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File Number: T 756/90 - 3.3.1

Application No.: 84 301 772.4

Publication No.: 0 126 524

Title of invention: Process for the preparation of formic acid

Classification: C 07 C 51/02

D E C I S I O N
of 29 August 1991

Proprietor of the patent: BP Chemicals Limited

Opponent: BASF AG

Headword: Formic acid/BP

EPC Article 56

Keyword: "Inventive step (yes)"

Headnote



Case Number : T 756/90 - 3.3.1

D E C I S I O N
of the Technical Board of Appeal 3.3.1
of 29 August 1991

Appellant :
(Proprietor of the patent)

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Representative :

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Respondent :
(Opponent)

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Decision under appeal :

Decision of Opposition Division of the European
Patent Office of 9 March 1990, posted on
10 August 1990, revoking European patent
No. 0 126 524 pursuant to Article 102(1) EPC.

Composition of the Board :

Chairman : K.J.A. Jahn
Members : R.W. Andrews
J.-C. Saisset

Summary of Facts and Submissions

- I. European patent No. 0 126 524 in respect of European patent application No. 84 301 772.4, which was filed on 15 March 1984, was granted on 14 January 1987 (cf. Bulletin 87/03).
- II. On 17 September 1987 a notice of opposition was filed in which the revocation of the patent was requested on the ground that its subject-matter did not involve an inventive step in the light of the disclosure of the following documents
- (1) GB-A-1 028 930
 - (2) EP-B-0 095 321
 - (3) US-A-3 620 674 and
 - (4) EP-B-0 001 432
- III. By a decision delivered orally on 9 March 1990, with written reasons despatched on 10 August 1990, the Opposition Division revoked the European patent. The Opposition Division held that the subject-matter of Claim 1 in accordance with the Appellant's main or auxiliary request did not involve an inventive step in the light of the combined teaching of documents (3) and (4). The Opposition Division considered that document (4) taught that imidazolium formates were easily formed and, although stable, were decomposable by heat to yield formic acid in good yields. The skilled person faced with the problem of improving the process for the preparation of formic acid from the adducts disclosed in document (1) would realise that those adducts could be converted into the desired imadazolium formates by the base exchange process disclosed in document (3).

IV. An appeal was lodged against this decision on 18 September 1990 with payment of the prescribed fee. In his statement of grounds of appeal filed on 30 November 1990 and during the oral proceedings held on 29 August 1991, the Appellant submitted that the analysis of the prior art and the conclusions drawn therefrom by the Opposition Division were made with the benefit of hindsight.

The Appellant argued that the problem solved by document (4) is unrelated to the problem underlying the disputed patent and, therefore, there was no reason for the skilled person to immediately turn to this document to find a solution to his unrelated problem.

With respect to document (3), the Appellant contended that, since it was primarily concerned with the purification of sulphur dioxide containing smokes, the person of ordinary skill faced with the present problem would have attached little if any significance to its disclosure. Although the treatment of a formate with a second base is possibly taught generically, there is no specific disclosure of the reaction of tertiary amine with imidazoles. In fact, while imidazoles are not mentioned, several bases which are quite unsuitable for use in the claimed process are exemplified.

The Appellant also maintained that it was far from obvious, and document (3) gave no guidance, that the base exchange reaction between a trialkylammonium formate and an imidazole would occur to a significant extent to be useful on a commercial scale.

V. The Respondent contended that the skilled person would be aware of documents (3) and (4), particularly since document (4) was regarded as representing a breakthrough in the manufacture of formic acid. From document (1) it is

known that the adducts of formic acid with tertiary amines disclosed therein decompose at temperatures of 130° to 200°C. Furthermore, it is common general knowledge that formic acid may be obtained on a laboratory scale by treating amine salts and addition compounds of formic acid with acids. The Respondent argued that the teaching of document (4) provided a way out from the dilemma of preparing formic acid from such compounds and, therefore, the skilled person would strive to prepare imidazolium salts from salts and addition compound of formic acid and trialkylamines. In the Respondent's opinion, document (3) clearly showed the skilled person the means by which this may be accomplished.

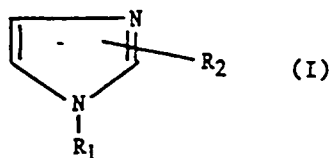
The Respondent also alleged that the skilled person would not use primary or secondary amines to form the salts since it was common general knowledge that formamides are obtained by the thermal decomposition of these salts.

Therefore, in the Respondent's opinion, the combined teaching of documents (3) and (4) rendered the claimed process obvious.

- XI. The Appellant requested that the decision under appeal be set aside and that the patent be maintained on the basis of Claims 1 to 5 and the amended description submitted at the oral proceedings. Claim 1 of the amended set of claims reads as follows:

"A process for the preparation of formic acid from a first base formate which is either a salt or an addition compound of formic acid combined with a first base which is a C₁ to C₁₀ trialkylamine characterised in that the process comprises the steps of:

- 1 100/50
- (1) contacting the first base formate with a second base of general formula:



where R_1 is a monovalent hydrocarbon group containing 1 to 12 carbon atoms and R_2 is either hydrogen or R_1 group, which is (i) weaker than the first base and (ii) is less volatile than the first base, under conditions to cause the second base to displace the first base and thereby form a second base formate which is thermally decomposable at a temperature higher than the boiling point of the first base;

- (2) separating, by distillation, the first base from the second base formate, and
- (3) thermally decomposing the second base formate to yield formic acid and the second base."

The Respondent requested that the appeal be dismissed.

VII. At the conclusion of the oral proceedings the Board's decision to maintain the patent in the form requested was announced.

Reasons for the Decision

1. The appeal is admissible.
2. There are no formal objections under Article 123 EPC to the present claims. Thus Claim 1 represents a combination of Claims 1, 4 and 5 as granted (see also originally filed Claims 1 and 4 in combination with page 3, lines 4 to 6 of the published patent application). Claims 2 to 5 correspond to Claims 2, 3, 6 and 7 as granted (cf. Claims 2 and 3 as originally filed and page 2, lines 11 to 19 of the printed patent application).
3. The patent in suit relates to a process for the manufacture of formic acid. Document (4), which is considered to represent the closest state of the art, also concerns a process for the manufacture of formic acid comprising hydrolysing methyl formate in the presence of 0.5 to 3.0 mole per mole of methyl formate of a nitrogen base which contains one or more nitrogen atoms which do not carry hydrogen atoms, boils at not less than 180°C under atmospheric pressure and has a pKa of 4 to 9 (cf. Claim 1). Suitable bases include imidazoles as defined by the general formula I in Claim 2.

In the light of the closest prior art, the Board sees the technical problem underlying the disputed patent in providing a further industrial process for the manufacture of formic acid.

According to the patent in suit this technical problem is successfully solved by contacting a salt or addition compound of formic acid combined with a C₁ to C₁₀ trialkylamine with an imidazole derivative of the specified formula which is a weaker base than the trialkylamine and less volatile than it and thermally

decomposing the resulting imidazolium formate after separating it from the liberated trialkylamine.

4. After examination of the cited prior art, the Board has reached the conclusion that the claimed process is novel. Since novelty is not in dispute it is not necessary to give detailed reasons for this finding.
5. It still remains to be decided whether the claimed subject-matter involves an inventive step.
- 5.1 As mentioned above document (4) discloses a process for the manufacture of formic acid by the hydrolysis of methyl formate in the presence of certain imidazole derivatives. According to page 2, lines 46 to 49 of this document the advantageous action of the imidazole derivatives is due to the fact that they form a salt-like bond with formic acid which is sufficiently strong to withdraw the formic acid from the hydrolysis equilibrium but is sufficiently weak for the formic acid to be readily distilled again from the base without decomposition and without any significant expenditure of energy.

Thus, the process disclosed in this document employs as starting material methyl formate which is obtained on an industrial scale from carbon monoxide and methanol. Although this document discloses that imidazolium formates are thermally decomposable to formic acid, there is no suggestion to prepare them from starting materials other than formic acid formed in situ by the hydrolysis of methyl formate, let alone from the salts or addition compounds of formic acid combined with trialkylamines.

- 5.2 Document (1) discloses addition compounds of tertiary amines and formic acid obtained by reacting 1 mole of a

tertiary amine with at least 2 moles of formic acid (cf. Claims 1 and 6). According to this document the addition compounds may be used to advantage in all known reactions which can be carried out with formic acid and may also be used to prepare pure carbon dioxide since they decompose at temperatures from 130°C to 200°C (cf. page 3, lines 5 to 24). Therefore, the teaching of this document would not provide the skilled person with any incentive to employ the addition compounds disclosed therein as the starting material for the industrial manufacture of formic acid.

- 5.3 Document (3) discloses a two-stage process comprising contacting, in the first stage, the salt formed from a volatile acid and volatile base with an organic base of low volatility under such conditions to liberate the volatile base in gaseous form and to form the salt of the low volatile base and, in the second stage, decomposing by heat the salt formed in the first stage to liberate the volatile acid and regenerate the solution of the low volatile base (cf. column 1, lines 6 to 29). This document suggests that ammonium formate is a suitable starting material for use in this process (cf. Claims 1 and 12 and column 3, lines 60 to 67). In the Board's opinion, the references to ammonium formate in the context of this document cannot be construed as including quaternary ammonium formates in general, but is restricted to the salt derived from formic acid and ammonia.

In column 2, lines 27 to 57 information is provided regarding suitable low volatile bases. However, imidazole derivatives would not fall within the scope of any of the classes (a) to (e) even though they cover an extremely large number of possible bases. Therefore, the skilled person would have serious doubts whether the base exchange

reaction depicted in this document could be successfully used on an industrial scale using trialkylammonium formates and the specified imidazole derivatives.

In the Board's judgment, a more important question is whether, without the benefit of hindsight, the skilled person, faced with the technical problem underlying the disputed patent, would have combined the teachings of documents (3) and (4). If document (2), which discloses a process for the production of formate salts, for example C₁ to C₁₀ trialkylammonium salts comprising reacting hydrogen and carbon dioxide with a trialkylamine base in the presence of a solvent and a catalyst (cf. Claim 1 in combination with page 3, lines 11 to 13), is left out of consideration, there is no reason for the skilled person to combine the teaching of these two earlier documents since he would not consider using such formate salts as starting materials for the industrial manufacture of formic acid. However, since the subject-matter of the present claims is entitled to the claimed priority date of 18 March 1983, document (2), which was published on 30 November 1983, only forms part of the state of the art within the meaning of Article 54(3) and (4) EPC, and is, therefore, excluded from consideration with respect to inventive step.

Accordingly, the Board holds that the proposed solution to the problem of providing a further industrial process for the preparation of formic acid is inventive. Therefore the subject-matter of Claim 1 and Claims 2 to 5, which relate to preferred embodiments of the process according to Claim 1, involves an inventive step.

Order

For these reasons, it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to maintain the patent on the basis of Claims 1 to 5 and the amended description, both submitted at the oral proceedings.

The Registrar

The Chairman

E. Görgmaier

K.J.A. Jahn