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**Datasheet for the decision
of 17 May 2018**

Case Number: T 0215/15 - 3.3.10

Application Number: 04817444.5

Publication Number: 1678106

IPC: C07C17/25

Language of the proceedings: EN

Title of invention:
PROCESS FOR PRODUCING FLUOROPROPENES

Patent Proprietor:
Honeywell International Inc.

Opponents:
ARKEMA FRANCE
Mexichem Amanco Holding S.A. de C.V.

Headword:
PROCESS FOR PRODUCING FLUOROPROPENES/Honeywell

Relevant legal provisions:
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Keyword:
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Catchword:



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Case Number: T 0215/15 - 3.3.10

D E C I S I O N
of Technical Board of Appeal 3.3.10
of 17 May 2018

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Decision under appeal: **Decision of the Opposition Division of the
European Patent Office posted on 24 November**

2014 revoking European patent No. 1678106
pursuant to Article 101(3)(b) EPC.

Composition of the Board:

Chairman P. Gryczka
Members: J.-C. Schmid
T. Bokor

Summary of Facts and Submissions

- I. The Appellant (Proprietor of the patent) lodged an appeal against the decision of the Opposition Division revoking European patent No. 1 678 106.
- II. Notice of opposition had been filed by the Respondents (opponents 1 and 2) requesting revocation of the patent-in-suit in its entirety on the grounds of lack of novelty and inventive step (Article 100(a) EPC), insufficient disclosure of the invention (Article 100(b) EPC) and extension of the subject-matter of the patent-in-suit beyond the content of the application as filed (Article 100(c) EPC).

Inter alia, the following documents were cited in the opposition/appeal proceedings.

- (2) US-A-6 548 719,
- (5) US-A-6 023 004,
- (6a) JP-A-11-140002 (English translation),
- (12) US-A-2 725 411 and
- (13) US-A-4 650 914.

According to the Opposition Division, the subject-matter of claim 1 of the then pending main and first auxiliary request did not extend beyond the content of the application as filed (Articles 100(c), 123(2) EPC). The patent-in-suit met the requirement of sufficiency of disclosure, the opponents having not brought any evidence to the contrary. The subject-matter of claim 1 of the then pending main auxiliary request was novel over document (5), since there was no unambiguous disclosure of the production of HFO-1234ze from HCFC-244fa. However the subject-matter of the claims of the then pending main and auxiliary request 1 was

obvious from the combination of document (2) with document (5) regarding alternative 2a of the claimed process relating to the decomposition using a caustic solution and in the light of document (6) regarding alternative 2b of the claimed process relating to the thermal decomposition.

III. During the oral proceedings held on 17 May 2018 before the Board, the Appellant defended the maintenance of the patent-in-suit on the basis of the main request and on the basis of the first to sixth auxiliary requests, all requests having been filed with a letter dated 17 April 2018.

The claims of the main request are identical to the claims of the main request pending before the Opposition Division, claim 1 reading as follows:

"1. A process for the preparation of 1,3,3,3-tetrafluoropropane (HFO-1234ze), comprising:

1) preparing a halopropane reactant which comprises 1-chloro-1,3,3,3-tetrafluoropropane (HCFC-244fa) by reaction of 1,1,1,3,3-pentachloropropane (HCC-240fa) with hydrogen fluoride in the vapour phase or the liquid phase; and

2) either:

a) reacting, without a catalyst, said halopropane reactant with a caustic solution of at least one alkali metal or alkaline earth metal hydroxide in a non-aqueous, non-alcoholic solvent for said alkaline metal or alkaline earth metal hydroxide that is essentially miscible with said halopropane reactant, wherein the reaction is performed within a temperature range at

which dehydrochlorination of HCFC-244fa will occur to form HFO-1234ze; or

b) thermally decomposing said halopropane reactant under conditions sufficient to dehydrochlorinate HCFC-244fa to form HFO-1234ze."

Claim 1 of the first auxiliary request differs from claim 1 of the main request in that the wording "a halopropane reactant which comprises 1-chloro-1,3,3,3-tetrafluoropropane (HCFC-244fa)" is replaced by "1-chloro-1,3,3,3 tetrafluoropropane (HCFC-244fa)" and "said halopropane reactant" is replaced by "said HCFC-244fa".

Claim 1 of the second auxiliary request differs from claim 1 of the main request in that there is a step of separating HCFC-244fa and HFC-245fa from the fluorination reaction product mixture of step 1), the halopropane reactant additionally comprising 1,1,1,3,3-pentafluoropropane (HFC-245fa).

Claim 1 of the third auxiliary request differs from claim 1 of the main request in that alternative a) is deleted, i.e. step 2 is restricted to alternative b) of thermally decomposing said halopropane reactant to form HFO-1234ze.

Claim 1 of the fourth auxiliary request differs from claim 1 of the third auxiliary request in that step 2 of the process is carried out in the presence of a catalyst selected from the group consisting of supported or bulk transition metal oxides and FeCl₃.

Claim 1 of the fifth auxiliary request differs from claim 1 of the third auxiliary request in that step 2

of the process is carried out in the absence of a catalyst.

Claim 1 of the sixth auxiliary request differs from claim 1 of the third auxiliary request in that step 2 of the process is carried out in the presence of FeCl_3 .

IV. According to the Appellant, with respect to alternative 2b) relating to the thermal decomposition of the process of the main and first to sixth auxiliary requests, document (6a) represented the closest prior art. This document disclosed a process of producing HFO-1234ze from HFC-245fa by thermal decomposition and that HFC-245fa, from which 1234ze was derived, could be produced from HCC-240fa. There was however no disclosure that the HFC-245fa used as starting material contained HCFC-244fa. There was no other document disclosing that HFO-1234ze can be obtained by a two-step process from HCC-240fa to HFO-1234ze via the intermediate HCFC-244fa. Document (5) led away from keeping the by-products, such as HCFC-244fa, and rather encouraged to recycle them to the reactor. Claim 1 of the fifth auxiliary request further required that the thermal decomposition be carried out in the absence of a catalyst. In document (6a) a catalyst was compulsory. The process of claim 1 of the sixth auxiliary request further required that the thermal decomposition be carried out in the presence of FeCl_3 . This catalyst was not mentioned as potential catalyst in document (6a). Furthermore, the use of FeCl_3 as catalyst permitted to obtain a selectivity of 98% and a single pass conversion of 95% in the thermal decomposition step. Accordingly, the subject-matter of the main and first to sixth auxiliary requests involved an inventive step.

V. According to the Respondents, with respect to inventive step concerning alternative 2b) of the claimed process, document (6a) represented the closest prior art. It disclosed the preparation of HFO-1234ze by thermal decomposition of HFC-245fa. HFC-245fa could be obtained from the fluorination of HCC-240fa with HF in vapour phase or liquid phase. Example 1 of document (5) taught that HCFC-244fa was obtained as a by-product in the production of HFC-245fa by fluorination of HCC-240fa in the liquid phase. Given the chemical structure of HCFC-244fa, it was obvious that this compound provided HFO-1234ze by thermal decomposition. Accordingly, the skilled person having prepared HFC-245fa from HCC-240fa as an intermediate of synthesis to produce HFO-1234ze as taught in document (6), and knowing from document (5) that HCFC-244fa is produced as a by-product, would have no reason to separate HCFC-244fa from HFC-245fa in order to proceed to the thermal decomposition to produce HFO-1234ze. He thus would have arrived at the claimed subject-matter by mere routine. A catalyst was not required by the thermal decomposition disclosed in document (6a). Furthermore, conventional dehydrohalogenation catalysts included polyvalent metal oxides and metal halide catalyst, such as FeCl_3 . No comparison showing any improvement was provided by the Appellant. Accordingly, the subject-matter of claim 1 of all requests lacked an inventive step.

VI. The Appellant requested that the decision under appeal be set aside and the patent be maintained on the basis of the main request, or subsidiarily, on the basis of the first to sixth auxiliary requests, all requests filed with letter dated 17 April 2018.

The Respondents requested that the appeal be dismissed.

VII. At the end of the oral proceedings the decision of the Board was announced.

Reasons for the Decision

1. The appeal is admissible.

2. *Inventive step*

Main request and first to third auxiliary requests

Claim 1 of the first auxiliary request differs from claim 1 of the main request in that it is explicit that the 1-chloro-1,3,3,3-tetrafluoropropane (HCFC-HCFC-244fa), which is comprised in the halopropane reactant obtained from the first step, is converted into HFO-1234ze. The subject-matter of claim 1 of auxiliary request 1 is thus covered by that of claim 1 of the main request. Thus, if the subject-matter of claim 1 of the first auxiliary request lacked an inventive step, this would also apply to the subject-matter of claim 1 of the main request, which would comprise that obvious embodiment. This finding was not contested by the parties. The process of claim 1 of the second auxiliary request differs from that of claim 1 of the main request in that HFC-245fa and HCFC-244fa obtained from the fluorination reaction product mixture of the first step are subjected together to the thermal decomposition to form HFO-1234ze. Claim 1 of the third auxiliary request is the process of claim 1 of the main request wherein step 2 is limited to the thermal decomposition (alternative b).

2.1 *Closest prior art*

The process of claim 1 of the main and first to third auxiliary requests comprises two steps, namely the preparation of HCFC-244fa (with HFC-245fa), from HCC-240fa and its (their) conversion into the desired HFO-1234ze. The second step is divided into two alternatives, the first one which is designated as alternative a) relates to the conversion using a caustic solution, whereas the second one designated as alternative b) involves a thermal decomposition.

The Board considers, in agreement with the parties that document (6a) represents the closest prior art to the invention for the subject-matter of claim 1 relating to alternative b).

This document discloses the preparation of HFO-1234ze from HFC-245fa by thermal decomposition (see claim 1; examples). HCF-245fa may be obtained by fluorinating HCC-240fa with hydrogen fluoride in the liquid phase in the presence of an antimony catalyst or in the gas phase in the presence of a chromium catalyst (see document 6a, page 3, last full paragraph).

2.2 *Technical problem underlying the invention*

According to the Appellant, the technical problem to be solved was the provision of a process to produce HFO-1234ze while reducing costs and increasing safety.

2.3 *Solution*

The proposed solution is the process of claim 1 which is characterized by the use of HCFC-244fa, possibly in combination with HFC-245fa, as an intermediate of synthesis.

2.4 *Obviousness*

HCFC-244fa is a known compound. It is obtained as a by-product in the manufacture of HFC-245fa from HCC-240fa (document (5), example 1, column 5, line 56; document (2), column 2, lines 20 and 21). Accordingly, the first step of the claimed process is known from the prior art, and consequently makes no contribution to inventive step.

It remains to be determined whether the skilled person would have contemplated HCFC-244fa as a useful intermediate of synthesis to produce HFO-1234ze by thermal dehydrohalogenation.

It is general knowledge in the art that olefins can be produced by dehydrohalogenations of alkylhalides. This is generally accomplished in solution with a base or by pyrolysis (thermal decomposition). It is also common general knowledge that dehydrochlorination occurs with a faster rate than dehydrofluorination, since chloride is a better leaving group than fluoride. Furthermore dehydrochlorination is safer than dehydrofluorination since no hydrogen fluoride is released.

HCFC-244fa is an alkylhalide which differs from HFC-245fa in that it has a chlorine atom in place of a fluorine atom at position 3 of the derivative. Thus, in view of its structure, the skilled person immediately recognises that HCFC-244fa will be converted into HFO-1234ze by thermal decomposition releasing hydrogen chloride. Hence, HCFC-244fa is an obvious alternative to HFC-245fa in the production of HFO-1234ze by thermal decomposition. Furthermore, HCFC-244fa is obtained as a by-product in the manufacture of HFC-245fa. Accordingly, in the interest

of process economy, the skilled person knowing that both compounds yield HFO-1234ze by thermal decomposition would have been led to dehydrohalogenate the mixture comprising HCFC-244fa and HFC-245fa rather than carrying out an extra step to separate these compounds.

Consequently, the Board comes to the conclusion that the skilled person facing the problem of providing an alternative process for preparing HFO-1234ze with increasing safety and reduced costs would have arrived at the subject-matter of claim 1 of the main and first to third auxiliary requests without the exercise of inventive skill.

The Appellant submitted that there was no hint in documents (6a) or (5) to use HCFC-244fa as the starting compound to produce HFO-1234ze.

However, the skilled person does not need an explicit instruction from document (5) or document (6a) to arrive at the claimed process, since he immediately recognises from the structure of HCFC-244fa that this known compound will produce HFO-1234ze by thermal decomposition. Moreover, although document (2) concerns dehydrohalogenation in the presence of alkali hydroxide, it nevertheless teaches that HCFC-244fa is a useful starting material for the production of fluoroolefins (see column 3, lines 15). Thus, the Appellant's argument does not convince the Board.

Hence, the subject-matter of claim 1 of the main and first to third auxiliary requests does not involve an inventive step (Article 56 EPC).

Fourth auxiliary request

3. Compared to the claim 1 of the third auxiliary request, claim 1 of the fourth auxiliary request comprises the additional feature that the thermal decomposition is carried out in the presence of a catalyst being a supported or bulk transition metal oxide or FeCl₃.

Document (6a) discloses that the thermal decomposition of HFC-245fa may be carried in the presence of catalyst supported on activated carbon, the catalyst being an oxide, chloride or fluoride of at least one metal selected from among aluminium, chromium, manganese, nickel, cobalt and titanium (see paragraph [0010] on page 4), such as chromium trioxide.

The Appellant conceded in the oral proceedings that this additional feature thus could not add any inventive ingenuity to the claimed process so that the findings and conclusion reached for the inventive activity of the subject matter of claim 1 of the previous requests apply *mutatis mutandis* to the subject matter of claim 1 of the fourth auxiliary request

Hence, the fourth auxiliary request must also be refused.

Fifth auxiliary request

4. Claim 1 of this request requires that the thermal decomposition is carried out in the absence of a catalyst. However, the presence of a catalyst is not mandatory in the process according to the closest prior art document (6a) (see claim 1), so that the same arguments as above also apply to this request.

Accordingly, the subject-matter of claim 1 of the fifth also does not involve an inventive step.

Sixth auxiliary request

5. Claim 1 of this request requires that the thermal decomposition is carried out in the presence of a catalyst being FeCl₃.

The Appellant referred to reference example 5 of the patent-in-suit, where a selectivity of 98% and a single pass conversion of 95% was achieved by carrying out the thermal decomposition in the presence of FeCl₃ as catalyst.

However, since there is no direct comparison with the thermal decomposition using a chromium catalyst disclosed in the examples of document (6a), the technical problem underlying the patent-in-suit remains the provision of a further process for preparing HFO-1234ze with reduced costs and increased safety.

Although FeCl₃ is not mentioned as a potential catalyst in document (6a), it is nevertheless a conventional catalyst to carry out dehydrohalogenation (see document (12); claim 1, example 2); document (13), abstract). Accordingly, the use of FeCl₃ as a catalyst in the thermal decomposition of HCFC-244fa does not confer inventiveness to the subject-matter of claim 1. Accordingly, the sixth auxiliary request also cannot be allowed.

6. *Other issues*

The Respondents raised several other substantive objections against the Appellant's requests, and also objected to the admission of some of the auxiliary requests into the proceedings.

However, in view of the negative conclusion in respect of inventive step for the subject-matter of all requests as set out above, a decision of the Board on those other substantive issues is not necessary. It is also not necessary set out reasons for the admission of the auxiliary requests.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



B. Atienza Vivancos

P. Gryczka

Decision electronically authenticated