skilled person, starting from compound HFO-1234yf of example 5 of D1a, would have included a second compound falling within the general formula $C_3H_mF_n$ disclosed in D1a, including HFO-1225yeZ, with a view to providing an alternative composition with low temperature glide. More specifically, it would have been obvious to the skilled person that adding from greater than 0 to 7 wt. % of a second compound, i.e. a small amount, would cause only a minimal change in the boiling point of the mixture. At such low concentrations, the thermodynamic behaviour of the mixture is dominated by the major component, so that the vapour–liquid equilibrium, and thus the boiling temperature, remains close to those of 100 wt.% HFO-1234yf. Consequently, upon distillation, only minor differences between the vapour and liquid compositions would arise, resulting at most in a low temperature glide.

5.5 The respondent's reliance on the alleged unpredictability of azeotrope-like behaviour and on the absence of a specific pointer to the claimed composition is likewise unconvincing. The skilled person would have expected that compositions containing more than zero wt.% and less than 7 wt.% HFO-1225yeZ would have a boiling behaviour close to that of HFO-1234yf, i.e. to exhibit at most a low temperature glide.

5.6 The selection of such a compound, and thus also of HFO-1225yeZ, would therefore have constituted an obvious measure for the skilled person seeking to solve the above-mentioned objective technical problem. By way of this selection, the skilled person would have arrived at the subject-matter of claim 1.

5.7 Consequently, the subject-matter of claim 1 lacks inventive step pursuant to Article 56 EPC.

6. The sole main request is therefore not allowable.

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:

U. Bultmann M. O. Müller

Decision electronically authenticated