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Bezeichnung der Erfindung:
Title of invention:
Titre de l'invention : Process for producing vinyl acetate, acetic acid and ethanol

Klassifikation / Classification / Classement : C07C 69/15

ENTSCHEIDUNG / DECISION

vom / of / du 2 February 1990

Anmelder / Applicant / Demandeur :

Patentinhaber / Proprietor of the patent / Titulaire du brevet : Mitsubishi Gas Chemical Company Inc.

Einsprechender / Opponent / Opposant : Hoechst Aktiengesellschaft

Stichwort / Headword / Référence :

EPÜ / EPC / CBE Article 56

Schlagwort / Keyword / Mot clé : "Inventive step (yes) - multistep process"

Leitsatz / Headnote / Sommaire

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Case Number : T 253/88 - 3.3.1

D E C I S I O N
of the Technical Board of Appeal 3.3.1
of 2 February 1990

Appellant : (Opponent)
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Representative :

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Decision under appeal :
Decision of the Opposition Division of the European Patent Office dated 11 April 1988 rejecting the opposition filed against European patent No. 0 028 474 pursuant to Article 102(2) EPC.

Composition of the Board :

Chairman : K. Jahn
Members : P. Krasa
W. Moser

Summary of Facts and Submissions

I. The mention of the grant of European patent No. 0 028 474 in respect of patent application No. 80 303 669.8 filed on 17 October 1980 and claiming priority of 18 October 1979 from a prior application filed in Japan, was announced on 5 October 1983 (cf. Bulletin 83/40) on the basis of twelve claims. The only independent Claim reads as follows:

"A process for producing vinyl acetate, acetic acid and ethanol from methanol, carbon monoxide and hydrogen which is characterised by the following five steps:

(a) methanol is hydrocarbonylated in a hydrocarbonylation zone to produce ethanol, acetaldehyde, methyl acetate and dimethylacetal and the products are separated in a separation zone;

(b) methyl acetate is carbonylated in a carbonylation zone to produce acetic anhydride;

(c) the acetaldehyde and dimethylacetal produced in the step (a) and the acetic anhydride produced in the step (b) are converted to ethylidene diacetate and methyl acetate;

(d) the ethylidene diacetate produced in the step (c) is thermally decomposed to vinyl acetate and acetic acid, and the products are separated in a separation zone; and

(e) the methyl acetate produced and separated in the step (a) or (c) is supplied to the carbonylation step (b)."

II. On 21 February 1984 a notice of opposition was filed requesting the revocation of the patent on the ground of lack of inventive step. The opposition was supported by the following documents:

(1) DE-A-2 856 791
(2) US-A-2 727 902

In the course of the Opposition Procedure and of the Appeal Procedure, i.e. after termination of the opposition period, a number of additional documents were cited by the Appellant.

III. By a decision of 11 April 1988 the Opposition Division rejected the opposition. The Opposition Division concluded that the subject-matter of the patent in suit was novel since none of the cited documents disclosed an overall process for the manufacture of vinyl acetate fulfilling all the requirements of Claim 1.

The claimed process was said to be also inventive as it overcame the drawbacks of a process for the manufacture of vinyl acetate disclosed in (1) in which acetaldehyde of high purity had to be used as the starting material. The particular combination of the process steps according to Claim 1 solved the problem how to use acetaldehyde dimethyl acetal (= ADMA) and methyl acetate (= MA) which were undesired by-products of the first reaction step - the hydrocarbonylation of methanol. The integration of this reaction step (a) into a closed compact systematic process for producing vinyl acetate and acetic acid wherein also undesired by-products were transformed into useful products constituted an inventive step.

Such finding of inventive step was supported by the fact that in step (c) of the overall process the ADMA was reacted with acetic anhydride to produce ethylidene diacetate (= EDA) and MA, a reaction not disclosed in the cited references. Thus, the overall process of Claim 1 was not simply resulting from a combination of processes known in the art.

IV. An appeal was lodged against this decision on 9 June 1988 with payment of the prescribed fee. A Statement of Grounds of Appeal was filed on 30 July 1988.

The arguments put forward by the Appellant in his Statement of Appeal and during the oral proceedings held on 2 February 1990 may be summarised as follows:

According to the opposed patent, only known processes were assembled to a multi-step process which did not give rise to any unexpected effects. As soon as processes were known for the hydrocarbonylation of methanol yielding inter alia acetaldehyde and MA, the skilled person had simply to combine this step with the process known from (1). Such combination could be achieved by logical considerations necessitated by economical requirements and guided by the teaching of (1).

The Appellant further contested the existence of a novel reaction in the claimed process, as ADMA should be transformed into acetaldehyde according to the process parameters prevailing in step (c).

V. The Respondent's arguments may be summarised as follows:

The Appellants did not show that there was any incentive to be taken from the state of the art that and how the steps

of hydrocarbonylating methanol could be combined with the teaching of (1) to form the claimed overall process.

While it was conceded that the hydrocarbonylation of methanol, step (a) of the claimed process, was state of the art, there was no teaching available for the skilled person how use could be made of the undesired by-products MA and ADMA resulting from such methanol hydrocarbonylation. To design the claimed integrated process it required the finding that in step (c) the ADMA reacted with acetic anhydride to form EDA and MA, the latter being recycled to the carbonylation step (b).

VI. 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.

VII. At the conclusion of the oral proceedings, the Chairman announced the decision of the Board.

Reasons for the Decision

1. The appeal complies with Articles 106 to 108 and Rule 64 EPC and is, therefore, admissible.

2. The patent in suit is directed to a multistep process for the production of vinylacetate via a thermal decomposition of EDA and starting from methanol, carbon monoxide and hydrogen, which process simultaneously yields ethanol and acetic acid also.

Such a process is not described in the documents cited and, thus, the Board finds that the subject-matter of the patent in suit is novel. Since novelty is not in dispute, it is not necessary to consider this matter in detail.

3. Document (1) discloses the most relevant state of the art. It is the only cited document relating to a multistep process for the manufacture of vinyl acetate via thermal decomposition of EDA. According to (1), such EDA is manufactured by reacting acetaldehyde with acetic anhydride, the latter being obtained from MA by carbonylation. While the vinyl acetate resulting from the thermal decomposition step is recovered, the acetic acid simultaneously produced is esterified with methanol to form MA which is recycled to the carbonylation step (see document (1), Claim 1 in combination with original page 7, last complete sentence).

Thus, the process of (1) requires, as starting materials for the overall reaction, methanol, carbon monoxide and the C_2-compound acetaldehyde, which is commercially produced mainly from ethylene or light hydrocarbons by direct oxidation (see page 1, lines 43-45 of the patent in suit). The disadvantages of such a process is its dependency on petroleum supply of which may be irregular due to factors outside the control of the manufacturer.

4. In the light of this prior art, the technical problem underlying the patent in suit may be seen in providing a process for the manufacture of vinyl acetate basically from starting materials which do not comprise C_2-compounds.

5. According to the patent in suit, this technical problem is solved by using as step (a) a hydrocarbonylation process for methanol - known per se, see the patent in suit, page 2, line 55 to page 3, line 6 - yielding a mixture of reaction products comprising MA, ethanol, acetaldehyde and ADMA, which products are separated and thereafter further processed according to steps (b) through (e) of Claim 1.

In view of the results obtained in the Examples of the disputed patent, the Board is satisfied that the above-defined technical problem is plausibly solved.

6. It still remains to investigate whether the requirement of inventive step is met by the claimed process. For this, the crucial question is whether or not it was obvious for the skilled person to combine the features of the vinyl acetate production known from (1) with the said known hydrocarbonylation of methanol.

6.1 While the skilled person would have seen that such hydrocarbonylation provides the necessary starting materials MA and acetaldehyde, he would have realised also that ADMA is formed as a by-product of this process. This would not have encouraged him seriously to contemplate this process as a source for the starting materials for the process known from (1), which required pure acetaldehyde (see the patent in suit, page 3, lines 16 and 17). This finding is also valid in view of the teaching disclosed on original page 18 of (1), lines 19-22, according to which not only monomeric acetaldehyde, but also its trimer or paraldehyde or mixtures of these two, can be used, as the only product obtained by depolymerisation of these two latter compounds is acetaldehyde.

6.2 The Board is aware that the requirement of "purity" in connection with a technical process will not necessarily mean "chemical purity", but may reasonably allow the presence of impurities, e.g. unavoidable side products of a technical process. However, even this consideration would not have led the skilled person to use as the first step for an integrated vinyl acetate production a process which not only gives rise to great amounts of MA but also of ADMA as by-products of the required acetaldehyde (see the patent in suit, page 3, lines 4 to 6), the amount of ADMA being up

to about 35% of the acetaldehyde (see the patent in suit, page 10, lines 51-53). For the same reason, the Board holds that a skilled person would not have considered the hydrocarbonylation of methanol known from (2) as a feasible first step, as this process was designed in particular for the manufacture of carboxylic acids and their derivates and produced only minor amounts of acetaldehyde (cf. (2), column 1, lines 15-19 and the examples).

To suggest that the hydrocarbonylation of methanol be used as the first step required as a prerequisite the realisation that ADMA, being an undesired product of the hydrocarbonylation of methanol, could be directly transformed to products useful for the manufacture of vinyl acetate, more specifically that acetaldehyde and ADMA could be fed simultaneously to step (c) of the present process. There is no example for this concept in the cited prior art.

6.3 Appellant's counter-argument in this respect - for the first time submitted in the course of the oral proceedings - is not convincing. The Appellant asserted that for the skilled person, knowing that ADMA forms acetaldehyde in the presence of water (and of an acid), there would have been no real difference between acetaldehyde and ADMA. However, it was not demonstrated to the Board's satisfaction that in step (c) the water required is necessarily present; no experimental proof was offered in this respect.

To the contrary, Claim 1 of the patent in suit requires that the products resulting from step (a) are further processed only after they were separated in a separation zone. This is supported by the specification teaching on page 5, lines 19 to 29, that the separation of the products shall be achieved in a separation zone (110), by using, inter alia, a distillation unit at temperatures between 40

and 200°C and a pressure less than 5 atm. There was no showing that within the given range of separation conditions the removal of water was impossible.

In support of his submission, the Appellant referred to the examples of the opposed patent which led him to the assumption that a major amount of water formed in step (a) is fed to the following steps. This is not convincing either:

The introductory sentence to the examples states that all the parts therein are by mole unless otherwise specified. Thus, Example 1 teaches that from the said separation zone (110) 6 mols/hr acetic acid are withdrawn through line (113) containing the "resulting water" (see page 10, lines 50 and 51 together with line 23). Similar conditions apply to the remaining examples 2 to 4. Therefore, in the absence of proof to the contrary, the Board is satisfied that the water formed in step (a) is withdrawn through line (113) and will not interfere in step (c).

6.4 Summarising: The process of Claim 1 results from an inventive step as the skilled person would not have considered a process giving rise to a complex product mixture as a viable source of starting materials for the process for the manufacture of vinyl acetate known from (1) in view of the required pure acetaldehyde for the latter process.

Dependent Claims 2-12 derive their patentability from that of Claim 1.

6.5 After careful consideration of late filed documents in accordance with Article 114(1) EPC, the Board concluded that, even if it were to take this prior art into account,

it would not arrive at a different decision. Thus, these documents are disregarded in accordance with Article 114(2).

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

M. Beer K. Jahn

K. 14.3.90